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CENTERS FOR MEDICARE AND MEDICAID SERVICES
Medicare Evidence Development & Coverage Advisory Committee

May 11, 2011

Centers for Medicare and Medicaid Services
7500 Security Boulevard
Baltimore, Maryland

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Panelists

Chairperson
Clifford Goodman, PhD

Vice-Chair
Saty Satya-Murti, MD

Voting Member/Patient Advocate
Phyllis Atkinson, RN, MS, GNP-BC

Voting Members
Wayne Chen, MD
Catherine (Eng) Chan, MD
Marie Griffin, MD, MPH
Paula E. Hartman-Stein, PhD
Alvin Mushlin, MD, ScM
Ralph Sacco, MD, MS
J. Sanford Schwartz, MD
Elaine M. Scorza, MSN, RN, APRN, CRNC
Robert L. Steinbrook, MD

CMS Liaison
James Rollins, MD

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Panelists (Continued)

Industry Representative
G. Gregory Raab, PhD

Guest Panel Members
John K. Niparko, MD
Paul R. Rao, PhD, CCC, CPHQ, FACHE

Invited Guest Speakers
Debara L. Tucci, MD
Teresa A. Zwolan, PhD

Executive Secretary
Maria Ellis

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PANEL PROCEEDINGS

(The meeting was called to order at 8:23 a.m., Wednesday, May 11, 2011.)

DR. GOODMAN: Okay. I would like to get started now, and I am looking for Dr. Rollins and Ms. Ellis to come back to the front of the room, and Ms. Ellis is going to offer some opening remarks in a moment, followed by Dr. Rollins.

I know that those of you that have attended MedCAC meetings before may notice that we have a slightly different layout today which I think offers better visibility for all of us here, and I also want to welcome in particular our interpreters, Ms. Mayhew and Mr. Winters, who will have an active day ahead of them, I am sure.

So Ms. Ellis, would you like to begin, please?

MS. ELLIS: Good morning and welcome, committee chairperson, vice chairperson, members and guests. I am Maria Ellis, the executive secretary for the Medicare Evidence Development and Coverage Advisory Committee, MedCAC. The committee is here today to discuss the evidence, hear presentations and public comments, and make recommendations concerning the currently available evidence regarding the outcomes associated with the use of unilateral and bilateral cochlear implant technology for

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hearing loss.

The following announcement addresses conflict of interest issues associated with this meeting and is made part of the record. The conflict of interest statutes

prohibit special government employees from participating in matters that could affect their or their employer's financial interests. Each member will be asked to disclose any financial conflicts of interest during their introduction. We ask in the interest of fairness that all persons making statements or presentations disclose if you or any member of your immediate family owns stock or has another formal financial interest in any company, Internet or e-commerce organizations that develops, manufactures, distributes and/or markets cochlear implants. This includes direct financial investment, consulting fees and significant institutional support. If you haven't already received a disclosure statement, they are available on the table outside of this room.

We ask that all presenters please adhere to their time limits. We have numerous presenters to hear from today and a very tight agenda and, therefore, cannot allow extra time. There is a timer at the podium that you should follow. The light will begin flashing when there are two minutes remaining and then turn red when your time is up. Please note that there is a chair for the next

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speaker and please proceed to that chair when it is your turn. We ask that all speakers addressing the panel please speak directly into the mic and state your name.

For the record, voting members present for today's meeting are Dr. Saty Satya-Murti, Phyllis Atkinson, Dr. Wayne Chen, Dr. Catherine Eng, Dr. Marie Griffin, Dr. Paula Hartman-Stein, Dr. Alvin Mushlin, Dr. Ralph Sacco, Dr. J. Sanford Schwartz, Elaine Scorza, Dr. Robert Steinbrook. A quorum is present and no one has been recused because of conflicts of interest. The entire panel, including nonvoting members, will participate in the voting. The voting scores will be available on our website following the meeting. Two averages will be calculated, one for voting members and one for the entire panel.

I ask that all panel members please speak directly into the mics, and you may have to move the mic since we have to share. The meeting is being web cast via CMS. This is in addition to the CMS Webinar and transcriptionist. By your attendance you are giving consent to the use and distribution of your name, likeliness and voice during the meeting. You are also giving consent to the use and distribution of any personally identifiable information that you or others may disclose about you during today's meeting. Please do not

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disclose personal health information.

If you require a taxicab, there are telephone numbers to local cab companies at the desks outside of the auditorium. Please remember to discard your trash in the trash cans located outside of this room.

And lastly, all CMS guests attending today's

MedCAC meeting are only permitted in the following areas of CMS single site: The main lobby, the auditorium, the lower level lobby and the cafeteria. Any person found in any area other than those mentioned will be asked to leave the conference and will not be allowed back on CMS property again.

And now I would like to turn the meeting over to Dr. James Rollins.

DR. ROLLINS: Thank you. The MedCAC serves three purposes, to get input from experts in the field on a topic, and that information helps us strategize our efforts related to future activities on the topic. Number two, it helps to disseminate information to the general public. And a more immediate use of that fact along with the external technology assessment is to help us craft our national coverage determinations.

I would like to thank the chairperson as well as the vice chairperson, as well as the members of the MedCAC committee for today's discussion.

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DR. GOODMAN: Thank you very much, Dr. Rollins, as always.

We have just this day until 4:30 p.m. to address a topic with considerable potential impact to the well-being of a large and growing number of Medicare beneficiaries. With that in mind, we expect that all of our guest speakers, those providing scheduled public comments later in the day, and any providing other comments, including my fellow MedCAC members, will be on point and concise today. This is especially important because we got started a little late, so we're a bit compressed today. As Ms. Ellis said, please do speak directly into the microphone. If you don't speak into the microphone at any time during the day when it's your turn to speak, our trusty court reporter along with the captioner will miss your gems of wisdom, and neither will our esteemed interpreters be able to convey that, so it's quite important.

And we have today time for scheduled presentations, we're going to have four such presentations a little later in the morning, each of which has been allocated a maximum of seven minutes by CMS. And given our tight agenda, including the need to hear from all of our speakers, we will need for you to stay within that seven-minute time frame. Later on we may have some open

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public comments, people may have signed up this morning, each of those will be allocated one minute, that will be closer to the middle part of the day.

And we kindly, though firmly, suggest that each scheduled speaker and each public commenter think now, start thinking now, please, or focusing your presentations on information that pertains directly to today's voting questions. We have a lot to accomplish today and

virtually all the focus is on getting good answers to our voting questions, and it is for informing our votes on those questions that we seek your input. If you planned to present some material today that you've heard someone else has presented or which at some point you think is redundant, you don't really need to include that in your presentation. Please use your time as well as you can and as concisely as you can.

If you've got a cell phone or other electronic device, please deal with it now. And as Maria said, Ms. Ellis said, all speakers will have to sign a disclosure form if you haven't done so already.

Speaking of disclosures, let's move to those. Mine's a little bit long and I apologize, along with Dr. Satya-Murti. I'm Cliff Goodman, I'm a senior vice president of the Lewin Group, which is a health care policy firm. Lewin is one of multiple subsidiaries of an

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outfit called Ingenix, a health care information and analysis firm. Ingenix in turn is one of multiple subsidiaries of United Health Group. On behalf of the Lewin Group I work on projects for a range of government agencies and private sector organizations including pharmaceutical, biotechnology and medical device firms large and small, though none recently on this topic, so I have no interest to declare pertaining to today's topic.

I will now move to Dr. Satya-Murti.

DR. SATYA-MURTI: I am a neurologist and health policy consultant. I have no conflicts of interest.

MS. ATKINSON: Phyllis Atkinson, gerontological nurse practitioner. Nothing to disclose.

DR. CHEN: Wayne Chen, I'm a geriatrician and a managed care medical director. I have no financial interests to declare.

DR. GOODMAN: Just a minute, please. We want to make sure that the volume is a little higher, because I'm having difficulty hearing all of that. Dr. Chen, could you repeat, sir?

DR. CHEN: My name is Wayne Chen. I'm a geriatrician and medical director of a managed care plan and I have no financial interests to declare.

DR. ENG: Dr. Catherine Eng, geriatrician, medical director of On Lok Senior Health Services in

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San Francisco. I'm also a clinical professor of medicine and geriatrics at UCSF. I have nothing to disclose.

DR. GRIFFIN: Marie Griffin. I'm an internist and pharmaco-epidemiologist at Vanderbilt University. I have nothing to disclose.

DR. HARTMAN-STEIN: Paula Hartman-Stein, I'm a clinical geropsychologist in Kent, Ohio and adjunct faculty at Kent State. I have nothing to disclose.

DR. MUSHLIN: I'm Al Mushlin, chair of the department at Weill Cornell Medical College in New York

City. I'm a professor of public health and a professor of medicine. I have no financial disclosures.
DR. SACCO: My name's Ralph Sacco, I'm a neurologist epidemiologist, and I'm chairman and professor of neurology and epidemiology at the University of Miami, and nothing to disclose.
DR. SCHWARTZ: I'm Sandy Schwartz, I'm a professor of medicine and health management economics for the medical school and the Wharton School of the University of Pennsylvania and I have no relative conflicts to disclose today.
MS. SCORZA: I'm Elaine Scorza, an advanced practice nurse specializing in geropsychiatry. I am a medical auditor and coder at Rush University, and an instructor in the college of nursing.

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DR. STEINBROOK: Robert Steinbrook, internist at Dartmouth Medical School. Nothing to disclose.
DR. RAAB: Greg Raab, I'm an independent policy consultant, no conflicts.
DR. NIPARKO: John Niparko, otolaryngologist at Johns Hopkins. I serve on two medical advisory boards for cochlear implant manufacturers, and I do that on a volunteer basis without remuneration, as disclosed to the CMS.
DR. RAO: I'm Paul Rao, the chief operating officer of inpatient operations at the National Rehab Hospital in D.C., and I'm the president of the American Speech-Language-Hearing Association, and I have no, nothing to disclose.
DR. GOODMAN: Thank you very much, panelists. So therefore, there are no further disclosures to be made; is that correct? That is correct.
We will now move to the CMS presentation and the description of the voting questions, and we'll start with Dr. Susan Miller, and I believe she will be followed by Dr. Sarah Meisenberg. And I will remind everyone today, if not for your sake, then certainly for mine because I'm kind of close to a slide projector that's got a little noise coming from it, do speak directly and clearly into your microphones all day today, please. I will appreciate

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that, thank you.
Dr. Miller.
DR. MILLER: Thank you. Good morning. On behalf of the Centers for Medicare and Medicaid Services, I welcome you to the Medicare Evidence Development and Coverage Advisory Committee meeting that will discuss cochlear implants for sensorineural hearing loss. My name is Dr. Susan Miller, as you've heard, and I am the lead medical officer on this project. I would like to take the next few minutes to review the history of Medicare's coverage of cochlear implants as it relates to the goals of this meeting.

Medicare's initial policy decision that provided coverage of these prosthetic devices was made in 1986. Over the years coverage has been twice expanded, the last time in 2005 when the national coverage determination or, as we otherwise call it, the NCD that is in effect today became operational. That decision stipulates that Medicare may cover cochlear implantation for the treatment of bilateral pre- or post-linguistic sensorineural moderate to profound hearing loss in individuals who among other criteria demonstrate a limited benefit from amplification. Limited benefit from amplification is currently defined by scores of less than or equal to 40 percent correct in the best-aided listening condition on

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tape-recorded or otherwise recorded tests of open-set sentence recognition. At the time of the 2005 NCD on cochlear implantation, Medicare was not confident that there was an adequate strength of evidence to warrant unmonitored expansion of coverage of cochlear implantation for all individuals who demonstrated hearing loss scores of less than or equal to 60 percent. However, the evidence at that time did lead us to infer the possibility of benefit to our beneficiaries who demonstrate this degree of hearing loss. Because of this, CMS extended coverage to this population group in the context of a clinical trial. We felt that the added safety monitoring that would be provided by the conditions of a well-designed study would assist us in providing quality care to those with preimplant hearing scores between 40 and 60 percent correct, while at the same time providing data that could be used to determine the medical necessity of the implants in this subset of our beneficiary population. Since the 2005 NCD was published, we have had no clinical trials submitted to us to address the impact of cochlear implantation in patients who demonstrate correct hearing scores of greater than 40 percent and less than or equal to 60 percent. Furthermore, the 2005 NCD does not specifically examine the usage of bilateral cochlear

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implants in our beneficiary population. More precisely, it does not investigate the evidence which may determine the existence of additional communication related and/or quality of life health outcomes that are conferred by the use of bilateral devices as compared to the use of a unilateral implant, with or without the additional support of a hearing aid. Therefore, this MedCAC has been convened. Its purpose is to examine the clinical evidence that has been recently developed in this field of cochlear implantation for both unilateral and bilateral devices, and to determine how these advances affect health outcomes for the Medicare population. Before I end my remarks this morning, I would like to say that Medicare is sensitive to the fact that

there may be cultural opposition to the use of cochlear implantation among some individuals with hearing loss. CMS believes that when merited by evidence, coverage should be offered to our beneficiaries in order to provide them the broadest decision choice in health care that we can under our statutory authority. However, we do recognize that not all Medicare beneficiaries will wish to avail themselves of the items and services that we cover. We very much respect the integrity of the opinions of all of our stakeholders on the issue of cochlear implantation even when personal philosophies and choices are not in

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agreement with our coverage decision. Unless there are further questions from the panel, I would like to introduce to you Ms. Sarah Meisenberg, who will advance today's agenda by introducing the CMS team who has worked on the issue for today's MedCAC. Sarah will also read the questions which will be voted upon by the panel later today.

DR. GOODMAN: Dr. Miller, I believe we do have one question from Dr. Steinbrook, and we'll keep this brief.

DR. STEINBROOK: Thank you. Could you clarify currently the status of coverage for bilateral implants as compared to single implants?

DR. MILLER: Our national coverage determination is silent on bilateral cochlear implants. That then infers that the local medical contractors at their local jurisdiction level can make their own decisions.

DR. STEINBROOK: Thank you very much.

DR. GOODMAN: Yes, Dr. Meisenberg, and thank you, Dr. Miller.

MS. MEISENBERG: Good morning and thank you. On behalf of the Centers for Medicare and Medicaid Services, welcome to today's MedCAC meeting on cochlear implants for sensorineural hearing loss. I would like to take this opportunity to introduce myself and the CMS staff

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responsible for today's meeting. My name is Sarah Meisenberg, and I am the lead analyst for this project. Lisa Eggleston is also an analyst. You just met Dr. Susan Miller. Maria Ellis is the MedCAC executive secretary. Dr. Jim Rollins is the director of the division of items and devices in the Coverage and Analysis Group, and Dr. Louis Jacques is the group director of the Coverage and Analysis Group. I would also like to thank my other colleagues at CMS who worked hard to prepare for today's presentation. Dr. Tucci, professor of otolaryngology, head and neck surgery from Duke University, will begin today's events by presenting on the medical and surgical aspects of cochlear implantation. We will then hear from Dr. Zwolan, professor and director, University of Michigan Cochlear Implant Program, on the assessment and candidacy

of patients for cochlear implants. The technology assessment commissioned by the Agency for Healthcare Research and Quality will be presented by Drs. Chung and Raman from the Tufts Evidence-Based Practice Center. The technology assessment is one of the primary inputs used by the panelists to formulate recommendations on today's topic. Panel members were also provided with additional background materials determined relevant to the subject matter. You will then hear several presentations

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from invited speakers and interested parties, and finally, we will discuss the MedCAC questions. The questions posed to the MedCAC panel consist of voting and discussion type questions. For those questions in which panelists are asked to express a degree of confidence, individual panel members will be asked to respond with a score of one to five. A score of five indicates that a panel member is very confident in response to the question posed, where a score of one indicates a complete lack of confidence in response to that particular question. Discussion questions are not scored but allow for a free exchange of ideas in the areas surrounding that particular topic. I will now read aloud each of the 11 questions that the panel will later react to by either casting an individual score in the case of the voting type questions, or discussing in detail for the case of discussion questions. The questions that are to come all refer to the use of cochlear implants in adults with bilateral sensorineural moderate to profound hearing loss who demonstrate limited benefit from amplification. Limited benefit from amplification is defined by the correct test scores noted in the question obtained from the best aided listening condition on tape or otherwise recorded tests of open sentence recognition.

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Health outcomes include symptom status, functional abilities and health-related quality of life. In your discussions, please note if your conclusions apply only to specific outcomes or more broadly. Question one: How confident are you that there is adequate evidence to determine whether or not a unilateral, i.e. first, cochlear implant improves health outcomes for adults with hearing loss who have demonstrated a test score of, A, greater than 40 percent and less than or equal to 50 percent, B, greater than 50 percent and less than or equal to 60 percent? Question one discussion: Is there an absolute or relative change in test scores that indicates a clinically meaningful difference in health outcomes for this population? Question two: If the result of question one is at least intermediate with a mean vote of greater than or equal to 2.5 for either range of correct open-set sentence

recognition scores noted in the last question, how confident are you that a unilateral cochlear implant improves health outcomes for adults with hearing loss who have demonstrated a test score of, A, greater than 40 percent and less than or equal to 50 percent, and B, greater than 50 percent and less than or equal to 60 percent?

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Question two discussion: Are there any specific factors other than test scores, for example anatomy, duration of hearing loss, characteristics of facilities or care providers that can aid in the identification of those individuals most likely to attain improved health outcomes?

Question 3.A: How confident are you that there is adequate evidence to demonstrate whether or not the use of bilateral cochlear implants as compared to a unilateral cochlear implant improves health outcomes?

Question 3.B: If the result of question 3.A is at least intermediate with a mean vote of greater than or equal to 2.5, how confident are you that the use of bilateral cochlear implants as compared to a unilateral cochlear implant improves health outcomes? If the answer to this Question 3.B is at least intermediate with a mean vote of greater than or equal to 2.5, you will continue on to questions four through nine.

Question four: How confident are you that there is adequate evidence to determine whether or not a sequential bilateral cochlear implantation as compared to a unilateral cochlear implantation improves health outcomes for adults with hearing loss who have demonstrated a test score in the ranges below? A, less than or equal to 40 percent. B, greater than 40 percent

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and less than or equal to 50 percent. And C, greater than 50 percent and less than or equal to 60 percent.

Question five: If the answer to question four is at least intermediate with a mean vote greater than or equal to 2.5 in any of the ranges noted, how confident are you that a sequential bilateral cochlear implantation as compared to a unilateral cochlear implantation improves health outcomes for adults with hearing loss who have demonstrated a test score in the ranges below? A, less than or equal to 40 percent. B, greater than 40 percent and less than or equal to 50 percent. And C, greater than 50 percent and less than or equal to 60 percent.

Question six: How confident are you that there is adequate evidence to determine whether or not a simultaneous bilateral cochlear implantation as compared to a unilateral cochlear implantation improves health outcomes for adults with hearing loss who have demonstrated a test score in the ranges below? A, less than or equal to 40 percent. B, greater than 40 percent and less than or equal to 50 percent. And C, greater than

50 percent and less than or equal to 60 percent. Question seven: If the answer to question six is at least intermediate with a mean vote of greater than or equal to 2.5 in any of the ranges noted, how confident are you that a simultaneous bilateral cochlear

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implantation as compared to a unilateral cochlear implantation improves health outcomes for adults with hearing loss with test scores in the ranges below? A, less than or equal to 40 percent. B, greater than 40 percent and less than or equal to 50 percent. And C, greater than 50 percent and less than or equal to 60 percent.

Question eight: How confident are you that there's adequate evidence to determine whether or not a simultaneous bilateral cochlear implantation as compared to a sequential cochlear implantation improves health outcomes for adults with hearing loss who have demonstrated a test score in the ranges below? A, less than or equal to 40 percent. B, greater than 40 percent and less than or equal to 50 percent. And C, greater than 50 percent and less than or equal to 60 percent.

Question nine: If the answer to question eight is at least intermediate with a mean vote greater than or equal to 2.5 in any of the ranges noted, how confident are you that a simultaneous bilateral cochlear implantation as compared to a sequential cochlear implantation improves health outcomes for adults with hearing loss who have demonstrated a test score in the ranges below? A, less than or equal to 40 percent. B, greater than 40 percent and less than or equal to 50 percent. C, greater than 50

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percent and less than or equal to 60 percent.

Question 10, discussion: What significant evidence gaps exist regarding the clinical criteria of individuals who should receive cochlear implants either unilateral or bilateral?

Question 11: How confident are you that these conclusions are generalizable to, A, the Medicare patient population, and B, community-based settings?

Thank you, and I will now turn it over to Dr. Goodman to introduce the next speaker.

DR. GOODMAN: Thank you very much, Ms. Meisenberg. I think the panel, all panelists will see that the questions are of certain types. We're often asked to look at the adequacy of the evidence, that is, is there enough evidence to go on, and then in cases where there is enough evidence to go on, we may vote on what we think the evidence says, and then there are discussion questions. Also at the end there's a question about external validity, that is, to what extent does the evidence that we will have seen apply to the Medicare population and apply to community settings, so that's the general text or nature of the questions.

We're now going to move to our designated presenters. We're going to start with Dr. Debara Tucci, who is a professor of otolaryngology, head and neck
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surgery at Duke University Medical Center, and Dr. Tucci has 20 to 25 minutes maximum, and we will keep track of that time to stay on time. Dr. Tucci, welcome, thank you for being here.
DR. TUCCI: Thank you very much. Good morning, everybody, and I have no financial conflicts to disclose. The prevalence of hearing loss in the U.S. is very common. There are approximately one in ten who have hearing difficulty accounting for 28 million people in the United States, and about one in a hundred of these are profoundly deaf. I also read in the technology assessment that in fact hearing impairment is the third most common chronic condition in older Americans. In those 65 and older, this makes up a third of the population, and affects about half of those over age 80.
A cochlear implant is an electronic device consisting of two components, one an external component and one an internal surgically implanted component that is inserted into the cochlea, and the purpose is that it can bypass the inner ear cells which are damaged and directly stimulate the auditory nerve. So the sound is picked up by the microphone, the signal then travels to the speech processor. The signal is processed in a variety of ways, usually with more than one speech processing strategy being available for any one cochlear implant system. It
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then travels to the transmitter, so this has a magnet in it and it sits over the skin where the internal receiver stimulator is situated internally that has a magnet as well to allow these to align. And then the signal travels across the skin through radio frequency transmission, it's picked up by the internal receiver and then delivered to the electrodes.
The FDA has reported that approximately 220,000 people worldwide have received cochlear implants, and this is a little over 80,000 in the U.S. alone. More adults than children have been implanted at this point in time.
The history of cochlear implantation is actually very interesting and begins in the 1950s in France. Djourno and Eyries did the proof of concept experiments. Djourno was an electrophysiologist and Eyries being a surgeon who placed an induction coil implant on the auditory nerve of a deaf patient, then proved that the patient did get an auditory percept. Dr. Bill House, an otologist working in Los Angeles, learned about this experiment from a patient and started developing the first cochlear implant, which was a single channel device. And you can see that the progress was rapid after that, with the first multichannel implant developed in Australia by Graeme Clark.

I started my own otology residency in 1986 and
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so I've had the privilege of watching this technology evolve over the course of my career, and I know many in the audience have as well, and it's been a joy to watch the impact of this technology on patients' lives. Dr. Miller has gone over the Medicare indications for cochlear implantation so I won't spend a lot of time here. Again, test scores need to be less than or equal to 40 percent correct, patients need to have the cognitive ability to be able to utilize the implant, and not have contraindications to surgery. The criteria are a bit different if patients are enrolled in a clinical trial. Speech recognition scores can be up to 60 percent if the patient is enrolled in an FDA-approved device trial. The FDA candidacy guidelines for use of the various implants varies depending on the circumstances of approval of the various devices. I'm going to talk about evaluation for cochlear implantation, and this includes assessment by various individuals who ideally work together as a team to give the best care to the patient. The first is a medical evaluation. The audiological evaluation is extensive and that will be reviewed by Dr. Zwolan in the next presentation. We always do a radiologic evaluation that includes at least an MRI and in some cases a CT scan as well. In some cases an MRI cannot be performed, such as
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in cases where the patient has a pacemaker and other contraindications, so in that case a CT would suffice. Extensive counseling is involved to make sure that the patient understands the implications of cochlear implantation and has appropriate expectations. There's no specific test that we can do that will guarantee what the patient's performance will be, and they have to understand and accept that fact. We make sure that the patient has proper resources for postoperative rehabilitation and good family support. At that time if the patient decides to proceed and they are a candidate, we'll submit for insurance preapproval. Patients often would like to meet with other cochlear implant recipients and we arrange for that if they would like. A general health assessment is necessary. Cochlear implantation is always performed under general anesthesia. Many of my older patients do go through some medical assessment to make sure that they are good candidates for general anesthetic and that they are able to undergo post-implant programming and rehabilitation, which can be extensive. Again, motivation and managing expectations is important. We assess for cognitive disorders, we only do a formal evaluation if that seems to be indicated, and
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assess for the need for a psychological evaluation. I think all of us who work with elderly patients recognize that patients who have significant hearing loss are often isolated and depressed, they're very frustrated with their inability to communicate, and we do know that this improves significantly in many patients after cochlear implantation, but we do look for signs of depression that's more than just situational.

The medical evaluation consists of a careful review of the medical records and past audiograms, a careful history and a physical examination. The main goal of this is to determine a possible etiology of hearing loss, and in particular to identify any possible treatable causes of hearing loss. So one potential treatable cause may be autoimmune sensorineural hearing loss and the typical history would be that of a sudden hearing loss within the past couple of months, and so this can be treated with a course of high dose steroids, and patients who do have autoimmune sensorineural hearing loss by definition will initially respond to that with improvement in their hearing.

Other potentially treatable metabolic causes include thyroid dysfunction and syphilis, these are rare, but can potentially be treated. We also evaluate for chronic ear disease and treat that as needed.

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Cholesteatoma would be an example of a condition that would need surgical treatment prior to cochlear implantation, but then could be followed by cochlear implantation if treated and resolved. We also evaluate for far advanced otosclerosis, which causes fixed hearing loss, and again, may improve with surgical treatment for the conductive component.

Preoperative imaging is important both to look for evidence of cochlear malformation or ossification and to identify, if applicable, the better ear to implant.

This is a temporal bone CT on an axial plane at the level of the temporal bone showing a normal appearing cochlea on the left side and a malformed cochlea without the normal internal structure on the right side. So, we can implant ears that look like this, but we certainly wouldn't choose to if there was a normal cochlea. And this upper slide shows, again, a fairly normal cochlea and an obliterated one on the right side due to ossification.

MRI is always obtained if possible. With a good MRI using special imaging capabilities, we can look at cochlear anatomy and patency. This is an actual scan, again showing the cochlea and the vestibule. This is the auditory canal showing the auditory nerve. We can rule out vestibular schwannoma and other CNS abnormality. The other indication for MRI is that after cochlear

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implantation we likely cannot do an MRI, so we would want to do one preoperatively.

There's three device manufacturers that we use in the United States, Cochlear Americas, Advanced Bionics, and MED-EL, and this shows their external devices, and in this slide internal devices that correspond with those companies.

There are special electrode arrays that can be selected for patients with specific kinds of indications such as ossification or malformations, just to let you know that there are some options available for special cases.

The external component consists of a microphone and a processor. The processor implements the speech processing strategies. Again, various strategies are available with the different devices and also within a single device. Importantly, they are able to upgrade these devices to take advantage of future capabilities so that we don't have to replace the internal device to do so. This also contains the power supply.

The speech processing strategy employed determines how the sounds in the environment are delivered to the listener, and they include the number of electrodes that are used, the speed at which the electrodes send information to the brain. Some strategies utilize a

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thousand pulses per second per electrode for various graphic transmission of information. The number of electrodes being used at a given time determines whether the stimulation is pulsatile or analog.

This is a schematic just to give you a very basic idea of how this may happen. This is an ah sound, a vowel, this is the speech waveform that corresponds to that. It's put through a band path filter bank and then the instantaneous spectrum is generated, and the highest peaks are selected which would be the highest amplitude sounds. A vowel is a low frequency sound primarily, so this is a low frequency response. The highest amplitude frequencies are selected for stimulation of the corresponding intracochlear electrodes. The cochlea is organized in an atopically funded phase mode stimulation at the apex where low frequencies are processed, and this is a pulsatile strategy which is presented non-simultaneously.

To tell you a little bit about cochlear implant surgery, this requires an incision behind the ear, a mastoidectomy is performed, and then the middle ear is entered from behind to the facial recess that I'll show you in a moment, and the electrode inserted into the cochlea so the rebound goes through the ear canal.

There was a study to actually look at surgical

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time to do cochlear implants, and this was a study that was done at a surgical center in Europe as well as an academic center in the U.S., and their times were fairly similar. The time for the actual surgery not including

anesthesia time for one cochlear implant averaged a little under three hours. It was somewhat device-dependent, with a window of 30 minutes. Surgical time for a bilateral simultaneous implant was five hours, so this is a little under double the time for one implant. Most patients are done as outpatients. My elderly patients I do admit overnight. After surgery my patients, if they work, can return to work in seven to ten days. So again, this is done under general anesthesia, and I think I'll just show you the steps here. This is the temporal bone with the top of the head here and the nose here. This shows the structures beneath the surface, the cochlea is here, that's in the middle ear space. These are the ossicles, the vestibular system here. This is the facial nerve that's going through the temporal bone. This is the initial mastoidectomy. Again, we expose the facial recess, which allows us to get from the mastoid into the middle ear space beneath the eardrum. This is the cochlea, and the electrode is inserted either through the round window or through an opening in the

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cochlea just anterior and inferior to the round window. It is then secured in a well behind the mastoidectomy, the electrode is curved within the mastoid and then secured and packed around the cochleostomy. This is a schematic of the cochlea showing the scala vestibuli, the organ of Corti. These are the surgical processes. The spiral ganglion cells are here, these are the first order neurons which are stimulated by the electrical signal. This is the scala tympani, and this is the scale in which the electrode is inserted, it's in closest proximity to the neural elements. This is the tonotopic organization of the cochlea with an implanted electrode array, again, highest frequencies in the base and lowest in the apex. There are risks and complications associated with any surgical procedure, cochlear implants are no exception, but the risks are really quite low considering what we do in implanting these devices. So the risks of minor complications are eight percent, and these are defined as complications that require no or conservative treatment. The incidence of major complications is 4.3 percent, and these are defined as complications that require revision surgery, involve meningitis, loss of the implant usually due to infection, or occasional nerve injury. Complications may be intraoperative, early

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postoperative or delayed, and the most common complications involve problems with wound healing, so the incisions have changed and evolved over the years to improve on this. Meningitis has been a concern in the past. About ten years ago it was recognized that children and

adults who received cochlear implants had slightly increased risks of meningitis, particularly pneumococcal meningitis, and so we always vaccinate our patients prior to cochlear implant surgery. Specific recommendations are available from the CDC, these change from time to time. We also have that information available on the website for the American Academy of Otolaryngology. The cost of vaccinations are covered generally by insurance, but I'm told that the manufacturers are willing to cover costs of vaccination if they are not otherwise offered.

There are many different measures of cochlear implant performance. These include just a measure of hearing thresholds, speech perception and production, language development, particularly applying to children, rehabilitation issues, and then we can also look at cost effectiveness. In children we look at the cost of education, for adults productivity in the workplace, and we can examine quality of life issues.

For cochlear implantation in adults, the

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questions that we ask are, is cochlear implant surgery safe in older adults, is it effective, is quality of life significantly improved, and is cochlear implantation cost effective in this population. So we've assembled some studies that will probably be reviewed in the technology assessment with the exception of some of the older studies. Cochlear implants are safe and effective in people over the age of 60 years. Intraoperative and postoperative complication rates related to cochlear implant surgery have been found to be low in patients over age 65. Cochlear implants facilitate significant improvement in speech recognition abilities of cochlear implant recipients over the age of 65.

And more studies here. Many studies report that speech recognition results of patients over age 65 are not significantly different from those obtained by younger patients. This study specifically looked at performance. It is one example of the studies that show equivalent performance for these age groups.

The impact of cochlear implants on quality of life in the elderly is well documented and shows an increase in confidence at work and at home, an increase in social activities, and an overall improvement in quality of life. This is certainly something that we see in our patients on a day-to-day basis.

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And last, cochlear implants are cost effective in older adults, which was demonstrated in a study by Francis, et al., where they looked at health utility scores and audiological data before and after cochlear implantation in 47 adults age 50 to 80, and found highly significant gain in health utility as well as a favorable cost utility of under $10,000 per QALY gained, as well as significant improvement in hearing and emotional

health. The improvements in speech perception were predictive of gains in health-related quality of life and emotional well-being.
And that's all I have.
DR. GOODMAN: Thank you very much, Dr. Tucci. Before you leave the podium, Dr. Tucci, if there is a question or two for clarification, we can take that now. If not, we will proceed. Dr. Chen, one question?
DR. CHEN: I assume by your presentation that the internal component of the device probably receives power from the external component using some kind of current induction. Is that a correct statement to make?
DR. TUCCI: The internal component power supply is in the external device, yes.
DR. CHEN: So my question is, with seniors having higher hospitalizations, higher ICU stays, is it possible for other external medical devices to perhaps

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cause or trigger unwanted signals in the internal component of the device, causing perhaps pain and discomfort to the patient?
DR. TUCCI: I'm not hearing your question, I'm sorry.
DR. CHEN: In other words, is it possible for other electrical devices to induce the signal within the internal component?
DR. TUCCI: Not that I know of.
DR. CHEN: Okay, thank you.
DR. GOODMAN: Thank you very much. Yes, one more question. Dr. Stein.
DR. HARTMAN-STEIN: At your center, how do you assess the cognitive level of the person, and do you not do this on people with early dementia or cognitive impairment?
DR. TUCCI: That's a good question. I actually saw a patient the other day who had fairly severe dementia and I didn't really consider implanting him because of that. I think if there's a question, I would get a formal evaluation, but I don't routinely do that. But I do spend some time with the patient and their family and talk about the implant procedure and see how it might impact a patient's life. I think dementia alone wouldn't indicate that I think under no circumstances should a patient be

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implanted, but I just think it requires very careful evaluation and a team approach to making that decision.
DR. GOODMAN: Dr. Steinbrook, one more question, and then we will proceed.
DR. STEINBROOK: Are there any trend data on the surgical risks and complications, and I'm wondering if the operation would be considered safer now than a decade or two ago.
DR. TUCCI: I think, I don't have that in front of me, but people have looked at risk of complications for

a long time, and I think that the more recent studies do show that the risks are less, particularly with meningitis. We do vaccinate them now to prevent that, so that has certainly come way way down.

DR. GOODMAN: Thank you very much, Dr. Tucci. Thank you.

We now move to Dr. Teresa Zwolan, who is professor and director at the University of Michigan Cochlear Implant Program, part of the University of Michigan Health Systems. Welcome, Dr. Zwolan.

DR. ZWOLAN: Good morning. Thank you for having me here. I would like to begin by disclosing that I am a member of the audiology advisory board for both Cochlear Americas and MED-EL Corporations.

I began my work with cochlear implants in 1985,

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so I, like Dr. Tucci, have been able to grow with this technology, and I hope that I can bring some of that information to you today. The purpose of my talk is to provide information regarding audiological management and assessment of adult implant patients. We'll talk a little bit about preoperative determination candidacy to help you understand what we do for that, and also postoperative evaluation of performance. I'll talk a little bit about the FDA criteria, Medicare criteria, audiometric data, speech recognition, and also look at postoperative management and patient results in bilateral versus unilateral implants.

So, the FDA has issued guidelines as to when to provide an implant and they oversee, as you know, the selling, distribution, labeling and marketing of cochlear implants, and they determine the specific wording used in device labeling, including the indications for use that is appropriate and valid. The wording approved by the FDA follows intensive clinical trials, from which we collected a great deal of clinical data on a large number of patients. So the specific indications for use really vary depending on whether the device meets FDA approval, so it's somewhat difficult to determine exactly what the FDA criteria are. The technological assessment did a really great job of outlining what the current criteria are for

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the forth various devices that are available.

So, a sample FDA indication for one cochlear device, the Nucleus 5, states a moderate loss in the low frequencies and a profound hearing loss in the mid to high speech frequencies bilaterally. It also indicates little or no benefit from hearing aids as defined as a score of less than or equal to 60 percent correct in the best-aided listening condition on tape-recorded tests of open-set speech recognition and a score of less then or equal to 50 percent in the ear to be implanted. So I included this sample wording of the FDA, and if we compare that to the Medicare wording we start to see a little bit of

difference and somewhat confusion.
If I have two patients in my waiting room, I could have them sitting right next to each other and they could both score 45 percent correct on a sentence test in my test booth, and I could have one of them receive an implant because their insurer follows FDA guidelines which requires a score of less than 50, and then I have a person next to them and if they have a different insurer, say Medicare, they cannot receive an implant, and I have to send one away.
To add even more confusion, the Social Security Administration states that adults with hearing loss who do not have a cochlear implant are considered eligible for

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disability if they obtain a score less than 40 percent on a word test, and word tests are traditionally harder than our sentence tests. If the patient has an implant, they've recently expanded their indications to state that if someone has a cochlear implant, they are considered eligible for disability up to a year post-implant, and after that we're to evaluate their speech recognition with sentences, so it's similar to this, but they state the patient can remain on disability if they score less than 60 percent on a sentence test.
So if we look at the criteria, we see that in summary we have Medicare that requires less than 40 percent for an implant, the FDA requires less than 50 percent for an implant, and then we have Social Security saying less than 60 percent on sentences makes someone eligible for intervention, treatment or disability. So as a clinician, it's sometimes difficult to get through all of the numbers. So my task today is to take you step by step through the Medicare criteria and we're going to go word by word, and hopefully at the end you'll have a better understanding of how we evaluate candidacy in the clinic.
I'm going to focus on the top three, the audiologic assessment, determining the appropriateness of hearing aids, and the speech recognition with hearing

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aids, and Dr. Tucci already covered some of these other areas.
So let's begin with moderate to profound hearing loss, what does that mean for our patients? So if we look at just the ear, a basic review, we have the sounds that travel through the outer ear, reach the middle ear, then come to the inner ear and then are sent up the hearing nerve to the brain so that we can hear.
We do audiometric testing that will help us determine the type of lesion and severity of the hearing loss. What do we do with audiometric testing? Everyone can remember times when they've had headphones put on and we raise our hands when we hear a soft sound. And what we do is present a pure tone via either an insert earphone or

via a bone oscillator, but both of these directly will stimulate the inner ear so we can evaluate the status of the hearing system. The insert earphone will send a signal through the outer ear and the middle ear, where the bone oscillator will go directly to the inner ear, so we can determine if there's a difference and if there's a problem at any point along the pathway of hearing. So what happens when our patients raise their hands when they hear a sound, we take that information and plot it on a graph called an audiogram, and here's the audiogram. Along this axis we have frequency that goes

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from very low to very high frequency, and along this axis we have intensity, starting with very soft all the way down to extremely loud. So somebody with normal hearing is going to be able to hear all of the frequencies at a very soft level, so all of their marks or their thresholds would fall up at the top of the graph. Someone who can't really hear anything, all of their marks will fall near the bottom.

For example, this one, this person heard this sound at 55 dB for 250 hertz, at 2,000 hertz they couldn't hear it until it was 70 dB, so this person clearly has a hearing loss. One of the nice things about audiograms, they always come with test symbols, so if you don't know what you're looking at, you can look at your test symbol chart. The right ear is usually signified by a circle and the left ear almost always with an X. They're also color coded, but not so much these days.

The severity of the hearing loss is determined by the location on the audiogram where the person is able to hear the softest possible sound. If their responses fall between zero and 25, that's considered normal; 25 to 40 is considered a mild hearing loss; 40 to 55 is moderate, so this is where we're starting to tap into the candidacy criteria for implant. 55 to 70 is moderate to severe, 70 to 90 is severe, and 90 and above is profound.

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So as Medicare criteria states, our cochlear implant candidates have a moderate to profound sensorineural hearing loss, and again, moderate meaning anywhere above 40, so this audiogram represents a typical audiogram of an implant candidate who has moderate loss in the lows, sloping down to a profound hearing loss in the high frequencies. This would be attained with insert earphones unaided, so that's just their natural hearing we're seeing here.

When we place a hearing aid on this person, we also do that in our evaluation, there's different ways to do that. One way is to put them in the sound field and we present sounds through the speakers with them wearing hearing aids. They raise their hands again, and hopefully that hearing aid is going to improve their detection so there could be pretty typical what we call functional

gain, by wearing these hearing aids the person is experiencing better detection than they do without their hearing aids, which is what we would expect. And preoperatively, it is very important for us to look at where they're getting responses with the hearing aid and compare that to what we would expect with a cochlear implant. So for this slide I placed our typical cochlear implant responses on this audiogram. Once they receive an implant, we put them back in the

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sound field, they raise their hand when they hear the sound, and usually their responses with current technology fall at about 15 dB for all of the speech frequencies. I like this audiogram because it shows real life information about what this patient is and is not hearing. So even with a hearing aid, you can see that up here are some very soft sounds, and even with hearing aids they are missing some very important speech sounds. They can hear things that are louder that this, but they can't hear anything above their marks, so this is why they're having reduced speech recognition. So we're looking at these charts for speech recognition because it really is very important for us to evaluate how well they're functioning in daily life and how well they're able to recognize speech when using hearing aids alone without any visual cues. So what does it mean when we say that the person has to attain a score of less than 40 percent on tape-recorded tests of open-set sentence recognition? Years ago we decided to use sentences for a variety of reasons. Right now I'm speaking in sentences, I'm not speaking in isolated sounds or words, so I do believe that sentences represent our everyday communications. And early on with implants our patients did so poorly that we really needed an easier test in order to measure any

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progress, otherwise, the test was too hard to score effectively, and it's interesting that now the technology has advanced so far that sentences are sometimes now having ceiling effects. So in terms of what does it mean versus open set or closed set, if we have a closed-set test we provide a set of choices from which the listener can choose their responses. So if I say I'm going to tell you a color, that gives you some context and there's only so many colors to choose from, and I might give you a picture playing test that has four choices and you could randomly guess, and your guess or your chance score would be 25 percent, you would have a chance of one in four of getting that correct. Open set means that there are no choices, it's really a completely open set from which you choose your responses from so your chance score theoretically is zero percent. So we're looking at tape-recorded tests, tapes

are more reliable than live voice, it's also more difficult than live voice, and we're looking at these open-set unlimited choices of sentences. I was not able to get us a sample HINT test, but one might be something like strawberry jam is sweet. They are actually somewhat easy sentences, so people who score low are really having great difficulty even when it's

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quiet and in a controlled setting. So what do we mean by the best aided listening condition? We want to identify their ability to understand words in sentences with the right ear aided, their left ear aided, as well as both ears aided together at the same time. So a typical patient might have something like this, which with their left ear aided they obtain a HINT sentence score of 22 percent correct, their right ear aided score might be something like 32 percent correct, and their binaural or both ears together, their score might go up to 42 percent with both ears. Unfortunately under CMS guidelines, this patient, although they meet the criteria in the right ear and they meet it in the left ear, they do not meet the criteria for less than 40 percent, so this person would not qualify for a cochlear implant. Another different patient here might have a left ear aided score of zero percent, a right ear aided score of 24 percent, and possibly a binaural aided score of 20 percent, and this shows you that the best aided condition is not always both ears together, it might be just one of the ears by itself, so it's important for us to evaluate that, but this person would qualify for a cochlear implant. I wanted to give you some information just about

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the types of patients that we're seeing in our clinics, so I looked at data from 14 subjects over the age of 65, I picked 2009, because I had postoperative data on that group. Their binaural aided scores on average was about 30 percent. The implant ear, the one we ended up implanting, preoperatively scored 12 percent on these sentences. And their non-implant ear had scores of about 26 percent. So I think it's clear to see, in these patients at least, that they're not hearing very well prior to the implant, and remember these patients because I will give you some more data on them later on. Once we've evaluated and determined that they are a candidate for the implant, we decide which ear to implant. Some centers prefer to implant the better ear, some prefer to do the poorer ear, and most centers do it on a case-by-case basis, and usually work very closely with the patient to determine the optimal ear for implant. So once we've determined that they're implant candidates they have surgery, they come back to our clinic about one to four weeks later, depending upon the schedule of the

clinic, and sometimes clinics will obtain an x-ray, you can't see it very well here, but it is typical for our program, and we're able to get a nice visual of the electrode array inside the cochlea before we start to activate their device.

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The first thing we do is we plug them into a computer, it's amazing that we can control their hearing via this computer, and we can send a signal to the internal device which sends a response back using telemetry, all three devices have telemetry, and it gives us a quick integrity check of the internal device, to make sure that we're communicating well.

So, how do we set the device? We begin by determining the lowest level of current, of electrical current required for the patient to hear with stimulation of each of those electrodes that have been surgically implanted in their ear, and that's referred to as threshold, like it was on the audiogram. And then we also determine the loud but comfortable setting, which is called the C level, for each electrode. And so what we will typically have here, the type of screen the audiologist will see, this particular device has 22 electrodes. We go from low pitch to high pitch. We've got where the patient first heard the sound, when they indicate it's very soft. We then take the stimulation when the patient hears the beep beep beep, and we make it louder, and then we set it to a comfort level.

Each of these electrodes will have a frequency range assigned to it, so if this one is assigned 500 hertz, so if this one was assigned a 500 hertz pure tone,

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most of the energy would be focused on that electrode for them to hear, and speech is multidynamic, so what you can see is things just going across all of the electrodes while they get different pitches and different pitch information, so it's like doing a lot of audiograms over and over again.

So that's all well and good, there's a lot of beeps, but then the really fun part comes when we get to turn on speech. The processor uses that information and it converts it into a map that we then download to the patient's processor. We go live, we tell them that they're going to hear speech, and patients will initially report that it sounds odd, maybe even chipmunk like, but that it usually goes away very quickly, probably within the first week or at least by the first month, and they start to say it sounds normal, they can recognize family voices, they can easily differentiate between a male and female speaker.

They come back about seven times the first year and we repeat the mapping, we check their thresholds, we check their comfort levels, they will change over time as they adjust to sound. And we do speech recognition

testing annually just to evaluate the efficacy of our intervention. Almost always, all of our patients will show this detection at around 15 to 20 dB across the
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board, and even if they have poor recognition skills, we can almost always, unless they have some abnormality of their cochlea, we can almost always give them this improved detection of speech.
And along with this improved detection comes improved speech recognition, and that's the really exciting part. To speak to this, about three-quarters of our adult patients are able to interactively use the telephone, which is really life-changing for many of them.
If we look at that group that I reported on from 2009, their average post-implant sentence score at their one-year post-implant evaluation is up to 80.5 percent, so we're taking these patients who are really not hearing anything at all and bringing them back into the mainstream of hearing by providing them with scores of an average of about 80 percent.
We're not the only ones that are seeing these amazing results in our patients over 65. There's a lot of data reported where others are seeing similar results in patients over the age of 65, so it's very clear that we're making a difference in the lives of these patients, and there is even more. There are many who report that speech recognition results in patients over the age of 65 are not significantly different from those obtained by younger patient groups, so I would encourage the panel to consider
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looking at the data that was obtained on the younger patients because I think it is very clear that there really isn't an age effect for this intervention, and to consider the data from the other patients.
So, one last thing I would like to talk about is the bilateral versus unilateral implant. To be honest with you as a clinician, I really wish that 25 years ago we would have started with both ears, because I see benefits in bilaterals that I really wish we had had right from the get-go. We can talk about sequential bilaterals, getting them later on in life after a time separation between the two versus getting both of them at the same time. I think the benefit is clearly there, benefits that you will hear about today so I won't go into much detail, are improvement in speech recognition and noise, improved ability to tell direction or location of sound, and to optimize their performance.
Speaking from my personal experience, if I have someone with bilaterals and one of their processors breaks down or their battery runs out in the middle of an important meeting, their world doesn't just stop, they can keep functioning with that backup or that second ear that's already on. Sometimes ears don't do well, one ear does better than the other, and we can hit their better

ear and maximize performance right away.
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Implants in both ears are particularly valuable for patients with visual impairments who really need them to be able to tell their sound and their environment to be able to maneuver in their environment. If you ask a patient with bilaterals what it sounds like, they will liken it to a stereo sound versus a mono, and they almost always say I don't know how I got by without my second one. And also, I don't have a single adult who doesn't use both of their implants who have bilaterals. Again, great results, and a lot of people have published important studies to show that bilateral implants are very beneficial for adults as well as for children.
So in closing, I would like to state that cochlear implants are really one of the most significant technological advances of our time, the safety and efficacy of them are well documented, and they are really a very important benefit for our Medicare population. Thank you.
DR. GOODMAN: Thank you, Dr. Zwolan. Dr. Zwolan, if you would remain at the podium, we'll take a few concise questions, starting with Dr. Satya-Murti.
DR. SATYA-MURTI: Speech recognition functioning in the real world is additive, isn't it, in addition to the critical mechanisms of central processing in the brain stem, so how much of a peripheral improvement, say a
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percentage, correlates to a functional improvement in life? Have there been studies, is five percent enough if the brain is intact, or if the brain is dementing, do we need 60 percent improvement?
DR. ZWOLAN: I'm thinking in explaining that, I took my daughter for a vision test recently, and the optometrist said to me, you know, she could either wear glasses or not. Some people can get by with this vision and not wear glasses, and other people really need to see better. And so I think there's a little of that, it depends on the person, it depends on their lifestyle, it depends on the hearing demands of their daily life. You can get somebody who's really only improved the lipreading benefit and we've changed their life, so I think that just getting them that little improvement in speech really is significant. I think we do even better by giving them at least five, ten, 60, 80 percent improvement.
DR. GOODMAN: Thank you. Dr. Schwartz was next.
DR. SCHWARTZ: Two real quick questions. One, what's the variance in testing? In other words, you gave an example of somebody with 42 percent. If they were retested or tested by someone else, what's the range of scores one might see?
And similarly, what's the relationship between sentence versus word recognition and how does that apply
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functionally to patients?
DR. ZWOLAN: I think we're going to be seeing a lot more studies looking at sentences versus words, because I think we do need to move to some word testing with our adults. The words are definitely harder, so someone who might score 80 percent on sentences might score something as low as 40 percent, I think the average is probably 60 percent for words, and 80 percent for sentences.
DR. SCHWARTZ: And how does that translate into function for the patient?
DR. ZWOLAN: Again, it depends on people using normal cues and contextual cues very well. And I'm sorry, I don't remember your other one.
DR. SCHWARTZ: In regard to variance in the testing. In other words, if one audiologist tests somebody and they get a 42 percent, and that person would be retested by the same person an hour later, or by a different person, how wide a range -- I know in cardiology with echocardiograms, there's a pretty wide range of ejection fractions one can get depending on the administrator of the test.
DR. ZWOLAN: If we go back to our sentences, we do a lot of sentences, we don't just use a few, so it helps us get more consistency and reliability, and I'm

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pretty sure somebody could go somewhere else that same day and score probably within a couple of points.
DR. GOODMAN: Thank you. Dr. Scorza I believe is next, is that correct, or Ms. Scorza.
MS. SCORZA: What is the infection rate in the people that you've seen with bilateral cochlear implants?
DR. ZWOLAN: I can only speak for our facility and it's consistently low, probably less than two percent. It's very low.
MS. SCORZA: And associated with that, what kind of sequelae or complications have you seen that have arisen?
DR. ZWOLAN: I would say probably wound infections, which are very rare as well, but that's probably the only common complication.
DR. GOODMAN: Thank you. Dr. Steinbrook, then Dr. Raab. Dr. Steinbrook. Oh, Dr. Raab.
DR. RAAB: You mentioned the different coverage thresholds and you mentioned disability versus Medicare. Could you go through those numbers again?
DR. ZWOLAN: The Social Security Administration just came out with new guidelines, and they define if a patient has an implant or does not have an implant. Without an implant, someone is able to receive disability if they score less than 40 percent on a word test. If

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they receive an implant or they have an implant, they're able to receive disability for a year post-implant or if

they score less than 60 percent on sentences with their implant.

DR. RAAB: And so it's a 60 percent threshold for disability and then a one-year waiting period, you get Medicare coverage, but then the Medicare coverage is 40.

DR. ZWOLAN: That's right.

DR. GOODMAN: Thank you. Dr. Sacco.

DR. SACCO: I'm trying to get a handle on the audiometric testing that you so nicely described and what it would look like in someone who had a 40 to 60 percent HINT score.

DR. ZWOLAN: That can vary. We might have somebody that has a very severe hearing loss that can score 40, or we might have somebody with a moderate loss that scores zero, so there's not always a direct correlation between the severity of the loss and speech recognition skills.

DR. GOODMAN: Okay, thank you. Dr. Zwolan, thank you very much, we very much appreciate your comments.

Panel, the next thing on the agenda is the technology assessment presentation from the experts at Tufts. That's going to take 40 to 45 minutes. Would you

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prefer to hear that now and then take a ten to 15-minute break after, or would you prefer to take a ten to 12-minute break now and then hear the technology assessment? If there's anybody that would like to take the break now as opposed to later, raise your hand? It look like we're going to push through, okay, thank you very much.

Next we are going to hear the technology assessment presentation from Drs. Mei Chung and Gowri Raman. They're from the Tufts Medical Center, the Tufts Evidence-Based Practice Center at Tufts and from the Institute for Clinical Research and Health Policy Studies, also at Tufts. For those of you who have not been to one of these meetings before, typically, it is often the case that when the Medicare program at CMS wants to conduct a MedCAC, it will request the Agency for Healthcare Research and Quality, AHRQ, to ask one of its I believe 14 or so evidence-based practice centers to prepare what is essentially a systematic review of the evidence that is relevant to a certain set of questions. As much as AHRQ and CMS can, they try to align the MedCAC questions and the questions posed to the evidence-based practice center.

So, we're now going to hear this technology center presentation. Welcome, Dr. Chung.

DR. CHUNG: Hi, good morning. I'm honored to be

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here to present to you our systematic review titled Effectiveness of Cochlear Implants in Adults with Sensorineural Hearing Loss. I'm Mei Chung and I'm going to go through some brief introduction of the report and

the key questions, followed by presenting to you the first part of the results on the effectiveness of unilateral implants, and Dr. Gowri Raman will present to you the second part of results on the effectiveness of bilateral implants.

DR. GOODMAN: Dr. Chung, if I could just interrupt you, I apologize. Panel, you have in your packet ahead of time the technology assessment report if you want to refer to it. Dr. Chung, please continue.

DR. CHUNG: This slide shows the names of my colleagues, other team members who cannot be here today, and we have two technical consultants, Dr. Dennis Poe, who is with us here today, and Dr. Neault, an audiologist from Children's Hospital. This report was funded by AHRQ, and CMS and AHRQ helped formulate the initial study questions but they did not participate in the literature search, the determination of study eligibility criteria, data analysis or interpretation, or preparation of this report.

One of our technical consultants, Dr. Neault, discloses her affiliation of audiology advisor on the advisory panel of Cochlear Americas. Her role in this

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report was limited to educating us on cochlear implantation and speech perception tests. All other investigators do not have any conflicts of interest to disclose.

The object here of our report was to evaluate the clinical effectiveness of unilateral cochlear implants and bilateral cochlear implants in adult patients with sensorineural hearing loss.

I'm going to go to our key questions. Key question one was what current cochlear implantation devices are approved by the FDA for individuals greater than 18 years of age, and what are the indications for their use?

Question two, what are the communication-related health outcomes and quality of life outcomes in adult patients with unilateral cochlear implantation?

Key question 2.A has to do with the preoperative predictors of postoperative health outcome in unilateral implantation. Key question 2.B is one of the MedCAC questions asking, of the studies of unilateral cochlear implants, are there data available separately for those individuals with sensorineural hearing loss as demonstrated by preimplantation test scores of greater than 40 percent and less than 50 percent, as well as those with test scores of greater than 50 percent and less than

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60 percent.

Key question three: Compare the bilateral implant to a unilateral implant in terms of their health outcome.

Key question 3.A and 3.B are similar questions about the preoperative predictor of postoperative outcomes

in simultaneous bilateral cochlear implantation and sequential bilateral cochlear implantation. Key question 3.C is also a MedCAC question asking of studies of bilateral cochlear implants, are there data available separately for those individuals with sensorineural hearing loss as demonstrated by preimplantation test scores of greater than 40 percent and less than 50 percent, as well as those with test scores of greater than 50 percent and less than 60 percent.

This slide shows the predictors of interest for key questions 2.A, 3.A and 3.B, including patient characteristics and device characteristics, for example speech recognition test score at baseline and age at implantation, and also the implanted devices.

I'm going to present to you the methodology used in the technology assessment. To search for the approval status of implant devices we searched FDA device database, FDA premarket approval database, and clinicaltrials.gov. For the systematic review of literature we searched

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MEDLINE, the Cochrane Central Register of Controlled Trials, and Scopus database for more recent published studies since 2004, using combined terms for unilateral and bilateral cochlear implants and sensorineural hearing loss. We limited our search to adult humans.

Population and condition of interest includes adult subjects with sensorineural hearing loss. We considered subjects greater than 60 years of age generalizable to a subset of Medicare elderly population.

Interventions of interest were twofold, unilateral and bilateral implants with one or two multichannel implants using whole-speech coding strategies. We include both sequential and simultaneous bilateral implants. We include also combined use of cochlear implants and hearing aids. We excluded brain stem implants, middle ear implants and bone-anchored hearing aids.

This slide should say comparisons of interest as opposed to comparators of interest. For comparisons of interest we are interested in the comparison of unilateral implant versus hearing aids in one ear or in both ears. We are also interested in the postoperative in comparison to preoperative outcomes. We are also interested in bilateral in comparison to unilateral implants with or without hearing aids. Especially for the study of bilateral implants, there are two types of study design,

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one type of design is comparison of cohorts and the other type is called crossover design, which will be explained later by Dr. Raman.

So for key question two, which is the effectiveness of unilateral implant, we required a minimal sample size of 30 patients with unilateral implant. This is because the effectiveness of unilateral implant has been previously reviewed. For key question three, which

is the effectiveness of bilateral implant, we required a minimum sample size of ten. We extracted a variety of data items from the published articles, including study characteristics, population characteristics, predictor outcome association, and outcomes of interest. For each individual study we followed the AHRQ methods guide to grade the quality of each study using a three-grade classification, A, B or C. Quality A studies are good quality studies that have the least bias and their conclusions are considered valid. Quality B studies are fair or moderate quality studies that are susceptible to some bias, but it is not sufficient to invalidate the result. Quality C studies are poor quality studies that have significant flaws that invalidate the study results. This slide is just to show some examples of quality B and quality C studies. A sample of quality B

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study would be a cohort study with clear importance, but they have some bias in selection criteria, recruitment methods, or, you know, their statistical analysis does not adjust for potential confounders. An example of a quality C study would be a retrospective cohort study that did not adjust for potential confounders in their analysis. Based on the studies rated quality A and B, we also rated the strength of the body of evidence following these four strengths, high, moderate, low or insufficient. We did not find any high level evidence in the technology assessment because for the highest level evidence we required at least two quality A studies. For the moderate evidence, level of evidence, little disagreement exists across studies. Further research may change our confidence in the estimates of effect and may change the estimate. And in general when only one quality, one B quality study has been published, the evidence was considered insufficient. We did not do any quantitative synthesis or meta-analysis because of great heterogeneity across studies, such as a wide duration of deafness across studies, variety of implanted devices used across studies, and different outcomes assessment across studies. I'm going to show you the first part of the results and --

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DR. GOODMAN: Dr. Chung, if you don't mind, I'd like to interrupt just briefly. Just to clarify for everyone here in addition to our panelists, who know this pretty well, Dr. Chung just described an approach to grading evidence and there are basically two levels, so one level has to do with, one type of evidence has to do with individual studies, so there's an A, B, C approach for individual studies, and then there's looking at a body of evidence which can be rated high, medium, low or insufficient. So when we're talking about the strength of

evidence, sometimes we're talking about, or she will be talking about individual studies, A, B, C, and sometimes the body of evidence, high, medium, low or insufficient. Sorry for the interruption, Dr. Chung.

DR. CHUNG: Thank you. This slide shows the summary results to key question one, the current approval status by FDA. There are three cochlear implant devices approved by FDA, including Cochlear Nucleus, Advanced Bionics, and MED-EL cochlear implantations. And as shown on this table, which a previous speaker already touched upon a little bit, the indications for their use in adult patients with sensorineural hearing loss vary across devices. Specifically as you can see in the table, the threshold for the open sentence recognition test varies from less than 40 percent correct to less than 60 percent

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correct depending on which device.

This slide summarizes the studies that we identified for key question two, which is a communication-related health outcome and health-related quality of life outcome in adult patients with unilateral cochlear implants. We also, although we identified a total of 22 studies with roughly 2,600 patients with unilateral implants, seven of these 22 studies were prospective cohort studies, the number of subjects ranged from 30 to 864 patients across studies. The mean baseline age ranged from 37 to 74 years old. Of the 22 studies, only nine studies were rated quality B, the remaining 13 studies were rated quality C. Six studies were conducted in the U.S.

This slide summarizes the results for effectiveness of unilateral cochlear implants. As a reminder, we only rated the body of the evidence based on quality A or B studies. As shown in this table, there are no quality A studies, so each row showed the strength of the evidence for each outcome, and all studies included for this question reported an average of test, speech test score at baseline of less than 40 percent correct. So we, the body of evidence was rated moderate for speech perception test outcomes, and also the body of evidence was rated moderate for health-related quality of life

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outcomes, and this rating was based on consistent clinical and statistical benefit as shown in the B quality studies.

This slide summarized the studies we identified for key question 2.A, asking about the association between preoperative patient characteristics and postoperative health outcomes. We identified a total of 21 studies with roughly 2,200 patients with unilateral implants. Four studies were prospective cohort studies, and the number of subjects ranged from 22 to 316 across studies, and the mean baseline age ranged from 37 to 74 years old. Of these 21 studies only four studies were rated quality B and it just happened, the four studies were the same

prospective cohort studies, and the remaining 17 studies were rated quality C. Seven studies were conducted in the U.S.

This slide summarized the results for association between preoperative predictor of speech outcomes after unilateral implant. So again, as a reminder, we only rated the body of evidence based on quality A or quality B studies. The body of evidence was rated moderate for the association between longer duration of impaired hearing and poorer speech outcome after unilateral implant across the three, consistent across the three B quality studies. The body of evidence was rated low for the comparison between age at implantation or type

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of implanted device and postoperative health speech outcomes.

For the remaining predictors of interest, the body of evidence was rated insufficient because we only identified one B quality study for each predictor, and please note that we did not identify any study examining implant sites or expertise of cochlear implant teams, or other patient-related disabilities in relationship to the postoperative speech outcome.

This slide summarizes studies that we identified for the preoperative predictors of health-related quality of life outcome after unilateral implants. Overall, the body of evidence for health-related quality of life outcomes is rated insufficient. This is because of only one B quality study each for different predictors of interest.

So, this slide showed the results for the MedCAC question asking the data available for the subset of individuals by their preimplantation test scores. We did not identify any studies from the key question two specifically reporting data for these two subsets of populations. As a reminder, all of the studies reported for key question two reported an average test score at baseline of less than 40 percent. Therefore, some of the individuals in this study had a test score of greater than

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40 percent but they were not analyzed separately.

From the studies, 21 studies included in key question 2.A, we identified two studies providing separate data for individuals with sensorineural hearing loss as demonstrated by test scores greater than 40 percent. The first study was rated quality B analyzed both elderly, and they matched younger adults. In this study the higher score was analyzed in three different categories, less than 20 percent, 21 to 40 percent, and greater than 40 percent correct in relationship to the postoperative HINT score outcomes, and they found that higher for implanting score, which is significantly associated with higher post-implant HINT score both in quiet and noise.

The second study was rated quality B and

analyzed patients implanted with either the Clarion or Nucleus device. In this study they reported both elderly and younger adults had significant improvements in HINT and BKB scores after implantation, there was no significant difference in improvement between elderly and younger adults.
And this study was rated quality C due to no adjustment for potential confounders in their analysis.
This slide just summarizes what I just presented to you. Overall the body of evidence was rated insufficient for the effectiveness of all unilateral

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implants by their preimplantation test scores of greater than 40 percent and less than 50 percent, as well as with test scores greater than 50 percent and less than 60 percent. This is because of the 22 studies included in key question two, no study provided data for this question.
Of the 21 studies included in key question 2.A, only one B quality study provided data for this question and we do not know the proportion of patients between the test scores greater than 40 percent and less than 50 percent in all the studies that we evaluated.
Now Dr. Raman is going to present to you the results for bilateral implants.
DR. GOODMAN: Thank you, Dr. Chung. Dr. Raman.
DR. RAMAN: Hi. Good morning, everybody, and I'm here to present the comparison of bilateral implants versus unilateral implants. This comes under key question three, communication-related health outcomes and health-related outcomes comparing bilateral implants with unilateral implants.
We identified 16 studies with a total of 443 patients who underwent bilateral implants. One randomized control trial consisted of three publications as a prospective cohort. There are an additional six prospective cohort studies, one retrospective study and

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six cross-sectional studies. The duration of follow-up from each study ranged between three to 12 months. The number of subjects ranged between 13 and 40 in each study. The mean age at baseline was between 46 and 64 years. Six studies were conducted as multicenter, eight studies were conducted in the U.S., and the remaining were conducted in Europe.
A continuation of the previous slide, we identified nine studies that evaluated simultaneous bilateral implants and five studies that evaluated sequential bilateral implants, and two studies included subjects with both simultaneous and sequential implants.
The study design that I would like to report a little bit more is the crossover design that was often used in bilateral implants. The bilateral subjects were, they were compared with right ear unilaterally within the

same subjects. The implant was temporarily disconnected and then the unilateral ear was tested. In a few studies the bilateral implants were also compared to an external cohort. Nine studies were rated B quality and the remaining seven studies were rated C quality. This is the summary results for the comparison of bilateral implants versus unilateral implants. The outcome characteristics included speech perception, sound localization, and health-related quality of life measures.

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As you can see from the slide, all studies were rated B quality. For the outcome of speech perception, we had nine studies that showed consistent statistically significant clinical benefit. The body of evidence was graded as moderate. For sound localization there were seven studies that were rated B quality studies, they also showed consistent statistically significant clinical benefit, and the strength of evidence was rated moderate. The disease-specific quality of life measures was evaluated in only one study which was rated B quality, and that showed significant benefit in two domains but inconsistent results in one domain. Similarly in the generic health-related quality of life measures evaluated in one B quality study, there were significant benefits in one domain and worsening in two domains. And the strength of evidence for the health-related quality of life measures for a bilateral implant versus a unilateral implant was rated low. This is the summary results for key questions 3.A and 3.B. Evidence was rated low, again, for the reason that we rate evidence low when there is a minimum of studies, no A quality study, or the studies provide inconsistent data. This was rated as low on two quality B studies that reported inconsistent data on age at implantation as a predictor of postoperative outcomes.

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Additionally, there were two B quality studies that evaluated hearing loss before implant, and implant or device characteristics in one quality B study that did not predict postoperative outcomes in bilateral implants. This is, again, key question 3.C, this is a MedCAC question, what is the data available on bilateral implants by their implantation test scores of greater than 40 percent and less than or equal to 50 percent, as well as those with test scores greater than 50 percent and less than or equal to 60 percent. This is a summary table from our report. The outcome category of speech perception test, all studies had the inclusion criteria of preimplantation open-set sentence scores of less than 50 percent. There were a number of subjects between the scores greater than 40 percent and less than 50 percent that were not reported, so we had a fair assumption that the majority of the patients included in these three studies had a score

less than 40 percent. There are three different types of speech perception outcome categories evaluated in these studies. The outcome pattern, the specific outcome pattern is also shown across these three studies. For example, Litosky in 2006 showed that bilateral cochlear implant patients did very well when compared to either ear unilaterally, which

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indicated some benefits. The study was rated B because it was a prospective study but there were some patients that were not accounted for in the final analyses. Similar results were also shown by Koch in 2009 and Buss in 2008, that showed improvement with bilateral cochlear implants when compared to either ear unilaterally. This is in continuation of the previous slide for simultaneous bilateral implants. The overall evidence was rated low for the effectiveness of simultaneous bilateral implants by the preimplantation test with open-set sentence test scores of less than 40 percent. This was based on the studies in the previous slide. There were three B quality studies that showed improved speech perception, sound localization, but of these three, only one study evaluated health-related quality of life and this study showed some inconsistent gains in hearing-specific quality of life when compared to the unilateral implant condition. This is the summary of results for key question 3.C. The previous slides were all for simultaneous bilateral implants, this is the slide for sequential bilateral implants. We rated the evidence insufficient, that meaning that there was insufficient information available for the effectiveness of bilateral sequential implants based on the preimplantation test scores of less

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than 40 percent. This was evaluated in one quality B study that showed improved speech perception in noise, and sound location. There was no difference in speech perception in quiet. There were some negative results or nonsignificant changes in health-related quality of life after the second ear implant versus the first ear implant. We also, in addition to the outcomes mentioned, we also looked at discontinuation of implant use across unilateral and bilateral implants. In total there were 20 subjects out of 495 study subjects that discontinued their cochlear implant specifically because of hearing-related complications, and the reasons included exacerbation of existing illness, tinnitus, disappointed with outcomes, cerebrovascular events, et cetera. So, just to summarize the conclusions based on the results provided to you, our report based on a systematic review identified that unilateral implantation is an effective hearing assistance that results in significant gains in speech perception in adults. Also, there are significant gains in health-related quality of

life.
The continuation of effectiveness of unilateral implantation, there is insufficient evidence, as Mei pointed out, among unilateral implants by the preimplantation open-set sentence scores of greater than
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40 percent and less than or equal to 50 percent, as well as those with test scores greater than 50 percent and less than or equal to 60 percent. This is basically because we did not have enough information on key question two, and there was only one quality B study that was identified under key question 2.A. In these studies, some subjects had test scores greater than 40 percent and because there was no subgroup analysis conducted, we have insufficient evidence there.
For the effectiveness of unilateral implant, there was moderate evidence for preoperative duration of hearing loss as a predictor of postoperative outcomes. Additionally, the evidence was rated low for age at implantation and based on implanted device characteristics. The other remaining predictors were rated to have insufficient evidence because there was insufficient information for the evaluation of the preoperative characteristics compared with postoperative health-related quality of life outcomes.
For the effectiveness of bilateral versus unilateral implants, the bilateral implants show greater benefits in speech perception outcomes as identified by the open-set sentence test scores in noise and mutisyllable tests on adults with bilateral implants when compared to unilateral implants. They offer better sound
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localization, there are benefits in binaural processing measures. However, there were inconsistent results for health-related quality of life that was reported in a few studies.
The summary of simultaneous bilateral implants, the overall evidence was rated low based on some inconsistent results across the outcome of interest, the effectiveness by their preimplantation open-set sentence scores of less than or equal to 40 percent. The strength of evidence is moderate as to three quality B studies that showed improved post-implant scores of open-set sentences in noise and quiet. There was insufficient evidence for the outcome of hearing-specific quality of life, which was elaborated in one quality B study.
For effectiveness of sequential bilateral implants by their preimplantation scores, the overall data is insufficient for the effectiveness by the preimplantation open-set sentence scores of less than or equal to 40 percent. Insufficient evidence was based on insufficient information that, we identified only one quality B study that showed improved open-set sentence test scores in noise and sound localization. In this

study the second ear implant resulted in negative or nonsignificant changes in health-related quality of life after first year of implant.

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In continuation, the effectiveness of bilateral implants by preimplant scores, overall there was insufficient evidence among bilateral implants by preimplant open-set sentence scores of greater than 40 percent and less than or equal to 50 percent, as well as those with test scores greater than 50 percent and less than 60 percent. This is basically, although three studies evaluated scores less than 50 percent, we did not have enough information on a subject group of patients who had test scores of greater than 40 percent and less than 50 percent.

Limitations of individual studies. In general, cochlear implant studies have short duration of follow-up, less than six months of follow-up. Few studies evaluated quality of life outcomes, often this was described as a subjective outcome. There are incomplete reporting of baseline characteristics, center characteristics, adjustment for potential confounders, and often missing recruitment site and year. There are duplicate publications and when I contacted the authors, some of them clarified this, and there were overlapping patients in multiple studies.

So basically, while trying to wrap up, I think for future research recommendations, the report identifies that there is a need for good methodological quality

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studies in terms of clear reporting of selection criteria. The majority of those studies are cohort studies, and we need more information on center characteristics, recruitment dates, and adequate reasons for loss to follow-up. Research should be conducted to address health policy needs. For example, we need more evidence on the subgroup of patients with greater than 40 percent and less than 50 percent, as well as patients with greater than 50 percent and less than or equal to 60 percent test scores.

I think this is important to emphasize, that we need a large database. The majority of these studies have been small sample size and it especially becomes difficult when evaluating studies, so we strongly emphasize that there is a need for a large database, a registry of patients who received cochlear implants, and especially we need to identify what are their long-term follow-up outcomes. There is also a need to develop better measures of disease-specific health-related quality of life measures. With this, I end my presentation. Thank you.

DR. GOODMAN: Thank you, Dr. Raman. Dr. Raman, if you would stay close to the podium, and Dr. Chung stay in the vicinity of the podium as well, as you are. Panel, let's take some questions now until 10:30, we'll take a ten-minute break at 10:30, and reconvene for further

questions for the technology assessment. Hands up from
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Dr. Satya-Murti, Dr. Mushlin, Dr. Schwartz and Dr. Eng.
Dr. Satya-Murti.
DR. SATYA-MURTI: This question is either for
Dr. Raman or Dr. Chung. On your slide 38, if you could
flip back, which concerns quality of life and bilateral
implants, your very last row shows there's one B study
with quality of life, but then you rate the evidence in
the last two rows as low. Would that be insufficient or
low? I'm sure you had a reason for calling it low.
DR. RAMAN: Yes. I think this is specific for
the quality of life measures. We thought there was some
inconsistent results and we were more in favor of leaning
towards low rather than insufficient, given that there
were not many studies, especially in bilateral implants,
that looked at health-related quality of life. I think
that's a fair question.
DR. SATYA-MURTI: But I wanted to clarify, it's
on slide 42, negative results. So looking at that, there
are some negative results with quality of life and then
your final conclusion about more data needed for quality
of life. I see a theme already where if we confine
ourselves to testing the numbers that are testable to a
peripheral function, they look very impressive, but when
we migrate more centrally towards quality of life and
overall functioning, either there's insufficient data,
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they're inconsistent or they're negative, so I'm seeing
this pattern there. I wonder if you agree with that,
either of you, and if you don't, your findings seem to
indicate this to us as panelists in trying to answer the
voting questions.
DR. RAMAN: I think that relates specifically
that there are not many quality of life measures that are
applicable directly to this cochlear implant population so
that becomes a challenge, and we've been seeing efforts as
the previous speakers alluded to, and these are the two
reasons that I believe are the reasons for insufficient
information.
DR. GOODMAN: Thank you. Dr. Schwartz is next.
DR. SCHWARTZ: I think Al was next, actually.
DR. GOODMAN: Dr. Mushlin then.
DR. MUSHLIN: Thanks, Sandy.
I really commend you, I think this was an
excellent technology assessment and a clear presentation.
I just have one question about methodology, and I wonder
whether you made a distinction in your evaluation between
cohort studies, whether they were retrospective or
prospective, whether you made a distinction between cohort
studies that followed the, if you will, the hearing of
individuals that were implanted, based your findings on
trends over time, basically before and after, or whether
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or not the cohort studies that you looked at took a sample of individuals with hearing loss and compared individuals who were implanted with individuals who were not implanted in your assessment. What I'm basically asking is in your assessment, did you make this distinction within the category of cohort studies?
DR. RAMAN: Yes. I think in unilateral implant, I think Mei addressed that, the majority of the studies tested before and after implant scores. I do not think that there are studies that compared unilateral implants with hearing aid users, but these are the type of studies that came across, but for bilateral implant, it is usually within such a comparison, and very few studies compared with an external cohort and one of these studies was rated quality C because there were some not, for the reasons that Mei pointed out, that they related to study selection, recall bias, those kinds of issues.
DR. GOODMAN: Okay. Let's take these two questions and then go to break, so let's take Dr. Schwartz next, and then Dr. Eng.
DR. SCHWARTZ: Cliff, I'm going to ask a question. Are you going to have, like sometimes, people come up at the end for a general discussion across the speakers?
DR. GOODMAN: Yes. What we will do after, we're

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going to have some scheduled presentations, and then what we're going to do is have our technology assessment presenters, our invited speakers, they will sit in the front of the room, and we'll have a discussion with, we will draw upon them as a group if you wish.
DR. SCHWARTZ: So let me ask the question, and then maybe defer the answer to then.
DR. GOODMAN: Pose your question, Dr. Schwartz.
DR. SCHWARTZ: The question I had was, what's the validity of comparing, making a unilateral versus bilateral assessment in somebody who has had bilateral surgery given that, I think the technical term is you guys have mucked around inside the ear, and is that a valid comparison compared to maybe the sequential case, assessing somebody when they're going up for a unilateral procedure or the bilateral procedure, or assessing different cohorts. So that's the question, and it will probably require comments by the various surgical and neurologic experts that we have here.
DR. GOODMAN: That does not sound like a question that Dr. Raman will be answering at this point, but I think some other presenters will be prepared to answer it. Thank you, Dr. Schwartz. Dr. Eng.
DR. ENG: I have maybe two questions, or possibly three. I wanted to know from the technology

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assessment, were there any studies, whatever grade, however good or insufficient, were there any studies that

looked at just over 60? Because there are a lot of studies being presented, they're small numbers, but I don't get the sense of the over 60 population. Were there any studies that you came across?
DR. RAMAN: There is one in the octogenarian population but it did not make it through for the unilateral exclusively because of the sample size. There have been a few in the unilateral with some subgroup analysis that may have compared the population greater than 65 versus in that population, but in bilateral we also had one with age at implantation that did a subgroup analysis.
DR. ENG: So there are subgroup analyses.
DR. GOODMAN: Dr. Eng, another question briefly?
DR. ENG: What is the prevalence of bilateral implants in the over 65 population now, does anybody know, or is this something that did not cover? I just want to get a scope.
DR. RAMAN: We did not look at the prevalence rate, but I know that most of the simultaneous studies came from the United States and most of the sequential studies came from Europe, and some of the Europe studies also included mixed populations.

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DR. GOODMAN: Thank you for now. By the way, a couple of the questions may be addressed later on today when we have all our speakers in front, we can look a little bit at some of the epidemiology here and some of the issues having to do with the age groups and so forth. If you look at your watch now and add 12 minutes, we'll reconvene and pick up with some further questions. Thank you.
(Recess.)
DR. GOODMAN: We're going to reconvene now, and Drs. Chung and Raman, we're still on the technology assessment so we still may have a few more questions for you, which means you should be in the vicinity of the podium, if you wouldn't mind. And I believe Ms. Scorza had a question from before the break, so if you would like to ask your question now, Ms. Scorza, we'll take yours and a few other questions if there are any. Please proceed.
MS. SCORZA: My questions for the device persons, or the technology persons are, did you see any studies independent of the makers of devices that did device failure rates and any consequences related to device failure rates just in general?
DR. CHUNG: We collected data on the prevalence of device failure but we did not consider that as an outcome of interest, so I'm afraid I can't answer that

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question.
MS. SCORZA: That was going to be my next question, is there any interest related to your findings? Thank you.

DR. GOODMAN: Thank you. Are there any further questions for the technology assessment? Dr. Griffin.
DR. GRIFFIN: Two things, just as a follow-up. I also noticed that there was no data on safety but that was because you weren't asked to look at that?
DR. CHUNG: We did look at that, but Dr. Raman is probably a better person to answer the question.
DR. RAMAN: Could you repeat the question?
DR. GRIFFIN: Yeah. I didn't see a quantification of the safety outcomes. Was that because it was not one of your key questions that you were asked to evaluate?
DR. RAMAN: Yes, that's correct. This was, at the beginning since this was a rather low complication procedure, we only specifically looked at one particular outcome of discontinuation of use, but we did not find much data, three or four studies that recorded that.
DR. GRIFFIN: And the second thing was, you mentioned that some of the studies were downgraded because they didn't control for confounders, but on the other hand, it's not clear that there are any real predictors of

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outcomes, so what confounders is it important to control for in these studies, and did that make a big difference in how you rated the studies?
DR. CHUNG: I think the confounding issue is particularly problematic in a lot of studies that evaluated preoperative predictor or postoperative outcome, because many of them, almost all of the studies were prospective database analyses of some kind, and then they are almost all interested in only one predictor at a time without considering the comorbidity differences, accounting for other disability or age differences, so basically a lot of studies were rated quality C. But in terms of effectiveness of unilateral implants the confounding issue is not so common, so we have more quality B studies.
DR. RAMAN: Especially for bilateral, the issue of confounding was around that.
DR. GOODMAN: Thank you. Dr. Schwartz and then Dr. Sacco. Dr. Schwartz.
DR. SCHWARTZ: My question has to do with age. I think you said there was one B quality study that looked at age at implantation and another that looked at older versus younger, and therefore there was only one in each category, so I have two questions here. One is, were the results between those two consistent, were they both in

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the same direction, recognizing that one sounded like it was categorical and the other sounded like it looked at it in a continuous basis.
And related to that is in your written material and I think in the slides, you talked about the Chapman study, which unfortunately I wasn't able to get a copy of,

that talked about greater than 70 versus less than 70, and the differences in the CID was .07, which is technically nonsignificant, but I just wondered what direction that .07 was in, because it's still .07 as opposed to a .7.
DR. CHUNG: That study showed improvement in both elderly and younger in the adult group, but the .07 referred to the difference between the groups.
DR. SCHWARTZ: So which group tended to do better, recognizing there was significant improvement in both?
DR. CHUNG: The problem is we cannot translate the difference in open-set sentence scores as a clinical benefit.
DR. SCHWARTZ: I understand. But did the older group, recognizing it was a significant improvement in both groups, the P of .07, what did that refer to, was the older group trending to do better or the younger group tending to have greater improvement?
DR. CHUNG: Can I answer that question after I

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refresh my memory?
DR. SCHWARTZ: Sure.
DR. GOODMAN: Thank you. Dr. Sacco.
DR. SACCO: I have a question that relates to slide 26 and I'm trying to understand, again, this issue of the degree of hearing loss based on the HINT. At the bottom of the slide you state a mean, median speech test score based on less than 40 percent correct, right? And you state all studies reported that. But then as I go back to at least your summary tables in your appendix, I can't find that data, and I know from your own review you seem to feel that there's not enough data regarding the HINT at baseline to stratify your results and look at it as a postoperative risk predictor.
DR. CHUNG: The mean baseline open-set sentence score was shown in an appendix.
DR. SACCO: Which table in the appendix, can you point me to that?
DR. RAMAN: Go to the indication for cochlear implant, which is the third column, or fourth column for each study, and specifically --
DR. SACCO: Which table are you at?
DR. RAMAN: Appendix D, D.1 through I think D.9 or something, there is --
DR. SACCO: So in D.1 among the D study, under

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implant indications, the two that are in D, the others are severe or profound.
DR. RAMAN: Yes. That is based on the description that is provided, so that might be studies that were not, clearly specified the scores, so I believe that the mortalities of them is not provided, the other specification in part of the cochlear implant criteria.
DR. SACCO: So subjective criteria for selection

into the trial. However, to calculate a mean or median preimplant HINT score, it sounds like there is insufficient data --
DR. CHUNG: Because a lot of studies, including the unilateral implant, were pre and post comparison, so it's probably not shown as a mean score, but we do have the mean score at baseline --
DR. SACCO: So if you can provide that, that would be helpful.
DR. GOODMAN: Hold on. Because we need to record what's going on here and we have to interpret what's going on, we cannot have speakers and panelists talking at the same time, so let's do this. Speakers, do you have anything else to say in answer to this question?
DR. RAMAN: For unilateral status, the results table, not the baseline characteristics, but the results table is applicable. We have test scores for the open-set

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sentence, and that would be the criteria, that is what we're seeing as the criteria.
DR. GOODMAN: Dr. Sacco, anything else on this point? Dr. Sacco, what are your take-home points from your question? In other words, you asked a question about validity of the data's biases. What for the panel's sake are the take-home lessons from your questions? And speak into the mic, please.
DR. SACCO: So my concern still in answering the questions put before us is the data regarding the 40 to 60 percent group at baseline, that's what we're specifically deliberating on in a lot of these indications. I gather from what the technology experts have described, there is insufficient data though a couple of the tables indicated that there are some patients in these studies in the 40 to 60 percent group, and I was just trying to get a better handle on if we could pull that and tease it apart.
DR. GOODMAN: Thank you very much. This is an issue, by the way, for all of us to consider. There isn't a truckload of highly rigorous data here, there just isn't, and we've got to deal the best we can with the limited data, so this is something we will deal with for the rest of the day, but thank you very much, a point well made. Any other questions for the technology assessment presenters? I see Dr. Mushlin.

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DR. MUSHLIN: This is a brief question, and I think the answer is probably yes. But in your technology assessment, particularly just looking at the unilateral, the single device, were all of the cohorts' hearing levels defined based on hearing aids values, that is, were all the studies individuals whose levels were determined with assisted, in the assisted state rather than, if you will, in the native state?
DR. GOODMAN: Can you make a statement across all the studies that way?

DR. RAMAN: Yes. All of the studies had some kind of assistance as the baseline scores.
DR. GOODMAN: Thank you for that, Dr. Mushlin, an important question. All right. Thank you very much for the presentation of the technology assessment by Dr. Chung and Dr. Raman, very helpful. Later on, Doctors, we will ask you to sit toward the front of the room where we have all our presenters.
But now we're going to move to our speaker list, and we have four predesignated speakers, each of whom will have seven minutes to present. We will start with Dr. Jill Firszt, associate professor at the Washington University School of Medicine, and she is noted here as representing the American Academy of Audiology. Welcome, Dr. Firszt.

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DR. FIRSZT: Thank you. I will just say that I am an audiology advisory board member for Advanced Bionics and Cochlear America, and any honoraria associated with those yearly meetings are provided to Washington University and used for student research funding.
DR. GOODMAN: Thank you. Dr. Firszt, can you start before your first slide is up or do you want to wait until it's up?
DR. FIRSZT: If I could wait, hopefully it will be up here in a minute.
DR. GOODMAN: That's fine. While we're waiting, panel, I know that one of the other challenges that we're going to have today, and maybe start thinking about it if you haven't already, is that you have to do a little mental crosswalk from the technology assessment key questions, the KQs, to our MedCAC questions, so there's not a perfect alignment there.
After we have our four prearranged speakers of seven minutes each, we're going to go to the open public comment period, and I have before me four speakers. It looks like we're back up.
Dr. Firszt, thank you for your patience. Please proceed.
DR. FIRSZT: Thank you. I also would like to thank the panel for the opportunity to speak here today.

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I'm going to talk about clinical outcomes in unilateral adult cochlear implants with better preoperative test scores. I'm going to talk about a longitudinal performance study that's a prospective study being conducted at Washington University. The goal of the study is to identify factors that predict word recognition or word understanding in adults who receive cochlear implants, and this study is supported by the NIH.
There are 108 postlingually deaf adults enrolled in the study, and they were implanted between 2003 and 2008. Here you see the mean age at implantation for this group of 108 as 57 years. The mean duration of severe to

profound hearing loss is 13 years and the mean preoperative sentence scores for this group was 15 percent. This refers to preoperatively using hearing aids, their best sentence understanding using hearing alone without lip reading scores, the average is 15 percent.

So we're looking at a number of independent variables which I have listed here, but for today's purpose we're going to focus on the preoperative sentence recognition score. We have a number of dependent variables and again, they are listed here, and for today's purpose we're going to focus on the final word recognition score, and this is the score that's achieved after two

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years of implant experience.

So you may be asking and have already asked perhaps, why assess with a preoperative sentence test and then a postoperative word test? As was described earlier, we evaluate candidacy for adult implant patients with simple sentences, an example is shown here. And then postoperatively patients tend to score high on these very simple sentences, and this can be problematic for longitudinal tracking. If we use single syllable words, and again, examples are shown, then we have fewer ceiling effects, and this was done for some of our longitudinal studies, and this was the measure that was chosen for our postop measure in this particular research.

So here you see data for 108 patients and each of these blue circles represents an individual. On this axis you have the preoperative sentence score, so again, this is the sentence understanding that each individual achieved prior to getting a cochlear implant using their hearing alone, with amplification. This is the postop word score, so again, through the cochlear implant, what is their word understanding after two years of experience. This is just an example of one individual person who has a preoperative word score of 20 percent but then a postoperative word score of 50 percent. You can see there's a wide range of performance both preoperatively

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for the sentence scores as well as postoperatively for the word scores, and if you look at just the individual people who scored at zero percent preoperatively on sentences, you can see that they have very wide ranges of performance, anywhere from two to four percent to as high as 95 percent. This box outlines the patients who have preoperative sentence scores below 40 percent and the smaller red box identifies those patients who have preoperative sentence scores in the 40 to 61 percent range.

Now I mentioned that the patients who are enrolled in this study enrolled between 2003 and 2008, and after 2008 we had ten additional patients who met this particular criteria of 40 to 60 percent, so going forward

I'm going to be discussing these 20 patients. Now of some importance, and maybe the most important part of this particular slide is the white space here, and you can see that for these 20 patients who scored in the higher range of 40 to 61 percent, that they actually, none of them had word understanding scores with a cochlear implant below 50 percent. So what this means is that if you have a better preoperative sentence score, you are much less likely to fall in the lower range of performance with the cochlear implant. So here are the demographics. Of these 20

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patients who fall into the red box, the mean age at implantation is 52 years, mean duration of hearing loss is nine years, and now we have a much higher preoperative sentence score, so we're talking about a mean of 50 percent. So here are the mean preop sentence scores, again, 50 percent for these 20 patients, and I wanted to show you what their preoperative word recognition scores are. So these are the same 20 patients, and the mean preoperative score is 11 percent for this group. These are patients who are listening in a soundproof booth, they are seated three feet from the speaker, they are listening in quiet, and they have their full attention to the task. Normal hearing individuals would score up or near a hundred percent with very little effort on this measure. Here I'm showing you the same 20 patients, this is their postoperative word score of 75 percent with at least one year of cochlear implant experience, and you can see that this is a substantial improvement in their ability to understand words with hearing alone through the implant. Now I've broken down this range. In the 40 to 50 percent we had 11 patients here, and 51 to 61 percent we had nine patients in that range. We had two individuals who scored right at 40 percent, so we included them in the range, and one of those individuals was 71

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years old, so he met the correct criteria for implantation. Here I'm showing, again, the two ranges, 40 to 50 percent, 51 to 61 percent. This is the mean preop sentence score of 45 percent, the same subjects' preop word score, and then their postop word score. So in the two ranges you can see a very similar profile, and a significant improvement in their understanding of words after their implants.

DR. GOODMAN: One minute.

DR. FIRSZT: Okay. This slide shows the individual data for these 20 patients, so each patient is represented with two bars. This is their preop word score and the orange bar is their postop word score, and you can see that all 20 patients showed significant improvement in their word understanding. And then finally, just looking at the postop word scores, this is the entire group of 118

patients. This is the group then divided into three, less than 40 percent, 40 to 50, and 51 to 60, and you can see the two green shaded bars on the right are substantially and significantly better, this one is significant and this one is almost as significant with respect to the individual who scored less than 40 percent. You also see this decreased variability in this group, which is why I showed you the individual panel with the blue circles on it.

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And this also fits clinically with what we see. It's very rare that a patient performs more poorly postoperatively than preoperatively, so if you're already starting a little bit higher in that range, we expect you to do better.

DR. GOODMAN: You need to finish up, Dr. Firszt.

DR. FIRSZT: Okay. So in summary, patients in this range perform significantly better with an implant, and preoperatively we believe that patients beyond 65 years of age will also benefit from this technology who fall in this range.

And I would like to acknowledge the NIH, our collaborators, our patients, and the American Academy of Audiology for allowing me to represent them. Thank you very much.

DR. GOODMAN: Thank you, Dr. Firszt. Is this among the published studies as of yet?

DR. FIRSZT: This is not. This is data. We are in the process of analyzing all these independent actors, but we will potentially move it up the priority list.

DR. GOODMAN: Thank you very much, so not yet published. Thank you, Dr. Firszt.

Next is Dr. Craig Buchman, professor and vice chairman for clinical affairs, chief of otology, neurotology and skull-based surgery in the department of

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otolaryngology, head and neck surgery at UNC Chapel Hill. It is noted here that he is representing the American Neurotology Society.

DR. BUCHMAN: Thank you for the introduction, I'm certainly honored to be able to present our information. I'm an advisory board member for all three implant manufacturers. At UNC we're a very busy implant program, we do 240 cochlear implants per year, about 60 percent of those are adults. And by way of understanding results, looking back at our database of nearly a thousand adults, 95 percent of those patients performed at greater than a 40 percent score for HINT in quiet, so the vast majority of patients postoperatively perform better than the HINT 40 preop criteria.

What I'm going to show you is data from both data directed to unilateral criteria from published studies as well as bilateral criteria. This was a prospective data collection but a retrospective review of

a group of patients that we analyzed with substantial preoperative residual hearing. We identified 15 of these 29 patients extracted from the discussion that had HINT in quiet scores of greater than 40 percent preoperatively in the best aided condition, their mean age was 56 years. I'm going to show you cochlear implant-only performance, not using a contralateral hearing aid. This

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graph I think depicts it well. Preoperatively, this is the patients that had sentence scores greater than 40 percent, and as you track these scores longitudinally looking at their cochlear implant performance at three months, six months and one year, you can see substantial improvements, this is a mean trend line with standard deviations. You can see that the vast majority of patients reach ceiling effects by one year of use. Looking at different metrics shows a similar outcome, whether you look at their outcomes in noise or if you look at CNC word scores.

So to summarize these data, patients with preoperative scores of 40 percent always surpass this metric and gain significant improvement with regards to their hearing, and if added, if their contralateral hearing aid is added, and I didn't show you that data, they do even better.

In terms of bilateral performance, I want to spend a bit more time on this. The benefits of bilateral implantation have already been discussed, and that's of course improved hearing in noise as well as sound localization. Maybe most important is that when one device is not working, the other one is.

The Buss study was already mentioned in the technology assessment and I'm going to comment on that.

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The Eapen study was a follow-up study to the Buss study where we looked at four-year outcomes. This was 26 individuals that had bilateral simultaneous implantation. All met criteria for unilateral implantation, which was a preoperative HINT in quiet score of less than 40 percent in the best aided condition.

This particular slide shows CNC word scores for the group at various intervals postoperatively. This dark bar shows the worst hearing ear, meaning the worst performing implanted ear, the white shows the better performing implanted ear, and then this shows the binaural condition, meaning both implants being activated. And at each of these follow-up periods, at one month, three months, six months and at a year, there's statistically significant benefit from using both implants than using one implant alone for CNC word score.

An adaptive noise protocol was used to look at benefits of hearing and noise, and the signal-to-noise ratio that was optimal for each patient was identified, and scores had to be between 40 and 80 percent to identify

their best noise condition. This graph shows the swell and it shows the tolerance of an individual to the increasing levels of noise over time. What you see at three months is that there's minimal tolerance to very very low signal-to-noise ratios, and as time goes on they

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tolerate lower levels or lower signal-to-noise ratios. This is important, that a lower signal-to-noise ratio gives a better performance. In the technology assessment I noticed that the arrow was going down for this, meaning that it was a worse predictor, but in fact from the exact same study, this was a mistake in their data assessment.

The head shadow effect is one that's been well characterized over time, and basically when noise is given to an individual opposite the implanted ear versus on the side of the implanted ear, you can characterize the effect of the head shadow. This shows head shadow results for that group of patients at one year. This is for the 26 patients. It's important to note that anything above this dotted line shows an improvement when the device for distolateral or contralateral noise is activated, so this shows that a head shadow effect is possible in nearly every single situation.

Finally, the squelch effect shows that the activation of two implants over one when the noise comes from the contralateral side, they looked at the benefit of activating that distolateral implant to the noise. This squelch effect is a central effect which requires significant central plasticity, and what you can see here is that early on the squelch effect is not prominent,

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meaning that you are as likely to be below the dotted line as you are to be above the dotted line. At a year, the vast majority of patients have a substantial squelch effect, meaning that they can integrate centrally the noise. If you follow this information out to four years, there's a substantial improvement in everyone with squelch.

So in conclusion, there are significant improvements in CNC word scores in the unilateral as well as in the bilateral condition. The bilateral condition is significantly better than either unilateral condition. Patients tolerate increasing signal-to-noise, or increasing amounts of noise which are demonstrated by reduced signal-to-noise ratios over time. The summation and head shadow effects are lost very early on, and the squelch effects which I just showed you is small early, but by four years of follow-up is robust. Thank you.

DR. GOODMAN: Thank you, Dr. Buchman. Since you were so efficient in your time and you've got 32.5 seconds left, before you leave the podium, you mentioned that you saw a contradiction in the CUNY findings that you cited versus the technology assessment. Can you concisely

describe the nature of that difference, or contradiction?
DR. BUCHMAN: Basically as you present increasing amounts of noise to an individual, the
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signal-to-noise ratio gets smaller, so in the technology assessment they gave a downward arrow for that particular metric, meaning that they saw it as a negative outcome. But lo and behold as it's reducing over time, as the signal-to-noise ratio is going down over time, that's an improvement rather than a worsening in performance.
DR. GOODMAN: Thank you for that explanation. Should it arise later I would expect that the technology assessment group may want to raise that, but not now, and if the panel thinks it's important, we will raise it then. Thank you for the clarification.
Next up is Dr. Rene' Gifford. She is an assistant professor at Vanderbilt, also director of the cochlear implant program, associate director of pediatric audiology at the Vanderbilt Bill Wilkerson Center department of hearing and speech sciences. Welcome, Dr. Gifford.
DR. GIFFORD: Thank you. I would like to thank the panel for having me speak today, and I would like to disclose that I am an advisory board member for both Cochlear Americas as well as Advanced Bionics. I'm going to discuss today an NIH R1 award that was given to Dr. Michael Dorman and myself to study bimodal and bilateral cochlear implant usage. Bimodal means that an individual has a cochlear implant in one ear and uses a well fit
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hearing aid in the other ear. Basically we wanted to study how these individuals performed in various real world listening conditions, because as you know, we don't live in a sound booth, and are rarely in a situation where sounds are presented in quiet without any such distracting noise or reverberant conditions. So the goal of our project is basically to determine a clinical tool that could be distributed to determine when an individual was ready to receive a second cochlear implant.
One of the realistic listening environments that we used utilizes an eight-loudspeaker array placed circumferentially about the patient's head and in this first condition we present restaurant noise simulation that comes from all eight of the loudspeakers, and the noise level is fixed at 72 dBA, which was the actual physical level in the restaurants where the noise was recorded. The speech is varied adaptively to get approximately 50 percent correct, so we are expressing this in terms of a signal-to-noise ratio where a lower score is representative of better performance.
We have run 82 subjects in our first year and the mean age is about 62 years. Thus far we have 25 unilateral implanted individuals, 34 bimodal and 25 bilateral recipients. What we're looking at here is this

signal-to-noise ratio. Here on the Y axis is the function
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of the three subject groups. Keep in mind, a large bar is representative of poor performance. So we have the unilateral, and then we add a hearing aid to the contralateral ear and see an improvement, and then with two cochlear implants we see further improvement. Now, going from unilateral to bimodal, or with a hearing aid, we see an improvement of about three dB in the signal-to-noise ratio, and in going from one implant and hearing to a second cochlear implant we see a further improvement of 2.5 dB. Now going from one implant to two implants, we see an over five dB improvement in the signal-to-noise ratio. Now some people in this room might think five dB is not a lot. However, every one decibel that you can improve the signal-to-noise ratio can actually translate to five up to 15 percentage points of improvement in speech recognition. So a 5.2 dB improvement could actually translate to more like 26 to 78 percentage points of improvement.
Now for individuals who had aidable hearing in the non-implanted ear but who were able to get a second cochlear implant, we would expect approximately a 2.5 dB improvement in the signal-to-noise ratio, again, much higher translational improvement when you look at percentage points.
Now the second realistic listening condition we
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looked at is reverberant speech. There is some reverberation here in this room I noticed, particularly up here, which is an echo off reflective surfaces in the room. We looked at two different reverberation times commonly encountered in your everyday life. Looking at sentence recognition performance, thus far we've looked at 53 subjects in the first year, 35 of which are bimodal, 18 bilateral. Here we're looking at percent correct, so a large bar is good. You can see for the bimodal listeners we have the quiet as well as the .6 reverberation time condition, and then for the bilateral users, in quiet it's important to notice there's no difference whatsoever because they're at this ceiling. However, in the more complex listening environment with reverberation, we see an improvement of 11 percentage points.
Now during the first year of our project, fortuitously five of our subjects who had been bimodal and studied prospectively, decided to go and get a second cochlear implant. This was not an intended goal of the project but we were able to then enroll those subjects bilaterally, allowing for a limited subject comparison. They were assessed on the same battery of tests and they had anywhere from 9.5 to 41 months experience with cochlear implants. Now again, keep in mind, this is five subjects within the subject sample.
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We're looking at the restaurant simulation, signal-to-noise ratio, so a lower bar is better in this case. So you can see for the first cochlear implant alone here on the left, and then the best listening condition on the right. Now when they got their second cochlear implant we retested the first implanted ear to make sure there wasn't an effect of learning over time and in fact there was not. But we did see a dramatic improvement in their signal-to-noise ratio required for performance of almost five dB.

Now for reverberation, we saw a similar degree of improvement. This is percent correct on the Y axis, so we're again looking at larger bars as being better. So in quiet, again, we see no difference, but we see an improvement in the complex listening environment of 11 percentage points at the .6 reverberation time, and 20 percentage points at the 1.3 second reverberation time.

Now this begs the question then, okay, we see a large improvement for bilateral cochlear implants, but might we expect older individuals to demonstrate less benefit? I do want to point out a study that we also did, this is while I was at the Mayo Clinic, looking at 232 patients, 50 of which were over 80, and 208 were under 80. We only looked at the newest CI technology because a lot of the previous studies looking at the effective age had

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much older technology, which could have contributed to that.

DR. GOODMAN: One minute left.

DR. GIFFORD: Thank you. Here, this is a relevant slide, but I wanted to point out here on the left we're looking at sentences pre and postop for the two groups. In the center is word recognition pre and post for the two groups, and then on the right is sentence recognition in noise pre and post for the two groups. The bottom line is that there is no difference in pre and postoperative performance for the two groups for words or sentences in noise.

Now after the fact, I have gone back and looked at the data and analyzed 65 and older, and 65 and younger, and the results were the same.

In the interest of time I will take us to the conclusion slide. Adding a second implant has been shown to improve speech recognition in complex listening environments such as diffuse restaurant noise as well as reverberation. This degree of improvement is quite substantial, and we found no effect of age on speech recognition outcomes for either words or sentence recognition in noise.

I would like to thank you for your attention.

DR. GOODMAN: Thank you very much, Dr. Gifford,

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very clearly explained.

We will now move to our fourth scheduled

speaker. He is Dr. Richard Tyler, who's an audiologist. He's the director of audiology and professor in the department of otolaryngology and neck surgery in the department of communication sciences and disorders at the University of Iowa, and it says that he is representing the American Speech Language Hearing Association. He is not bringing any Power Point slides. Welcome, Dr. Tyler.

DR. TYLER: Thank you. We have received grant support from all three of the cochlear implant companies over the past 15 years. I've trained both as a clinical audiologist and have a PhD in human psychophysics. I'm a co-author and investigator of an NIH-funded 20-year grant on cochlear implants. I'm going to supplement my data which I shared with you before with some general observations.

I will start off by saying everybody in this room is going to get a hearing loss eventually. You're going to start off missing some of the words at the end of sentences, sounds will be too soft, you will start to have difficulty hearing in noise, and eventually you will start to withdraw from conversations. You won't want to admit it, but you will be getting a sensorineural hearing loss. It's been almost 30 years now since I left my

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first job as a medical research consultant at the Institute of Hearing Research in England to come to Iowa to help start the cochlear implant program at that time. Cochlear implants were quite controversial and I thought that it was my job to show that cochlear implants did not work. I was quite surprised a few years later when the first patients actually repeated a word back without any lip reading.

So who should get a cochlear implant? Well, from my perspective, the selection criteria has never changed, it's always been if there's a good chance you can improve somebody's hearing, you should give them a cochlear implant. Now what a good chance is is subjective judgment, but you have the data now that has been presented to you today and in the past weeks to know how well cochlear implant patients perform.

It's a little more complicated now in selection criteria because now we're talking about two ears, whereas before we were simply talking about one. Doing the two ears is important because a sound coming from over there reaches the two ears at a different time, it's louder out of one ear, and the sound coming from this ear has a different quality because the high frequencies have been attenuated more by the head. The brain does a wonderful job of using this information from the two ears to help us

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localize where a sound is coming from, to help us hear noise, to help us listen to this speaker and to listen to that speaker, and to ignore the noise coming from the fan up there. The brain is also able to ignore the sound on

this side if it's too noisy and listen to the other side, as long as you have two ears. And if there's a soft sound on this side and you have hearing on that side, you can hear it, but if you don't have hearing on this side at all, you won't be able to hear the soft sound on that side.

My understanding is that it's your task to make some judgments about whether two ears are better than one. From my experience and understanding of the literature that is clear, and it deserves a number five on your scale.

I'm also surprised that age is even an issue at all. It's been over 15 years now that we published data from about 50 or 60 people showing that age had no effect, and since this time there's probably at least 15 studies in the literature indicating age has no effect whatsoever. There's also no difference in the published literature between patients receiving simultaneous cochlear implants and those receiving sequential bilateral cochlear implants, although for a while people with sequential implants go without hearing for two years until

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they get their second implant.

The average sentence recognition score for somebody with a cochlear implant is 80 percent correct. Let me say that again. The average sentence perception score in published literature is 80 percent correct from somebody with a cochlear implant, that's average. So your questions about those less than 40 percent correct and those less than 50 percent correct, from my perspective, the chances that they'll get to the average of 80 percent is pretty high. Now for the population of less than 60 percent correct preimplant, well, most of them are going to benefit because most of them are going to be at 80, but maybe that deserves a four and not a five, because there will be a normal distribution.

I don't happen to agree with the quality and status assessment and the technology assessments that have been proposed today. I think that there's a lot of studies that have been omitted, the grading system I have some real serious disagreements with, and I think often some of the wrong measurements were chosen. As an example, I'll just say that the standard of using a randomized control study it is not always appropriate, it assumes that the two different groups are equal or that you know the factors to try and determine if the two groups are equal post randomization. It turns out that

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cochlear implant patients are not like that, there's lots of individual differences that we don't understand. There's differences in their hearing nerve, there's differences in their brain, and from my perspective the best scientific approach to understand the benefits of cochlear implant is to use each subject as their own

control, and that's the standard of research in this area. I've also been interested in quality of life scales for quite a while now, and I've always been concerned about how do we really validate these scales, how do we know if it's worse to be deaf or worse to be blind, or worse to have a limb missing. I've explored this now with a new questionnaire, which I'll just refer to now as the meaning of life. I've got about 200 patients with cochlear implants and 200 patients with deafness, I've done a factor analysis, and I now know the meaning of life. The factor analysis suggested that it has to do with friendship, that's the most important factor, positive outlook, physical well-being including disease-specific quality of life, and emotional well-being.

It turns out that communication has to do with all of these things, it's not just about hearing, it's about interacting with people, and I'm sure we have relatives or friends who we've seen lose their hearing,

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we've seen them withdraw, we've seen them have difficulty communicating, and the consequences that they've had. So in summary, the average score now in cochlear implantation is 80 percent correct sentence recognition. We need to hear from both sides in order to localize and hear where speech is coming from, you need to have hearing from both sides to hear soft speech from one side. And I'll bet you if everybody on the panel had a speech perception score of sentences of 60 percent correct or less, you wouldn't be able to participate in this panel.

DR. GOODMAN: Thank you very much for your comments, Dr. Tyler, points well taken. We will now proceed to the nonscheduled speakers, of which there are four, I believe, and each one has been allocated generously by CMS this time for two minutes. And you will forgive me if I botch my interpretation of the handwriting, but I believe the first speaker is Dr. Jack J. Wazen, affiliated with AAO-HNS. Dr. Wazen, if you would come to the floor mic, please, we would appreciate that. Welcome, sir. Two minutes.

DR. WAZEN: Thank you, Dr. Goodman and members of the committee. I'm Dr. Jack Wazen. I'm an otologist-neurotologist practicing in Sarasota, Florida. I am here representing the Implantable Hearing Device Committee of the American Academy of Otolaryngology-Head

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and Neck Surgery. I am also here representing my patient population, the senior citizens of the state of Florida. You have heard plenty about the science and of the research regarding cochlear implants. Now I would like you to stand in the shoes of the hearing impaired. You may know somebody afflicted with severe hearing loss, a family member, a neighbor, it could even be one of you, one of us, a few years down the line. Fortunately, the

majority of the hearing impaired do not require cochlear implant, they do well with hearing aids. For those who don't, a cochlear implant can provide them with a miraculous transformation from the world of deafness to the world of hearing. We all have the privilege of participating in this journey from science to manufacturing, from implantation to training, and as importantly, funding.

As I was preparing for my trip here I asked some of my patients who are wearing bilateral implants, how did the second implant change their quality of life? Their responses were clear, I am better able to tell the location of sound and I can better understand speech with background noise.

Dear colleagues, the concept of binaural hearing is not new, for we were designed to have two ears. Hearing from both sides is not luxury, it's a necessity.

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We need it not only to determine the direction of speech but also to identify risks and dangers, the car or bicycle approaching. Why don't you, as a simple experiment and for not more than one day, plug up one of your ears. While this does not reproduce deafness, it may give you an idea of how it feels to hear only from one side.

So I would like to conclude by asking you to truly consider the importance of hearing in the lives of our seniors. If they can have two hips or two knees replaced, or two cataracts extracted, they should have the option of two cochlear implants.

As Helen Keller wrote, the problems of deafness are deeper and more complex, if not more important, than those of blindness. Deafness is a much worse misfortune, for it means the loss of the most vital stimulus, the sound of the voice that brings language, sets thoughts astir, and keeps us in the intellectual company of man.

DR. GOODMAN: Thank you very much, Dr. Wazen, we appreciate your comments. Thank you, sir. Next is Robert Wolford, affiliated with MED-EL Corporation, I believe.

MR. WOLFORD: Thank you very much. I am employed by MED-EL Corporation, I'm manager of cochlear research for MED-EL USA, and on the disclosure I noted that I was speaking on behalf of implant researchers, that's not a formal group.

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But given that I am entering my fourth decade of research in cochlear implants and in review of the technical assessment and so on and what seems to be a lack of studies specific to this, I think there are some things that are worth pointing out. One of the stalwarts of cochlear implants is that we are not, the patient population is not homogeneous, it's heterogeneous. And there have been multiple studies predating the cutoff date of 2004 that have looked at factors trying to identify preimplant, post-implant predictions, and those weren't

included.
And therefore, in studies of cochlear implant research, the gold standard is single subject research designs, so they have to meet preimplant candidacy through their best aided condition and then because it's not a single treatment, there is the surgical implantation and then there's multiple parameters that can be manipulated postoperatively to influence outcomes, and that's what's creating the change from mean preimplant scores as Dr. Zwolan described earlier of 11 to 80 percent. That also drives and eliminated a multitude of studies that because of reduced sample size, when you get an effect of nearly 70 percent, or in the case I just described, eight-fold, you do not have to have an insurmountable N to drive the significance. Thank you.

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DR. GOODMAN: Thank for your comments, sir, points well taken. Next is Pete Weber, Dr. Pete Weber from Cochlear Corporation. Welcome, Dr. Weber.
DR. WEBER: Thank you. I speak both as the chief medical officer for Cochlear as well as a practicing neurotologist who's planted somewhere almost over a thousand implants in the last 20 years.
In looking at the data that was presented today, just a couple of quick points. One, we do agree with the technical assessment that it seems bilateral cochlear implants significantly demonstrate better performance for all patients when compared to unilateral or hearing aids alone.
We also want to take into account the effect of what types of studies could be done in the future. Someone had mentioned the possibility of a randomized study. As was just alluded here, and also with Dr. Tyler's comments, we also agree that randomization really is not something that would occur here. If a patient comes to me and cannot hear, qualifies for a cochlear implant, it would be unethical not to be able to treat that patient and offer him the ability to hear again. As was stated, these patients are their own controls, it is the best study out there.
We also looked at the tech assessment when they

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rejected studies or put studies down to a low category based on confounding factors. They did not really discuss what the cofounding factors were and it's hard to discern what these were that made it from moderate to an inconclusive or low study.
And then finally, I think all the studies have shown when we look at age as a factor, we can look at adults going from 40, 50, compare them to over 65, there is no difference in outcome in age in any studies that have been done, and therefore, we feel very confident that age is not a factor in performance with cochlear implantation. Thank you.

DR. GOODMAN: Thank you very much, Mr., excuse me, Dr. Weber. Next up is Tom Walsh, from Advanced Bionics. Mr. Walsh.

MR. WALSH: Yes. I'm with Advanced Bionics as the manager of strategic and health policy reimbursement, and one of the things I would like to point out is that when you look at the commercial health plans that operate, they typically cover cochlear implants up to 50 percent, and we can see this in the medical policies that are on line. About four or five years ago the major commercial payers were involved in their own technology evaluation and looking to cover bilateral cochlear implants, and again, up to fifty percent.

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And so in my role in Advanced Bionics, the most common complaint that I hear from Medicare beneficiaries and the clinicians who treat them is that the Medicare beneficiaries don't have access to cochlear implants to the same level as basically the rest of the world in terms of going beyond 40 percent and also in terms of access to bilateral implants, so these are issues facing those folks out there and I wanted to bring that to your attention. Thank you.

DR. GOODMAN: Thank you very much, Mr. Walsh, we appreciate that. Panel, I think based on our experience here in the building, it's approaching 11:50. Rather than going into Q and A right now and risking being late in the lunch line, maybe what we ought to do is take our 60 minutes now, we'll beat the crowd and come back. Look at your watch now, 60 minutes from now we'll start once again.

And when we do start, we ask that the scheduled speakers, including Drs. Tucci and Zwolan, Drs. Chung and Raman from the technology assessment, and our four scheduled speakers, Drs. Firszt, Buchman, Gifford and Tyler, arrange yourselves in the front row or as close to it as you can so we can find you easily when we ask our questions.

Thank you very much. We'll see you in 60

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minutes.

(Luncheon recess.)

DR. GOODMAN: Let's reconvene, and our interpreters, are you placed okay? You're placed okay, fine. Thank you very much.

Panel, what we've done here is we've asked the presenters and invited speakers to sit up front to be close and personal for this discussion, and what we want to do now is address any questions you might have about the presentations you heard this morning. Now, I know that that could be far ranging, so to keep it on point, I just want to remind you that we are going to need to answer our questions today, of which there are approximately 11 with subparts, so you need to absorb a

lot of information necessary to do our primary job here. So to the extent that you've got questions, I hope that they will be focused on material that will answer our questions. Keep in mind as well that in addition to the voting questions, there are some discussion questions, some of which deal with evidence gaps and so forth, so we will get to those as well. But keep in mind that these questions largely are a set of paired questions, especially those in the beginning, where we're looking for adequacy of evidence on a given issue, and if we think the

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evidence is adequate on said issue, we proceed to vote on it, and that vote has to do with what the evidence says. And the whether to vote or not threshold, whether to vote or not is set by a threshold of 2.5 on the adequacy of evidence question. That's pretty much how it goes. So with that, I'll ask for any questions that panelists have for our presenters, and again, to the extent that your question is something specific to do with the questions that we've got to answer, all the better, and we'll start here with Ms. Atkinson.

MS. ATKINSON: This is to Dr. Gifford. You indicated on your slides that they showed significant improvement with implant, but what were their scores previous to that?

DR. GIFFORD: Preoperatively they all had actually met the FDA criteria for cochlear implantation, so it would have been less than 60 percent if they were less than Medicare age, and less than 40 percent if they were of Medicare age. So it did represent not only statistically significant improvement pre to post-implant, but also from one to two implants.

DR. GOODMAN: Thank you. Dr. Chen I believe is next.

DR. CHEN: Thank you. I have a quality of life question, and I'll open it up to the entire panel. I

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understand that there are particular improvements with perhaps language, word recognition and localization with cochlear implants, but as a primary care provider it's not quite clear to me that the cochlear implants have impacts on function, a lot of functions such as activities of daily living, and for me these are very crucial activities that I always have to keep in mind when I consider initiating a therapy, will it improve their functionality in this regard. And so the way to ask it -- also, I haven't heard of any data to suggest that this cochlear implant can improve, for example, rates of depression, medication adherence, decrease in hospitalizations, all of which are important not only for me as a clinician, but also as a health plan administrator, so I wanted to open this question up to all of you.

DR. GOODMAN: Any of our presenters have a precise or concise answer? This is Dr. Gifford.
DR. GIFFORD: There are actually a number of studies that have looked at that, they were prior to the 2004 cutoff for the technology assessment. One that comes to mind immediately, it was by the VA, I believe was the sponsor, it was Abrams et al., in the late '90s, and it did show a significant reduction in depression for elderly individuals following the implantation.

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DR. GOODMAN: Thank you. Dr. Eng is next.
DR. ENG: I want to thank every one of the presenters for actually providing different aspects of a broad education on this topic, and especially important for the geriatric population. I know that today it was very hard to tease out the studies that looked at the over 65 population and the younger population, and I think that that's one of the gaps that's going to have to be filled. But I wanted to ask Dr. Gifford, you're on the hot seat, on one of your slides you mentioned that there were three groups, there was the unilateral, the bimodal and the bilateral, and they all did word recognition, or was that somebody else's?
DR. GIFFORD: Yes.
DR. ENG: Do you think that 80 percent, is that the achievement level that we expect people to have after implementation? What I'm getting to is if you have a person that is profoundly deaf, less than 40 percent to start with, the question that I have is, what's the chance of that person reaching 80 percent with one, or do you need two, or would one plus an aid augmenting it? Because for a geriatric population, we just don't have the numbers or the length of time, and as they age, more of the hearing loss impacts on our ability to evaluate their cognitive ability.

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DR. GIFFORD: Great question. There are, Dr. Buchman stated that he showed that with two, you were more likely to reach a higher level, as well as with a paper that we published a few years ago, the bilaterals were, their averages in terms of sentence recognition, so closer to 80 was higher than either the bimodals and/or the unilaterals, and that was the same story that my data presented today. However, can I give you a prediction of how many people preoperatively versus postoperatively will reach that 80 percent mark with one, I can't give you an estimate personally. Maybe someone else can speak to that.
DR. GOODMAN: Anyone who can answer Dr. Eng's inquiry here? Dr. Eng, seeing that no one is able to answer that, what might we conclude, is there some conclusion or observation to make relative to your question, what do we learn from that?
DR. ENG: So, we're dealing with 30 percent of

the elderly population will have some kind of hearing loss, not all of them will have SNL, so if you have a Medicare patient, an over 65 person who has a profound loss, less than 40 percent, and they're functionally intact, and I think what hasn't been addressed is function other than hearing. My expectation would be that if they can get by with one implant and reach 80 percent, that

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would be terrific, but I would be really pleased if they reached 60 percent. So you see what the proportion of improvement is with those that start off with a profound loss. Once you start having a person with a baseline of, let's say 60 percent, if what I'm looking at is at optimum, at 80 percent, would the person perceive a functional improvement going from 60 percent to 80 percent?

DR. GOODMAN: So if that's the question, do any of our presenters have any evidence to offer in response to that question, and we're not looking for a case of N equals one, but is there any kind of body of evidence that might address this?

DR. BUCHMAN: One of the dilemmas that you have in the data is if you start at 60 percent, as you start to approach the ceiling then there tends to be no differences, and so that's where we get into the dilemma of having multiple different measures to look at outcomes. So your question is really good for a patient who starts out at zero or 20 percent, to look at their frequency of making it to 80 percent. But if you look at a 60 percent person making it to 80 percent and you look at their change, it's only like 20 percent difference, and then you start saying that's not very good at all.

DR. ENG: But can they perceive it?

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DR. BUCHMAN: They do perceive it, they perceive it as a great benefit. The problem is the way that we present our data is an escalating paradigm that makes it more and more difficult, so the bilaterals, we don't usually show that simplest of data, we start adding background noise and more challenging listening situations to show the benefit, versus their preop score at the beginning. Does that make sense?

DR. GOODMAN: Dr. Eng, is that about all you can get out of this question?

DR. ENG. Yeah, I think so.

DR. GOODMAN: I must point out that Dr. Eng's question is quite material here. We're talking about going from one to two devices in particularly the Medicare population, and we care about functional status and ability to operate in a social environment, so that's certainly a material question. Dr. Zwolan.

DR. ZWOLAN: In terms of functional gain, I want to make sure we understand just improving detection. So I know we're talking about speech recognition scores going

from 40 to 80 or 60 to 80, but even the patients that score zero with their implant get improved detection, so their lip reading skills are improved, and right now we don't really do a detailed assessment of lip reading, but you can take someone who can't carry on a one-on-one

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conversation that can do that with the implant now because they have improved detection. So they can hear but they might not be able to understand without seeing the speaker, and that to me is of great dramatic functional improvement. I don't want to forget about, those poor performers are not failures, they're great improvements in functional performance.

DR. GOODMAN: Thank you, Dr. Zwolan. Dr. Raab was next.

DR. RAAB: I was going to ask, when we look at those scores, that's sort of a unidimensional aspect. Are there methodologies where patients could somehow rate other aspects that are important? How would you know if sound localization, how important is sound localization to you? How important are some of these other outcomes to a patient? We're just seeing this one score, one performance, but is there any sort of feedback from patients or testing that shows the relative importance of other sorts of measures?

DR. GOODMAN: Can any presenter address that question? Dr. Gifford, please, thank you.

DR. GIFFORD: There is one study published in I believe 2007 by Waxman and colleagues, and they looked at bilaterally implanted patients, and they looked at both objective, which would be these unidimensional scores, and

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then they also did subjective analysis of how patients perceived their benefit with the second implant. And what was interesting is there was actually no correlation between the two because the bilateral, the measures that they used for speech perception were actually quite simple, so the degree of bilateral wasn't large, but the degree of subjective benefits from what the patients perceived by getting that second implant was tremendous. So what it said was that sometimes our objective measures do not necessarily yield what the patients perceive as a functional benefit.

DR. RAAB: So essentially we have inadequate measures out there? That's what I'm asking.

DR. GIFFORD: In that particular study, yes, because our patients are reaching ceiling levels.

DR. GOODMAN: Thank you. Dr. Tyler, is this pertaining to this question, sir? Thank you. This is Dr. Tyler.

DR. TYLER: So, there's at least two validated spatial hearing questionnaires that have reviewed pre and post on cochlear implant patients. So if you ask the patients how well they localize, how well they're able to

tell where a sound is coming from or understand speech with speech and certain separate noise, they're able to say, they're able to give those ratings before they get

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their implant and after they get their implant, and in those situations it's very clear that there has been improvement, and it's also clear that the improvement is better with bilateral implants than unilateral implants, and those are published studies in peer reviewed journals.

DR. GOODMAN: Thank you. Dr. Sacco is next, then Dr. Steinbrook and others.

DR. SACCO: I wanted to also thank some of the speakers that supplemented some of the data we heard this morning, including some unpublished data, and I wanted to follow up a couple questions, I think from Dr. Firszt and Dr. Gifford. So for Dr. Firszt, I think you showed some intriguing data on subjects who were in the range of interest, 40 to 60 percent, looking at pure word scores, so in your study I'd ask a couple of questions. One is, you're still enrolling and this is unpublished; do you have a planned total sample size that you're going to go? Two, do you have other outcomes that you're collecting, including outcomes like health-related quality of life or auditory-specific quality of life measures, and any of that data that you've also looked at in a preliminary way that you can share?

DR. FIRSZT: My study had 108 postlingually deaf adults, that study enrollment stopped in 2008, so we're following those patients for two years and they're tested

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at 12 different intervals over that two-year period to look at their trajectory of performance. So single syllable words are kind of a gold standard in traditional audiology, they are the diagnostic speech recognition measure that we use to identify an individual's speech understanding, so our dependent variables are primarily that measure. And because we are interested in what variables would be predictive, we are looking at a number of predictive variables that I didn't go into today. So those are the, in that particular study with that sample size, that's what we're looking at.

We have a study at Washington University looking at the rate of progress in bilaterally implanted adults who received their devices sequentially, and they are followed for 18 months at three-month intervals and tested prior to implantation and after implantation, and so we're looking at rate of progress, and that particular sample size based on our statistical estimates and measures, we're using a sample of 321 to meet our significant levels. In that study we are looking at word recognition, sentence recognition, sentence understanding and noise, and the questionnaire that Dr. Tyler mentioned, the SSQ speech and hearing scale. So, I think going forward we will have more additional measures with respect to that

level of performance.
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DR. GOODMAN: Thank you. I would remind everyone that as Dr. Sacco pointed out, it's fine to share information about ongoing studies or things that you've written up that haven't been submitted to a peer reviewed journal, but I remind all of us that things that are submitted as a manuscript to a peer reviewed journal often doesn't come out that way, so CMS saw fit to have presenters share with us that kind of information, but do keep in mind that there's a difference between things that have been peer reviewed and things that have not, not to inordinately discount one or the other, but there is a difference.
Dr. Steinbrook, and then Ms. Scorza.
DR. STEINBROOK: Two parts, if you'll allow me, and the first is a direct follow-up to that. I wanted to clarify in terms of the scheduled presentations, the first three, I think it was clarified that the first presentation of the data were not yet published. I'm confused about the second presentation because a number of studies were mentioned and they seem to be published, and I'm wondering if those studies would have ended up under consideration for the tech review. And then for the third presentation, I was confused because about page 11 of the handout there was reference to 2010, so it wasn't clear to me whether the first ten pages were unpublished data or
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published data, there were two different things going on, so if people could clarify that, that would be helpful.
DR. GOODMAN: Now, I know you're talking about the two studies presented by Dr. Gifford, but were there studies presented by Dr. Buchman as well?
DR. STEINBROOK: There were references throughout the presentation, and presumably if they were published studies the tech review would have had the opportunity to consider them.
DR. GOODMAN: Dr. Buchman first.
DR. BUCHMAN: There's two published studies, one in 2004, one in 2008. One was under, the first author was Cullen, and the second was under Adunka, those were both unilateral implantation studies. And then the bilateral implantation study was referenced and that was the Buss study and the follow-up to that was the Eapen study. All four of those are published.
DR. STEINBROOK: Thank you.
DR. GOODMAN: Thank you, Dr. Buchman. Dr. Gifford, there were two studies in your presentation, I believe.
DR. GIFFORD: Yes. In dealing with the bilateral, that is unpublished data pursuant to our NIH award, and then page 11 was a published study that we published relative to effective age on benefits.
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DR. GOODMAN: Okay. So the bilateral study has not been published. Thank you both. Ms. Scorza is next.
MS. SCORZA: This question is directed to anyone who would like to answer it. Can any of you comment on any research data that's available that focuses on the impact of multiple medical illnesses on the quality of leave in people who have either received unilateral or bilateral implants? What I mean by multiple medical illnesses would be people who have cardiovascular disease that's being managed medically, diabetes, or some other chronic medical condition like that. I guess my real question is directed towards, in people who have multiple medical illnesses like that, would it be worth doing either implant or would the outcome be negligible in light of the seriousness of chronic medical conditions?
DR. GOODMAN: So, Dr. Tyler is going to approach the mic. This is a very good question, because some of our Medicare beneficiaries are somewhat highly affected by these chronic conditions. Dr. Tyler.
DR. TYLER: I think generally speaking, if you have some other disability like blindness or a cognitive disability, or some other traumatic event happening to you, the ability to communicate and find out what's going on and getting support from your peers is really important. So you might not get the same advantage with

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somebody that's blind, for example, of getting a cochlear implant, but the significance and the importance to communicate with that person as an individual, I think most of the community involved in cochlear implants realizes that that has significant impacts on their particular lifestyle.
DR. GOODMAN: Thank you for the question as well as the answer. Dr. Satya-Murti.
DR. SATYA-MURTI: Two questions. The first is simple and mechanistic. How much of a learning effect contributes to both ceiling effect as well as postop testing? These are validated hearing tests, so I suppose learning effect isn't much, but when you talk about word versus sentence recognition, especially sentence recognition, the learning effect could be considerable, I would think. So, any of you can answer that, and I'll follow it quickly with a second.
DR. FIRSZT: There is some learning effect with receiving a cochlear implant, it varies quite a bit. Some adult patients achieve their level of performance very quickly in one month to three months time, and then basically their performance stabilizes if you look at post-implant verbals. Other patients have a much lower trajectory in terms of their level of performance, and continue to improve even after two and three and four

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years with implantation, so it's variable.
DR. SATYA-MURTI: Thank you for the answer. So

we haven't factored that into our assessment as to what the ultimate benefit is. With long-term benefit given unilateral implant, maybe some of this learning effect could contribute before a second one is planted in.
DR. FIRSZT: I think the learning curve is also different when you get a second implant, but I will say that there's only so much you can learn with a first device, and a lot of the sentence scores that we're talking about, 80 percent sentence scores in a unilateral implant recipient, we're generally talking about their ability to understand sentences in quiet. As soon as you add noise in the background, which, we didn't show a ton of noise data today, the performance is not quite as high. And it's listening in noise and localizing sounds and so forth that really, those tasks require two ears. So again, I think with the single implant, there's only so much that you can do, and then to really get along in your environment from morning to night, that's where really having that second ear makes a tremendous difference.
DR. GOODMAN: Thank you, Dr. Firszt. Dr. Tyler, on this question.
DR. TYLER: I would say there's several published studies showing performance over time and in

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almost all situations for most patients, the learning is complete within six to eight months after receiving a cochlear implant. There are some patients where you might see small gains like five percent correct beyond one year to up to four or five years perhaps, but the biggest changes from 10 percent correct to 20 percent correct, whatever the preimplant score, up to 80 to 90 percent correct occurs within the first year for almost everybody.
DR. GOODMAN: Thank you. Dr. Satya-Murti, given the two answers you received, what can the panel learn from that interaction?
DR. SATYA-MURTI: That the protagonists feel that learning effect flattens out, plateaus after about a year or so. So what we need to recognize is there is going to be further benefit only by bilateral implant. Whereas, my take on that is we haven't allowed enough time for learning effect to accrue and establish itself before accepting bilateral as useful, but an option yet.
DR. GOODMAN: Fair point to make. Thank you. Dr. Hartman-Stein. Oh, did you have a follow-up? Pardon me.
DR. SATYA-MURTI: I wanted an answer for the first one as well.
DR. GOODMAN: Dr. Gifford.
DR. GIFFORD: My interpretation of your question

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may have included it, but when you originally posed it, I thought that you meant relative to the speech material, maybe they become better because they learn the materials.
DR. SATYA-MURTI: I meant that as well, but it

led on unintentionally to a more interesting point.
DR. GIFFORD: Got you. So I would just comment on that. As far as the sentences, for example, there's over 650 sentences, so it's unlikely that the patient would get the same sentence twice, and in fact we record the list that we present on any given presentation, and the same goes with the word, as well as other sentence matrix.
DR. SATYA-MURTI: Thank you.
DR. GOODMAN: Thank you, Dr. Gifford.
Dr. Satya-Murti, once again.
DR. SATYA-MURTI: The last point is, it's disappointing to keep hearing that randomized control studies cannot be done, and the gold standard is the same issue, before and after. It is often posed as a challenge to doing controlled studies in search of patients, but controlled data randomized outpatients have been carried out in surgical studies, arthroscopy is the most famous of them all, I think, it came out from the VA some eight or ten years ago. And there were two neurology studies, deep brain stimulation and epilepsy resection surgery, they

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have used those patients waiting to be operated, they have been allocated with an intention to treat, but they have been followed up because they haven't really found a place yet for the surgery, such as in Canada where waiting times can be long. So I would like to ask if the otologists, particularly the neurotologists here can devise a study where a patient is waiting. It may not be possible to do if the resource is readily available and funding is available, but while they are waiting they could be used as control subjects. There may be other methods of randomizing them, but to state that in surgical, collection of surgical data is either unethical or gold standard in only pre and postintervention comparison, I think that's not readily acceptable, at least for me as one of the panel members.
DR. GOODMAN: Let's do this. That is an important issue that we do want to address, and I'm going to give fair warning to some of our methodologists like Doctors Mushlin, Schwartz, Steinbrook and others who look at trial designs and so forth. I'll ask you to let that percolate for a few minutes because we are going to come back to that directly, and I'm glad Dr. Satya-Murti brought it up, but for now I want to go to Dr. Hartman-Stein. We will return to that issue. Dr. Hartman-Stein.

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DR. HARTMAN-STEIN: Thank you. This is for Dr. Tyler. Now this is in reference to the written material that you submitted to our panel. Everyone here pretty much has talked about how age is not considered to be a confounding variable, and in your written paper that you submitted it says that ample data exists showing that

individuals who are even greater than 90 years still show benefit from bilateral cochlear implants, and you quote a study in 2009. And you say that, it could be argued that senility might impair the maximum potential to integrate information from both ears. However, it can be argued that those with mental handicaps are more in need of the advantages of hearing with two cochlear implants. I'd like you to expand on that a little bit, we didn't hear too much about that. In the Medicare population, we have old old in there.

DR. GOODMAN: So this is Dr. Tyler first. I would hope that there would be other presenters as well ready to address this. First Dr. Tyler.

DR. TYLER: So on page eight I also noted that I did, I referenced a quality of life study published on the veterans population, an older population, back in 1995. My point was similar to the one I made earlier in that people that have difficulties in their lives, including those with mental disabilities, really benefit from being

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able to share things with their peers and family members, so that being able to communicate is really really important to them. So although the evaluation process must go through with great care, I think that those people that are older and have cognitive ability and mobility issues really have the potential to have a significant impact in their lifestyle by being able to communicate with one or two cochlear implants.

DR. HARTMAN-STEIN: The study does illustrate that?

DR. TYLER: Yeah, the study is a study on a validated disease-specific quality of life scale in the older population, showing that it does help these people.

DR. GOODMAN: That was which study, Dr. Tyler?

DR. TYLER: That was one of the studies by, Bill Noble is the first author.

DR. GOODMAN: And that was a published study?

DR. TYLER: Yes.

DR. GOODMAN: How big was it, do you recall?

DR. TYLER: I do not recall. There's two studies that report it.

DR. GOODMAN: Okay. And whether you or our technology assessment people might look into that, we would be interested in that. Dr. Zwolan, on this question.

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DR. ZWOLAN: From a clinical standpoint we've been faced with patients with dementia or senility and trying to decide if we should implant, and lo and behold we found that some of their behaviors that were attributed to their dementia were really caused by their hearing loss, and once they got up and running with their implant and they could hear better we found out they weren't as bad off as everyone thought they were. So I think

oftentimes there is confusion with someone with a profound hearing loss as to what is hearing loss and what is dementia.

DR. GOODMAN: Thank you. Dr. Hartman-Stein, give us a kind of kernel of what we just learned.

DR. HARTMAN-STEIN: Well, I'll tell you what I learned, that we shouldn't necessarily have a cutoff score or a rule-out with even moderate dementia. I don't know what the degree of dementia is. So what you're saying is that dementia alone should not rule out the person as a candidate, and it actually may improve their functioning because what we have attributed to dementia may be more toward hearing loss in the way they miss things and can't communicate.

DR. GOODMAN: Thank you for that. Dr. Rao is next.

DR. RAO: I guess the question I would ask for

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any of the audiologists in the group. We've talked about the HINT and the other tests that we do post-implant. My question is not just the quality of life but are there functional measures that you're gathering that look at the nexus between hearing and speech and communication? In other words, after one becomes successful, they're getting out more, they're going to the doctor, they're communicating, et cetera, so looking at the impact of the implant on their overall communication skills and not just the hearing tests.

DR. GOODMAN: Can a presenter venture a response to this? Dr. Firszt is the brave one.

DR. FIRSZT: Well, I think because the primary outcome with cochlear implants has been auditory speech perception ability, that has been the primary outcome since we started. Now that we're getting into bilateral devices, localization hearing and noise, we're just expanding and trying to make these opportunities greater and greater. I would say that we are now incorporating more of these types of questionnaires into our studies because we've gotten past that sort of primary outcome point in time. Cochlear implants are still relatively young, and so I think for many of us there's the feedback that we get from patients and research participants who are in our studies.

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For example, with our bilateral cochlear implant patients, I've worked with about 120 of them, and there's not a single one that doesn't use both devices. And in fact, not a single one of them would go back to wearing just one implant. And I even had an individual who lost his processor and did not have insurance coverage for it, and only had about 10 percent, we're going back to the scores, in that single ear of speech perception, and he paid out of pocket to replace that processor, it was that important to him. So I do think that functional benefits

are reported to us from patients.
DR. GOODMAN: Great, thank you, Dr. Firszt.
Dr. Gifford, on this point?
DR. GIFFORD: Yes. Dr. Rao, great point. For adults, there really is only one questionnaire that specifically was designed for cochlear implant users, it was designed in the late '90s to early 2000s, it's called the Nijmegen Cochlear Implant Questionnaire, and actually it's even quite dated, because some of the questions say can people understand you when you talk, where we know that that's something that's just not even an issue anymore. And so I think that we have really a need in the field to develop cochlear implant-specific types of questionnaires that will gauge these types of questions.
DR. GOODMAN: Good, thank you. I would just

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remind the panel that our questions that we're going to arrive at pretty soon, many refer to health outcomes, and that's not a very specifically defined term. The guidance given to us by CMS says that health outcomes include symptom status, functional abilities, and health-related quality of life, symptom status, functional abilities, health-related quality of life. And it goes on to say when we address these questions dealing with outcomes, to please note that our conclusions apply only to specific outcomes, or more broadly to outcomes in general. So this isn't defined in any crystal clear fashion but that's the guidance that we have here. I think you've also noted that even how some of these particular types of outcomes are defined or measured varies quite a bit as well, so that's a challenge that we face here.
I believe Dr. Steinbrook was next.
DR. STEINBROOK: I apologize for asking a question that perhaps logically should have been earlier, but I have a chance to ask it now. It would be helpful to me at least to have some sort of overview, either from CMS or one of the presenters or one of the guest panelists of the epidemiology of these procedures at this point in time, in other words, about how many implants a year give or take in the Medicare population, do they tend to be unilateral or bilateral, are they sequential, are they

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simultaneous.
And also I'm curious, because there certainly is an element to someone looking at this from somewhat of a distance of patient choice here, that I can imagine people who have one implant wanting to have a second implant or not wanting to, wanting to immediately or later. So is there any longitudinal data on people having a unilateral implant who have gone on to have a second one, does that inform anything here?
DR. GOODMAN: So we've actually got the longitudinal question that you just posed, but before that you asked basically the epidemiological one.

DR. STEINBROOK: Exactly, two parts.
DR. GOODMAN: And I recall from my notes, it was said that worldwide there are 220,000 people with these, I believe, and in the United States about 42,000 adults and 28,400 children. I think that's all the epi data that I had heard.
DR. STEINBROOK: Is there CMS data, just a ballpark really, about how many per year unilateral, bilateral, and then is there any longitudinal data on people who have had unilaterals over time as to what they did?
DR. GOODMAN: Any insight into that? I know that none of those are our evidence questions, but they

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are context questions that may be useful. Mr. Walsh.
MR. WALSH: I took a look at the OPPS data, and for 2009, which is the latest year available, there were 1,481 cochlear implant procedures performed under Medicare in that year, and they were all unilateral, meeting their criteria.
DR. SCHWARTZ: And do you know how many in addition to Medicare?
MR. WALSH: In addition to Medicare?
DR. SCHWARTZ: Like total U.S.
MR. WALSH: I think the U.S. total was about 7,500.
DR. STEINBROOK: In the United States, 7,500?
MR. WALSH: That's the total in the U.S., yes. Medicare is the 1,400.
DR. GOODMAN: Let's just recap, because we don't want four people talking at once. So, is it true that there are about 7,500 implants done in the U.S. per year?
MR. WALSH: Yes.
DR. GOODMAN: Okay, we've nailed that. And then in the Medicare population there are, did I hear 1,400?
MR. WALSH: About 1,500, 1,481.
DR. GOODMAN: 1,481 in the Medicare population.
MR. WALSH: In 2009.
DR. GOODMAN: Okay. Dr. Raab.

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DR. RAAB: And the question I have is on Medicare. What we learned earlier in the beginning of the day is that with, the coverage permits bilateral implants at the local level if it meets the numerical threshold that was given. And the question I have, if you look at OPPS data and you see 1,400 implants, would two per person be on the bilateral side if a local Medicare contractor covered bilateral implants, so do we know how many local contractors do bilateral?
MR. WALSH: I don't know the answer to that question.
DR. RAAB: But you had just said that 1,400 were unilateral, and the answer really is we don't know if we don't know what the local contractors are doing.

MR. WALSH: Yeah.
DR. GOODMAN: Thank you, Dr. Raab. Actually Mr. Walsh did say presumably because of the policy, he did not say that indeed that he knew that they were, and I believe that Dr. Miller has a comment.
MR. WALSH: If I could say one more thing, if we looked at the data the way the data are based on the claims, it would be difficult to see.
DR. GOODMAN: Thank you, thanks for your data, Mr. Walsh. Dr. Miller.
DR. MILLER: In personal conversations with some

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of the local contractors that we had as we prepared for this MedCAC, we did discover that some of them do allow bilateral implantation, it may be on a case-by-case basis. I think that the gentleman's statistics agree with our sort of very quick and dirty look back of the middle to end of the 2000s in which we thought that there were approximately 1,500 to perhaps 1,800 cochlear implants billed by HCPCS number to Medicare. Of those we do not know how many are unilateral and how many are bilateral.
DR. RAAB: Presumably you could do same day billing, you could explore the data?
DR. MILLER: Yes. It would take a deeper data search, yes.
DR. GOODMAN: Thank you. Any other questions on those numbers? I don't think so, but I think that, well, actually Dr. Niparko was next.
DR. NIPARKO: My question is for Dr. Tyler. If we go back to Tyler and Summerfield, 1996, published in Hearing Research, it was the first of several publications that put out a mathematical model of prediction that seemed to be heavily weighted toward duration of deafness and preoperative hearing. If we look at those two parameters and we think about a senior coming to us with 50 to 60 percent hearing, how do we think about the cut point of waiting for that hearing to decline to get under

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50 or to get under 40 or whatever the criteria might be, versus in fact perhaps providing an intervention that is more likely to be beneficial based on that model. And the follow-up to that is going to be if that model applies to senior populations.
DR. GOODMAN: Dr. Tyler is taking the microphone and if anyone else has a response, I'll look to that as well. Dr. Tyler.
DR. TYLER: So, I'm not quite sure I understand your question entirely, but over the past many years we have tried to look for correlations between a variety of preoperative measures such as age and duration of deafness and degree of hearing loss, and in general when you look at the scattergram the correlation coefficients are very weak and so that, and I forget the correlations, but some of them might be significant. I think the biggest factor

was duration of deafness but age was not, and so people that have been deaf for 30 years and are over the age of 60 or over the age of 70 still receive significant benefit. And certainly based on that, we decided to go ahead, and I don't think anybody clinically therefore, based on that data plus other data, would deny somebody a cochlear implant because of their age.

The other variable that we found that might have some significant correlation in the later analysis was the

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amount of preoperative hearing, so that if somebody had 20 percent word recognition preoperatively they were more likely, at least on average, to do better with the understanding that they had a better hearing nerve, or more of a hearing nerve survival, and therefore their final outcome is going to be better than if they had a zero percent correct on a preoperative score. So it's based on that, but if we expect people to get 40 percent correct and 50 percent correct and 60 percent correct, and we know the average is over 80 percent correct, that we expect there to be an improvement in all of these groups that you folks have to vote on today.

DR. GOODMAN: Thank you. Dr. Steinbrook and then Dr. Eng.

DR. STEINBROOK: I was just, to follow up the second part of my prior question. I'm assuming that there are no data where people looked to see how many people who get a first implant at some point later get a second implant. I would be delighted to be wrong, but I didn't hear anything.

DR. GOODMAN: I don't believe we've heard anything thus far on this issue.

SPEAKER: Manufacturers know that data.

DR. GOODMAN: It doesn't help if you're in the back and haven't been recognized and haven't come to the

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microphone, but if you have a good answer and would like to approach the mic, we'll take it. Dr. Walsh, if you've got an answer, especially one with data, we would welcome it. Dr. Tyler, excuse me.

DR. TYLER: I think there are published -- I'm not sure I understand the question, but there are certainly published data in peer reviewed journals on patients that have had a second cochlear implant sequentially.

DR. STEINBROOK: I think I'm asking sort of an epidemiology question, which is of people who have had an implant over a period of time, how many of them end up getting a second implant?

DR. TYLER: What percentage of the people with single implants?

DR. STEINBROOK: Right, the people followed over time.

DR. GOODMAN: Dr. Firszt, do you have some data

on that?
DR. FIRSZT: I can just speak for Washington University. Out of 498 adult recipients we have 43 with bilateral implants, so it's about nine percent. And the question of whether or not everyone who has a unilateral implant would then want a second implant, it is not going to be a hundred percent, and actually when we look at our
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patient population, I think it's going to be less than 50 percent. I think that there may be somewhere between 30 and 40 percent who medically can receive a second implant, that we would recommend an implant for, and who want a cochlear implant.
DR. STEINBROOK: Thank you. But I know that nine percent, to follow up, were they all sequential, or were any of them done simultaneously?
DR. FIRSZT: The majority are sequential. We have simultaneously implanted patients and oftentimes those patients are the ones who have overnight sudden profound hearing loss in both ears and they want both ears treated, that's been our experience.
DR. STEINBROOK: Thank you.
DR. GOODMAN: Now, did Mr. Walsh or Dr. Weber have a response? Dr. Weber.
DR. WEBER: There is a recent paper out, I believe by Peters et al., that does address statistics across all three manufacturers as far as numbers for bilaterals. I'm blanking on which journal it's published in, but it is out there.
DR. GOODMAN: Before you go on, before you leave today, or tonight in any case, if you could find that and give us the citation and send it to our good friends here at CMS, that will be helpful for the record.
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DR. WEBER: And I would agree with what Jill said. I think if I recall the averages, it probably in adults is going to be less, somewhere in the five to ten percent range, they're going to be mainly sequential, the reason being that for most of us, reimbursement is such that it, you know, you don't do simultaneous on adults and the vast majority of your simultaneous, or more bilaterals are going to be in children than they are in adults.
DR. GOODMAN: Okay, thank you. Before we go on, one thing that we might be noticing here is that there aren't a lot of rigorous data here in the first place for various reasons that we're starting to recognize. We're also I think seeing that many opportunities are missed to collect data from among folks in a limited universe. So not only do we not have a lot of rigorous data but there are opportunities where we could have been collecting data where we only have sparse, scarce or episodically collected data. So the universe of data isn't big, but what there is, much of it is slipping through our fingers.
Dr. Eng.

DR. ENG: Does CMS have any data on the percentage of denials? We heard about the approvals. What about the denials?
DR. GOODMAN: Dr. Miller, you can try to answer that. I know that that's not going to be an easy number
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to get.
DR. MILLER: No. At this point we have no information about that.
DR. GOODMAN: And I would add, Dr. Eng, that decisions will be made before experiencing a denial if one understands what their local carrier's policies are or tendencies are with regard to reimbursement for the second procedure, for example, so one might not even pursue a second one. So again, some opportunities, we're missing some data. It does underline, though, that there's variation in practice, although we're not even very good at tagging or collecting information on that variation. So there is some uncertainty here in the market and I think a couple of our speakers, it might have been Dr. Buchman, I think called attention to that, and Dr. Firszt as well. Okay. Further questions? Dr. Griffin is next.
DR. GRIFFIN: I think Dr. Tucci talked a little bit about the prevalence of hearing problems, but I want to get a better handle on what the prevalence is in the elderly of hearing at the various levels we're talking about, like less than 40 versus 40 to 60, how much would that expand the populations potentially eligible for these implants, and then I have one follow-up question.
DR. TUCCI: I don't know that I have a breakdown of all of that, but we do know that if you look at the
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whole population of hearing impaired in the United States, it's 28 million, and one in a hundred are thought to be profoundly hearing impaired, so we have that number. How many are moderately to profoundly impaired, I don't know, but we know that the incidence goes up markedly with increasing age.
DR. GOODMAN: Second question, Dr. Griffin?
DR. GRIFFIN: I guess this is not a question specifically for you but it's just about the safety again. If we expand the eligible population, then maybe the risk-benefit equation is a little bit different, and I'm wondering if there are other data on safety and if this is -- I think the technology assessment said they didn't address this because it's considered a safe operation, but how safe then, are there data on that?
DR. ZWOLAN: In early studies we assumed patients would lose all of their residual hearing when they received an implant, so there are published studies now in preservation of hearing following cochlear implants, and surgical procedures have gotten better to preserve residual hearing, and I believe that would be the biggest risk that you would be talking about with

expanding it out to people with more hearing. So I believe there are published data, we would have to get those for you, but they would be more with the EAS trials,

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which would inform for patients with more hearing.
DR. GOODMAN: Thank you. Dr. Schwartz is next, and then Dr. Niparko. Dr. Schwartz.
DR. SCHWARTZ: One is do we know about anything about device failure? Do these things fail, do they last forever?
DR. GOODMAN: Did the technology assessment when it looked at the FDA first question have any data on that? This is Dr. Raman.
DR. RAMAN: We didn't look at the failure rates, for question number one, but when we considered discontinuation of implants, there were few failure rates, very minimal U.S. failure rates, and when failure happened, the patient refused to undergo cochlear implant, that's what that particular study looked at, but it's very minimal, four patients out of 495.
DR. SCHWARTZ: Do any of the surgeons here have any experience with that?
DR. GOODMAN: Dr. Niparko, do you have any data on that, or experience?
DR. NIPARKO: Failure rates, that's the question, and the highest failure rate was with a particular model of the Advanced Bionics device, a ceramic device that exceeded nine percent. Since then to my knowledge, there is no model that has exceeded three

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percent, and the current generation are well under one percent.
DR. GOODMAN: So the nine percent is an historical figure?
DR. NIPARKO: Right, the 9.0 percent is a historical figure, a device that has not been used for over nine years now.
DR. SCHWARTZ: And the current is about one percent?
DR. NIPARKO: I'm going to ask Dr. Weber for that, I think he's going to have a better sense of this, but my understanding is that none of the current devices are looking at anything beyond one percent.
DR. WEBER: They're all less than one percent at current. It's published on the website of each manufacturer as their rates, anytime an implant is removed or replaced, they do count it as a failure now, even if the device itself hasn't failed, so it may not be a true hard failure of the device but it is reported. The other one, if you want to read it, was Dr. Peters in Laryngoscope, Volume 120, issue five, 2010, by Peters, et al., it's called Worldwide Trends in Bilateral Cochlear Implants.
DR. GOODMAN: I missed the beginning of the

citation.
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DR. WEBER: Laryngoscope, Volume 120, issue five, 2010.
DR. GOODMAN: And that addresses which question?
DR. WEBER: That was the original one that came up when we were talking about the percentage of bilaterals.
DR. GOODMAN: Excellent. I wanted that for the record. Dr. Schwartz, did you have a follow-up?
DR. SCHWARTZ: Well, actually it's going back to the question I raised before the break that I said I wanted to get to. That is, I'm just wondering about the appropriateness of assessing the incremental value of bilateral over unilateral implants in people who have already had both implants put in and then you turn one off, since you're not dealing with a natural hearing system. So I'm just particularly interested in any of the surgeons who have experience with this or any of the manufacturers or whatever.
DR. GOODMAN: Dr. Schwartz, I must have missed it. What's your question again?
DR. SCHWARTZ: The question is, it was stated this morning in the literature review and other times that a lot of the information on incremental, a lot of the studies on incremental benefit from bilateral as opposed to unilateral implants were due to what was called a
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crossover design where you turned one off, turned the right ear off and listened with the left ear, turned the left ear off and listened with the right ear, and then had both on. And in all those patients who have had two devices put in, you've disrupted their normal hearing to some degree, and I'm just wondering how appropriate that was and if we had any insight into if there were studies, how those rates compared to maybe looking at a person, and then subsequently found themselves without it, or matched cohorts or something.
DR. GOODMAN: Thank you. So it's a potential confounder is what you're describing.
DR. SCHWARTZ: Right.
DR. GOODMAN: Dr. Tyler seems to have a response to that.
DR. TYLER: So, those of us involved in the cochlear implant work have been aware of that as a potential confounding factor for probably over a decade, and we have published in peer reviewed studies both comparisons between unilateral and bilateral in different groups of subjects which are matched for things like age and duration of deafness, and we've also published pre and post data on individual patients who first got one implant and then after two years or three years or four years get a second implant, so in that case they're their own
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control.
DR. SCHWARTZ: Are they recently consistent across those things?
DR. TYLER: It's consistent across all those studies that speech perception scores showed improvement, and localization scores show improvement.
DR. GOODMAN: Thank you. Ms. Scorza is next.
MS. SCORZA: Briefly revisiting the idea of device failure, I asked the question and the other ones I asked in light of this. If there's a one percent failure rate, and possibly with the Medicare population where these devices are used more, that one percent starts turning into bigger and bigger numbers, and I'm wondering if anyone has seen any statements on predictive modeling of factors that might go wrong, and can we possibly identify, say a treatment plan or a work flow that would help clinicians identify potential patients who might fail based on the medical complexity, even though at the time of implantation the person might seem like a wonderful candidate. An example would be someone with multiple medical conditions, and might have a condition like keloid formation or something that might eventually tangle up the implant or cause it to be removed. I'm just wondering if there are any predictive modeling studies out there.
DR. GOODMAN: Yes, Dr. Zwolan, this has to do

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with any predictive factors with regard to failures.
DR. ZWOLAN: I would just like to clarify that failures almost always are due to technical difficulties of the implanted device, so they're not usually due to anything with the patient unless it's something where they were hit in the head, and that causes a technical difficulty with the implanted device. That's the vast majority of failures.
MS. SCORZA: And if there is information on the vast majority of failures, are there any industry, is there anything in the industry that would help to identify those early on so they could avoid a more serious consequence in a patient who had such a device implanted?
DR. GOODMAN: Any response to that? Dr. Weber, are you slowly approaching the microphone?
DR. WEBER: I'm trying to couch an answer. If you're asking, is there a predictive way of knowing which implant is going to fail, that answer would be no, there's no way of predicting which implant that gets implanted will fail. If an implant does fail, however, there are numerous studies out that show that you can explant a failed implant, reimplant with another implant, and then that patient will do as good if not better than they did with the one that did fail.
MS. SCORZA: Thank you, that's what I was

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getting at.
DR. GOODMAN: Thank you very much. I've got Dr.

Rao, Niparko and Mushlin. Dr. Rao.
DR. RAO: I just had a question for the technical folks. When you talked about discontinuation of use, 20 out of 495 discontinued use due to adverse events. Did you classify what those adverse events were when patients refused to re-up?
DR. GOODMAN: As I recall, as one of the TA people approaches the mic, there was, we had two figures. We had a four percent certain kind of adverse event, and an eight percent of a less serious type of adverse event as I recall, and this is Dr. Raman.
DR. RAMAN: Yeah. We have tables on D-12 of the appendix, and then we have listed the four studies.
DR. GOODMAN: Give us the high order of numbers, Dr. Raman, please.
DR. RAMAN: 137 was the highest, which is published from the U.K., which had like nine patients; of these, three had coexisting illness, two were due to tinnitus, three had complications because of device failure, and one patient who had successful outcome but because of the, when they took out the implant, he refused to undergo the second one.
So this is the study from the U.K. and we

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thought the next study had some overlap, but we could not confirm with the authors, we sent an e-mail, we did not get a response. That study had one out of 34 patients had a cerebrovascular accident which was a central cause for having a hearing loss, and that study was not because of the cochlear implant but was related to the cause of hearing loss.
DR. GOODMAN: Dr. Raman, that's helpful, but at a higher level, I thought I recalled a four percent figure and an eight percent figure.
DR. RAMAN: Yes, there was 20 patients out of 495 evaluated across these four studies.
DR. GOODMAN: And what kind of adverse events, you had two categories?
DR. RAMAN: Uh-huh.
DR. GOODMAN: What were they?
DR. RAMAN: The one study had the age number and either they did not -- it does not look at specific categories within the field, but some patients refused to use it because they were not happy with the outcomes, or they had a central cause that did not help the device.
DR. GOODMAN: Okay, thank you. I believe, was it Dr. Niparko, and then Dr. Mushlin.
DR. NIPARKO: Thank you. For Drs. Chung and Raman, I assume from your presentation that there is a

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relatively modest level of insight into the correlation between cochlear implant benefit and general health effects. I have to tell you, I'm a little bit surprised by that conclusion. Now this may be a methodological

issue, but a well done multicenter prospective study published about six years ago that in fact used controls who were waiting for surgery, demonstrated a 20 percent improvement in Ontario Health Utilities Index scores, and it was not cited in your review.

My question for you, is that because it was adults and not seniors only, and if that's the case, would this panel be remiss in generalizing from that published work?

DR. RAMAN: Yeah. The one thing that we clearly looked at is the age range of the included population and when the age range, I think in that study was like six to 65, quite broad, so that had an N in that population, and if the studies did not present separately in that population, then we could not really see the direct population, so we excluded that study.

DR. NIPARKO: Thank you.

DR. GOODMAN: Dr. Mushlin is next.

DR. MUSHLIN: I've got one or two, maybe even three, or maybe four questions.

DR. GOODMAN: Watch it, Dr. Mushlin.

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DR. MUSHLIN: If I'm allowed. They are mostly for the technology assessment group, because I would like to hear a little bit more from them. I think I heard a lot of information presented today, including your very good review, but we've heard additional information. So I guess the first question I'm asking is, is there any update that you would provide us with? Admittedly, you haven't had a lot of time to consider everything that's been talked about today, but we have to be guided by, to at least some extent we have to be guided by your technology assessment. So, have you heard today any things that would cause you to amend the conclusions, if you will, that were part of your report?

DR. GOODMAN: Dr. Raman.

DR. RAMAN: We updated the literature search the end of February, we completed the report in April, so until then we had many of the reviewers send us information and we had included as many studies as possible. Of course if there are studies out there that we have not included, we would be willing if it meets our eligibility criteria. The one thing is they have to have the separate population data and the sample size. Number two is, I think in the morning the speaker brought out that there's a discrepancy in the figures. We realized that and we adjusted in in the text,

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but we forgot to transfer that data to that figure and thus the problem grows, the figures speak a thousand times louder than the words, so people have picked it up from the figures.

DR. MUSHLIN: That was the ratio showing the misinterpretation, or the change in the interpretation?

DR. RAMAN: Yes. It's in the text but not in the tables, and that we will have to fix.
DR. MUSHLIN: But it's addressed in the text correctly as it is?
DR. RAMAN: Yes.
DR. MUSHLIN: The other question, I think several of us have touched on it but I want to ask it in perhaps a more direct fashion. And that is, on the risk side or safety side of the equation, we have not heard much data. We did hear a little bit from the surgeons talking about the surgical sort of experience, but particularly in the systematic review and some of the other presentations today, we have not heard very much about a formal quantification of the both short and long-term complications and the safety of the device and the procedure.
Now that can be for two reasons. One is it doesn't occur, there aren't any difficulties, and the second reason is they're not the focus, it may not be the

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focus of studies, and therefore not reported. And I guess the third reason is the people doing the meta-analysis focused only on benefit and not on the risks, safety and harms. So maybe, can you help clarify?
DR. RAMAN: When we started we approached it as a safe procedure and we had the discussions with the AHRQ, and this was our approach, towards looking at the benefit part and the effectiveness part, and there was not a priority question looking at the safety part. That is one of the issues that was not considered.
DR. MUSHLIN: That's very helpful.
DR. GOODMAN: Dr. Mushlin, so again, what are we to conclude from this exchange you just had?
DR. MUSHLIN: I conclude, I don't think I have been presented with enough information on the harms, potential harms side of the equation to factor that in the judgment.
DR. GOODMAN: It did seem that what data there were nearly always came up with small numbers, although the universes were all small as well, weren't they, sample sizes?
DR. MUSHLIN: That's my -- Dr. Goodman, I think that's a correct sort of inference. I wouldn't want to give the impression that I feel that this is a risky procedure, because I don't, but I think the, we just

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haven't been presented with the data.
DR. GOODMAN: Point very well taken.
Dr. Buchman, on this issue?
DR. BUCHMAN: Yes. So, there have been a number of studies that have looked retrospectively at revision surgery rates amongst patients that have undergone cochlear implants previously, and if you look at those studies, 75 percent of the revisions that are

undertaken -- well, first of all, the overall revision rate approaches 10 percent in most of those studies, somewhere between eight and 10 percent. The vast majority of those revisions are device-related, and they also have many many patients that were implanted many years earlier that may have had an older version of the device, so if they have a device-related failure from a 15-year-old device, that would be included in there. So that revision rate doesn't necessarily mean that you have a 10 percent rate of failure, because most of the revisions that are undertaken are related to device, and the reliability of the devices have improved over the years, the revision rate is dropping as time goes on, so it's hard to say what the real time revision rate is.

DR. MUSHLIN: Actually, I wasn't even really thinking that much about revision, recognizing that you've got a device and that one of the reasons for revisions is

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the failure of the device. I was thinking more along, particularly operating on elderly patients results in anesthesia issues, risk for infection, we heard things about that, there are bleeding complications, and there's sometimes morbidity and sometimes mortality associated with hospitalizations.

DR. GOODMAN: Thank you very much.

Dr. Satya-Murti.

DR. SATYA-MURTI: AHRQ permits a comment period after the TA draft has been posted, our TA folks might know, at CMS as well. So if there are significant deletions or omissions in the AHRQ or aspects that are brought in today ought to be submitted as a comment before the TA is finalized, and they post the comments and the responses as well. If I'm mistaken, correct me, but if not, I think that's the normal sequence of events.

DR. GOODMAN: That is correct. Okay. Now, we need to return to the issue that Dr. Satya-Murti raised a little earlier, and I want to have us address it before we get into the questions, because it bears a little bit on what we consider to be adequate evidence, which is going to be something that we're going to address.

As we noted earlier, this is not the most robust body of evidence you're ever going to see on interventions, including surgical interventions for that

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matter, and there was some discussion today regarding the desirability and need for conducting randomized control trials versus what we sometimes call NL1 trials, and there seemed to be some explanation in support of NL1 trials in this kind of instance. Because we're going to be looking at adequacy of evidence next and because one of our jobs is to cite potential gaps in evidence for CMS's attention and for the attention of the field in fact, we need to hash this out just a little bit. So I'm going to try to have us conduct a focused discussion on this issue with

regard to the appropriate type of study, starting with RCTS vis-a-vis NL1, and then perhaps eventually later today this might get into something along setting up registries and so forth.

But Dr. Satya-Murti, I don't know if you want to restate this issue or does the panel think he laid it out pretty well? The panel's got it.

So, I warned Dr. Schwartz and Dr. Mushlin and Dr. Steinbrook I was going to start by picking on them, and we're not going to stop with the three of you if others have comments. Dr. Schwartz, and let's try to have this as a focused conversation.

DR. SCHWARTZ: Yeah. I think given the volume of the procedures that are done, there's a lot of low hanging fruit here, and I was really surprised when I

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learned more about the field that more hadn't been done. I've got a list of probably a half page of research questions that could probably be answered from large center experiences or certainly coalitions of large center experiences that would inform a lot of the things that we've talked about, even longitudinally following cohorts over time and routinely in some sort of structured way getting longitudinal along the lines of what we heard about in some of the NIH studies, not that it's simple and not that they don't require any money, but they're not rocket science, they're not large barriers.

I also think, I was also very surprised when I was approached about the panel and started reading the background information that was given, that given the decision made back in 2005, that nobody had really taken advantage of the coverage with evidence development option of randomizing patients to between 40 and 60 percent, because there's a lot of the country that's not covered, and this would be a way to get coverage and at the same time get data, which is what the coverage with evidence development is all about, and to be able to really inform this question a lot better.

Even, you know, it's routine in these studies, and there's a lot of advantage to the patients, even in the ones who would be randomized initially not to the

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intervention, not to the device implantation, because right now they wouldn't get it anyhow, and two, if the studies are positive, that the people who are in the control group get offered the intervention as soon as it's shown to be useful, that's sort of a social and ethical responsibility we have for those patients.

So I think there are three things that can be done, and there are some trials that could be done, particularly in the 40 to 50, 50 to 60 percent group. I think there are good observational studies, whether they're registries which I'll let Al talk more about because he's got a lot more experience than I do with

those, or just better assessment of function. I mean, we all know there's nothing magic about 40, and, you know, when I first read this, you know, my body said if I was getting only 60 percent of the words right in the sentences, I wouldn't be able to function in my job, my family might be happier at home, but, you know, so I think that it's really good to get this information, and maybe also CMS could work with the NIH to try to identify some of these questions.

And then the last thing is, I think we can do something by coming out of a group like this and identifying, as the technology assessment people did to a degree, but it doesn't make sense to me why we, and I'm

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talking about all of us here collectively playing this game, where we don't tell people exactly what we want, and then we settle all these studies into this and this. Now we know what the studies need, and we could easily create a checklist as a part of this process, that if you're going to do an observational trial, these are the things that should be in it?

DR. GOODMAN: Very helpful, Dr. Schwartz.

Dr. Mushlin, a comment at this point?

DR. MUSHLIN: Yeah, but not much to say. I think I totally agree with Sandy. I think I had the same impression. You know, here you've got a wonderful technology, I think, you know, with a dearth of information, and I think there's a real opportunity to have proven to the world that it's incrementally advantageous, the things that might be done currently. And I also, although I don't know the details, and I don't want to by any means speak for CMS because I don't know that what I'm going to say now is something that they would want to do. But I do think that it's at least an attractive idea to approach CMS, given that there is the option of coverage with evidence, approach CMS and pose, not necessarily randomized trials, but some either prospective cohort studies done in the correct manner or the establishment of a registry. I think a registry in

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this situation could be extremely valuable, and there is precedent with automatic cardiac defibrillators, to not only to do that under evidence, coverage with evidence development, but require it, so that you could actually capture this entire universe and avoid bias, any bias, including selection bias. So I think it's a very attractive option.

You know, and the other, it gets more to the context I guess of, and maybe if it's appropriate we might want to hear from some of the experts about this. I think my looking at it, thinking of it in the context, thinking of this technology in the context of diffusion of technology more generally, I would wonder whether or not there is going to be a situation where there is, you are

really going to want to know whether this device works not only in the people that you're suggesting that should get coverage now, but a group that's expanded beyond that. You know, I don't know what the context is and I don't know what people are saying when they get this, and what the clinicians are really thinking about the future of the devices. But if I'm correct, I would think that there's even more argument for getting the stage set, so to speak, for getting the kind of evidence that we need.

DR. GOODMAN: Thank you, Dr. Mushlin. Dr. Steinbrook, did you have a question? And if you don't

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mind, I'm also going to pick on Dr. Eng and Dr. Raab on this issue, just in case you've got something to add, fair warning. Dr. Steinbrook.

DR. STEINBROOK: I don't have to add anything.

DR. GOODMAN: Thank you. Dr. Eng, anything on this issue about the kinds of study design?

DR. ENG: In the context of coverage by Medicare, first of all, when I read the studies I said wow, you're really at a disadvantage if you're a Medicare patient, you have to have such a higher proof of loss. But then the evidence isn't there. I mean, the studies are weak.

And so what I would say is that when we're designing the studies or as a way of registry or however you want the studies, I think that I would say that age is probably not a factor but function is a factor, and function is a final common pathway of either medical frailty or medical complexity, but how does a person function. If you have a 90-year-old who has let's say a 40 to 50 percent loss, that person can't do some of the instrumental activities of daily living to the extent that, you know, telephone, driving, or just simply taking public transportation, really, that person is functionally not able to do that.

So I would say that the studies need to look at

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Medicare beneficiaries, and that's why I asked about the denial rate. Functional assessments for implant candidates, I'm taking a look at not just hearing function, but functions in terms of everyday living. And then to follow those who have had the implants, to look at their function in these parameters. And I wouldn't wait until two years, I would say, you know, six months, one year. And one of the things that I'm interested in is a more focused approach on whether one group gets a unilateral or sequential bilateral, or today we talked about unilateral unaided, and we just don't have that data. And I think it's very important for the Medicare population because hearing loss is a disability, it really is a disability, more than a couple of bum knees. I think that in addition to the fact of it being a disability, it makes it difficult as people age, like

from 60 to 70 to 75, it makes it very difficult for us to assess in cognitive impairment with a slow decline in cognition, and is it the hearing loss, and then you mix that in with depression. So, I just think that because there's such a large pool of candidates possibly, we do need the studies, and however you design the studies, there should be resources put in.

DR. GOODMAN: Thank you, Dr. Eng. Dr. Raab, I want to pick on you because I know you've got a lot of

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experience in the device industry in particular, and you have spoken and written quite a bit about some of the particular challenges of doing these kind of studies in devices. Dr. Raab.

DR. RAAB: I would like to express my disappointment that CED wasn't a screaming success here, but I would like to explain why I think, having lived through it very closely with a bunch of companies. The mid 2000s were a very confusing time when CMS was putting out CEDs to begin with. This NCD that we're working with came out, offered the possibility of CED, yet it was a year later that CMS issued its guidance document on how to do CED, and at that time as well other issues were in the mix.

This panel had countless meetings on PET imaging and PET imaging was an area that was targeted for CED and it was a real success, but it took some time to figure it out. ICDs, took some time to figure it out. So we had a decision here in the mid 2000s and no one came forward right away, but it was a real confusing time and no one understood it yet.

What I would hate to have happen is to have this CED opportunity and what we have talked about as a way to generate data, have it end too soon. I mean, it's been six years, but I would hate to have it end. I would

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rather view this meeting as a way to reboot the system and reinvigorate the system than ask again for studies. And I think the TA really serves as a road map as to what we need, and I would like to point out that when we're talking about these measures and the need for metrics, there are endpoints that are identified, or we need work done on endpoints to do these trials, and the observational studies I think are just ideal for this sort of technology.

DR. GOODMAN: Thank you, Dr. Raab. Briefly, Dr. Schwartz, and briefly, Dr. Steinbrook. Dr. Schwartz.

DR. SCHWARTZ: What I would say is if we're getting into this area, that coverage of evidence development was implemented as I understand it where there wasn't sufficient data to really make a determination but there was enough preliminary data, and the thought was that the benefits of covering it in the absence of silent data were worth the risks from the societal perspective.

I think it may be time to think about sunsetting this. In other words, if the evidence hasn't been developed in five years, the coverage decision is no more, and then it will have to be reconsidered freshly. That would give people the incentive to develop the evidence that's implicit and explicit in coverage with evidence development, similar to what the FDA is now able to do with the postmarketing

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surveillance, putting some real teeth into it, because I don't think it's good for the patients or for the system to just go on and make the determination based on a guess of what we think is most likely to be a risk and a harm, and then five or ten years later -- and the time frame would have to be different for maybe, it would have to be determined at the time the coverage with evidence development was made, something to think about for us and CMS.

DR. GOODMAN: Dr. Steinbrook, briefly.

DR. STEINBROOK: Briefly, and to try not to duplicate, I don't know how we're going to vote on this, but I do think that a lot of the questions which are being posed are answerable questions and that we can get there. And I think that if this process is to go forward, it clearly needs some sort of a jump start. How much of that comes from CMS, how much from industry, how much from academia, how much from something convening or facilitating function, I don't know, but I think that progress can be made which has not happened so much in the last period of years.

DR. GOODMAN: Thanks, Dr. Steinbrook. If he doesn't mind, Dr. Rollins, I'm just going to give you a second to warm up here. Just to remind us as a group, this group does not set coverage policy at all, we don't

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do thumbs up or thumbs down on cover or no cover. We don't even say or vote on whether there should be coverage with evidence development. We look at the evidence and we raise this discussion now, we just had the discussion because we're about to answer some evidence questions and we needed a little bit more context about what is adequate evidence and what may not be adequate evidence. Some of our discussions spilled in to what CMS or the industry or other advocates might do in the future, but it is still germane to our needing to answer these evidence questions. Dr. Rollins, at this juncture, would you mind responding or opining on some of these future evidence issues?

DR. ROLLINS: Absolutely. Earlier today when I talked about the functions of the MedCAC, one of the things I said was to get input from experts in the field on a topic, and that information helps us strategize our efforts related to future efforts on the topic, and this is a classic example.

As somebody just mentioned, in terms of

sunsetting a CED or NCD, that actually has not been built into CEDs but in the future it probably will, because this one has been out there for six years and we've had no takers. But basically it's still out there, so if this committee feels that the subject is worth pursuing and

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says there are three different avenues, one is a CED as we've talked about, the second is using CMS's clinical trial policy or, number three, category B FDA IDE studies, so there are three avenues I would say. If the CED is the one that's most practical, then that is something that yes, this committee can pursue.

So I would hope that this would be the jump start and if there is sufficient evidence to pursue it, that will be a good thing. If CMS were to bring the topic up again, it might be to sunset it. And I'm not saying that's exactly what it's going to do, but I am saying this is an opportunity to move forward with this great research that can be done.

DR. GOODMAN: Thank you very much, Dr. Rollins, and thank you for being ready to go without much warning. Dr. Satya-Murti, since you raised this issue, do you want to make a rounding out comment about it?

DR. SATYA-MURTI: A brief comment here. With the dementia CED also, if I'm not mistaken, no data were collected, and that is probably not going to happen even if you didn't sunset and gave it a lot of time, because the CED was given to look for PET scan FDG and now we have plaque imaging instead of D14 FDG, so FDG would probably not be done.

So even as we conceive of CEDs giving extra

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time, lead time on it, the CED has to be so carefully framed that it does not peg it down to the existing technology which might make it passe very soon, so it might be viewed as a very broad category of is it helpful or not and not so much confined to a particular type of device-specific or location-specific surgery. So that's just a general comment, having lived through those.

DR. GOODMAN: Thank you. I want to proceed next to our questions, and just a little warning here, and this is particularly the TA people. So as we mentioned earlier, the people that do the technology assessment are given a set of key questions, they are given these questions many months ago and they are intended to but typically don't perfectly align with the questions posed to the MedCAC, so here is my warning/request to you. We're going to start with questions one and two. I know that you have looked at this evidence, but you looked at it, maybe the key questions aren't numbered the same way, so before we vote on these, I'm going to ask the technology assessment folks from Tufts to summarize at least from their standpoint, that is the standpoint of the technology assessment, something about the adequacy of the

evidence and perhaps what the evidence says. So, you're nodding that you understand that, very good. We're going to start soon with question one.

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Do we need a break? Is that what -- the court reporter would like to have a break, that is a smart idea, so here's what we're going to do. This will give the TA folks some time to ramp up. We are now going to take a 7.5-minute break, we'll see you back soon, and we're going to have concise discussion and voting on the questions. See you in seven-and-a-half minutes.

(Recess.)

DR. GOODMAN: Let's get started, and just before we get into the voting, I know that there was a request to provide some specific clarifying information regarding the FDA-approved category B sorts of trials, and so I belive this is Deborah Arthur, who has by the way signed a disclosure statement that all of our speakers have to sign, of course, and did you want to provide some clarifying information with regard to a particular issue?

MS. ARTHUR: I work for Cochlear Americas, I'm vice president for regulatory affairs, responsible for all communications with the Food and Drug Administration for the company. We have solicited pre-investigator meetings since 2007 to enter into clinical trials with the said population, and our device. We initiated the original submission of an IDE for this indication with the Food and Drug Administration as early as 2008, finally got it assigned a number in '09, and 24 months later, conditional

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approval of the IDE. So we have just recently secured additional approval and are working through those conditions. We have investigators identified, we have packets in their hands, but this process has been over three years.

DR. GOODMAN: Thank you very much, and it's to the point and helpful at this juncture.

What we're going to do now is begin with the voting questions, and I know that Maria Ellis has handed you the little voting machines. What we will do here is in each instance, we're going to ask the Tufts team who prepared the technology assessment to remind us about their findings with regard to the particular questions that we've got, so that will save us the brainwork of having to do the cross-off between the two sets of questions. But we won't limit the discussion to that, we will also ask our presenters if they have anything directly germane to the questions, we'll see if there's any discussion on the part of our panelists directly germane to the questions and then we will vote, okay?

So with that, the first question, actually it's a pair of questions. The first question is an adequacy question and this is, how confident are you that there is adequate evidence, so we're not judging what the evidence

says here, we're just trying to determine what the
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adequacy of the evidence is, to determine whether or not a unilateral, i.e., first cochlear implant improves health outcomes for adults with hearing loss demonstrated in test score of, those two test scores, A, 40 to 50 percent, and B, 50 to 60 percent inclusive. All right?
So if I could turn to the Tufts people, and if you could summarize for us anything you would like to say about the adequacy of the evidence there, and then if you could go on to say in what direction you think the evidence is taking us, in other words, what does the evidence say, that would help.
By the way, before you start, I see, the noise once again is the fan from the projector and I apologize for that, but we do need to display the voting when it occurs for everyone to see.
So Dr. Chung, I know this is a tough order on short notice, but can you talk about the adequacy of the evidence with regard to the unilateral cochlear implants with regard to improving outcomes?
DR. CHUNG: So, we rated the overall body of evidence specific for this question insufficient based on one B quality study that analyzed 28 elderly subjects greater than 65 years old, and the much younger, so in total, 54 subjects in this study. And in this study they analyzed the association between preimplant HINT scores in
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quiet in three categories, less than 20, 20 to 40, and greater than 40, and in relation to the post-implant HINT score, and they found that the higher the preimplant score was significantly associated with post-implant score, both acquired and in noise. This is important because this data showed that greater than 40 established by HINT score preimplant was a significant association with better post-implant outcomes.
DR. GOODMAN: Okay. So you talked a little bit about the type of evidence, that is the adequacy and what the evidence seems to suggest. Thank you. When you come up again, I know that I'm going to be picky about this, I'll ask you and all speakers to speak directly into the microphone and as clearly as possible, especially because we've got this machine up here, at least in my left ear.
And we had a further bit of observation from the Tufts team? Yes.
DR. POE: Dennis Poe, and I was a consultant to the Tufts group. So, a couple of the panelists asked a very important question, what do these numbers mean, 40 to 50 percent, 50 to 60 percent, and although I don't have specific data on that, the surgeons in the group, the audiologists as a ballpark just so you understand, below 40 percent you're basically reading lips, and a person has to face you in order to get enough cues to make sense of
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what distorted hearing they're getting. Between 40 to 60, you're starting to get some better recognition of words, but it's not good enough to talk on the phone. By 60 percent you're beginning to be able to have a limited conversation, probably with known contexts and with known speakers on the phone, but it's quite limited. Above 80 percent, most people can do a pretty good job on the phone.

DR. GOODMAN: Remind us before you leave the microphone, when we talk about 40 percent, 50 percent, 60 percent, remind us what scale this is.

DR. POE: This is referring in this context to the HINT open-set sentences that we've been using for most of our discussion here. There was a lot of other discussions about other word lists and sentence lists, but for the most part these were administered with the HINT open-set sentences.

DR. GOODMAN: Thank you. Now, on questions one and two, perhaps two if we reach the threshold for two, do any of our presenters have anything new to add or something different, or something that would enrich what you just heard from the technology assessment and/or the earlier discussion? Dr. Tyler.

DR. TYLER: Well, I would like to say that generally I think the notion that for people with high

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levels of speech perception preimplant with hearing aids like 60 percent or more probably need more data to try and sort out their binaural advantages and whether they're a candidate or not. However, I think there is adequate data already published in peer reviewed journals to address the issue of whether unilateral implants work or not, and I'll just say that although we don't always call this the wait list control, all of these patients have been tested several times before they get a cochlear implant, and we could easily republish our data and change the bar graphs from preimplant to post-implant to wait list control, and the treatment group, and I will just say that we can test these people over and over and over again every day for the next year, and if they have a profound hearing loss, they're not going to do that well no matter what tests you have.

And then finally I'll say for binaural hearing, we actually stopped testing their localization if you only have one ear probably almost ten years ago, not because we're not interested in a well-designed study, but because if you have only one ear you cannot localize, and so for us the best science is individual single subject design, and we can call it a wait list control if that makes it easier to sell.

DR. GOODMAN: Thank you, Dr. Tyler. I will

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remind all speakers that for this part of our discussion we need, you must address the evidence question, not the

peripheral stuff, help us with the evidence that addresses the question in particular.
Now, panel, any things to clear up about this question? Dr. Mushlin and Dr. Griffin.
DR. MUSHLIN: I've got a question about how adequate, if you will, the technology assessment is to enable us to make a judgment of the adequacy of the data. And I notice that the criteria for this, for the literature review that was the basis of the technology assessment was January 2004, that is articles from, published from January 2004 through to February 2011. So the question could come up about whether or not older studies, studies prior to 2004 are germane to the question that we are asked to address.
DR. GOODMAN: Allow me to try to answer that. When we are addressing these questions we do not have a time limit, okay? So the technology assessment, by virtue of time and budget I would guess, and the fact that the CMS has looked at this issue about five or six years ago, called upon them to focus on the more recent years. However, the evidence presented to you, though it tended to focus largely on the evidence that the TA pulled together by its inclusion and exclusion criteria, was not

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limited today to that, we did hear references to older studies and we have many of them cited in the text. So your answering our questions is not necessarily cut off pre-2005, okay? I know that most of the discussion focused on more recent stuff, so that is a bit of a challenge and that is understood, so thank you. And then it was Dr. Griffin.
DR. GRIFFIN: I'm not sure you can answer this, but I note that FDA has licensed two of the devices for indications of less than 60 and less than 50 percent, and I'm wondering if FDA reviewed data that we didn't see that made them determine that these devices were effective?
DR. GOODMAN: Dr. Arthur, yes, I would ask you to come to the microphone, since you would be in a position to know at least part of the answer. You don't represent the whole industry, of course.
DR. ARTHUR: The answer is yes. That information is publicly available in the FDA's summaries of safety and effectiveness relating to manufacturers' products. So for manufacturers like Cochlear Americas, that have approvals for other than the less than 40 percent, we have submitted clinical trial data with our device showing safety and efficacy.
DR. GOODMAN: So those data are, once approved, in the public domain?

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DR. ARTHUR: That data, the clinical summaries and the whole summary of adverse events, complications and everything is in the public domain.
But one other point I was going to make is if

you go to MAUDE database, you'll see the complication rates, adverse events for all of our products reside there, and it resides there all the way back to the initiation of the MAUDE database, so that's publicly available.
DR. GOODMAN: The MAUDE, M-A-U-D-E, is a formal database. Now, that does not necessarily mean that those data in the public domain have been converted into a published article, correct?
DR. ARTHUR: They are, part of the data in the public domain are the subject of many of the articles that you have reviewed and discussed here today, but this is not an article that was covered.
DR. GOODMAN: So a better way of saying it, it's highly likely that the data that are in the public domain as a result of your having submitted the data for approval and the FDA has made available, those data are reflected in one or more published articles.
DR. ARTHUR: Absolutely.
DR. GOODMAN: Okay.
DR. ARTHUR: And as you'll see, information in

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the MAUDE database is the commercial complication or adverse event rate. The product, while in the clinical trials, it doesn't go into the database, so you're seeing the longitudinal adverse events associated with these products.
DR. GOODMAN: Thank you. So Dr. Griffin, chances are we've seen it, and the chances are the technology assessment has covered it. There's not always a one-to-one correspondence between a given study and one published result, one published article, excuse me, but it is in the public domain. So, Dr. Sacco.
DR. SACCO: So, this is just causing more confusion for me. I would say, one, FDA approval is based on different regulations than often we are looking at. And it's helpful to hear that the FDA has approved these devices based on clinical trials that are focused on specific outcomes that the FDA had some clinical trials on, but I have not based my deliberations on FDA approval, and I guess I'd ask the chair to tell us whether that kind of information we need to consider, first. And a second issue you've raised now, all data before 2004 that we are supposed to take into account in our deliberations, and I have not reviewed data prior to 2004.
DR. GOODMAN: Right. It's always dealing in a limited universe. The fact that the FDA has approved the

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device for market of course is not the same as Medicare or any other third party making a coverage policy, and so it is likely that payers tend to look at even the same data for different purposes, different populations and so forth. Clearly FDA approval is something that is noticed and almost all payers take that into account, but payers

have sometimes additional considerations when it comes to this.
Second, as I mentioned before, yes, we have not had a chance to look at all the studies, especially the pre-2005 ones. They have been in fact referenced in some of the things you heard about today, but we need to deal with the evidence that has been presented to us and of which you are aware. That's the limitation within that, how it works, and the best we can do today before 4:30.
Questions, comments? Dr. Miller, did you have a point?
DR. MILLER: The fact that the cochlear implants were covered in 2004 or 2005, that data was reviewed and has been accepted by CMS as indicating that these devices are reasonable and necessary for the population that has been previously described. So therefore, we started, we queried about the literature from basically then on, because at that time we were not comfortable with the questions that we had adequate evidence to confirm or deny

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similar questions that we have posed to you today. So that is why -- I mean, we are accepting the 40 percent and less group, okay, for unilateral cochlear implantation.
DR. GOODMAN: That's not even on the table today.
DR. MILLER: Right, it's not on the table, it's what has happened since then, it is that evidence we wish to review.
DR. GOODMAN: Correct. Dr. Sacco.
DR. SACCO: I have just kind of a follow-up question. So then I presume, and please help me here, that in your 2005 meeting, the committee, in reviewing all the data that existed up to that point, felt very weak regarding coverage determinations beyond 40 percent.
DR. MILLER: Yes. And to clarify, there was no MedCAC at that time, there was an evidence review that was performed basically in-house, but we accept that, okay? But then the question that was posed today were questions that we felt were unanswerable at the time, that the evidence was not adequate to answer those questions, and so now that is why we have convened the current MedCAC.
DR. GOODMAN: So that should help. We're not looking at the whole universe of evidence, there may have been some evidence pre-2005 that was considered before. We may not have as close a look at it now but there was

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that benchmark and that's why, one reason why we're not looking at the below 40 percent, is that was a benchmark from several years ago.
Other points on this issue before we run a vote on these questions? Dr. Steinbrook.
DR. STEINBROOK: Just very briefly, and this may be obvious, but I think it's worth calling attention to. I found the data which was presented by Dr. Firszt

potentially relevant to this issue, but my concern, however, is that it hasn't been published yet and it hasn't gone through the same process that all the other evidence has gone through. Nonetheless, we need to look at this now. If we had a different evidence base, that's just something which we don't have, so I think we have to deal with the evidence that we have now which has gone through the rigorous process.

DR. GOODMAN: That is correct. CMS did not tell Dr. Firszt to not present that evidence in the works, but as a group of professionals involved in looking at evidence and clinical indications and so forth throughout your careers, chances are you recognize the difference between evidence that has been subject to peer review and that which has not, and you might take that into consideration as you see fit for this voting purpose.

Dr. Ellis, or Ms. Ellis, I understand you've

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handed out the voting gizmos to everyone, and do you need to tell us anything before we proceed here?

MS. ELLIS: Yes. As stated earlier, there are going to be two scores. There will be two sets of voting scores, one for voting members and the other score for the entire panel. So the nonvoting scores, they will not, you do not have a keypad to vote with, but you will state your vote once everyone else states their vote. So again, all you need to do is push the number on the keypad that matches your vote, one through five.

DR. GOODMAN: We're going to do that in a moment, and in the following order we're going to push the number on the keypad. After everybody has pushed the number on the keypad and that registers, then we're also going to ask you to voice your vote because we need to have it recorded that way. And finally before you leave today, we need those written, the old fashioned way on your paper. So you're going to register your vote every time three times.

So, call the question, question one. How confident are you that there is adequate evidence to determine whether or not a unilateral, i.e., first, cochlear implant improves health outcomes for adults with hearing loss who have demonstrated a test score of, A, 40 to 50 percent, that is greater than 40 percent and less

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than equal to 50 percent.

(The panel voted and votes were recorded by staff.)

MS. ELLIS: We have all the votes.

DR. GOODMAN: I see a 2.6 plus; is that correct, Ms. Ellis?

MS. ELLIS: Yes.

DR. GOODMAN: That means when the time comes, we're going to proceed to question 2.A for that. Let's go down the table quickly, and Dr. Satya-Murti, would you

state your vote?
DR. SATYA-MURTI: Two.
MS. ATKINSON: Four.
DR. CHEN: Two.
DR. ENG: Four.
DR. GRIFFIN: Four.
DR. HARTMAN-STEIN: Three.
DR. MUSHLIN: Two.
DR. SACCO: Two.
DR. SCHWARTZ: Two.
MS. SCORZA: Three.
DR. STEINBROOK: Steinbrook, two.
DR. RAAB: Raab, four.
DR. NIPARKO: Four.
DR. RAO: Rao, four.

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DR. GOODMAN: Thank you all. The recorder didn't necessarily get all the names. You'll excuse me, and this is my oversight. You have to say your vote and your name, as some of you did. We need to see it and need to hear it both times, so I apologize. Once again, your name, last name and your vote, please, Dr. Satya-Murti.
DR. SATYA-MURTI: I should have known better, I apologize. Satya-Murti, two.
MS. ATKINSON: Atkinson, four.
DR. CHEN: Chen, two.
DR. ENG: Eng, four.
DR. GRIFFIN: Griffin, four.
DR. HARTMAN-STEIN: Hartman-Stein, three.
DR. MUSHLIN: Mushlin, two.
DR. SACCO: Sacco, two.
DR. SCHWARTZ: Schwartz, two.
MS. SCORZA: Scorza, three.
DR. STEINBROOK: Steinbrook, two.
DR. RAAB: Raab, four.
DR. NIPARKO: Niparko, four.
DR. RAO: Rao, four.
DR. GOODMAN: Thank you all. Same question, different test range. How confident are you -- oh, Dr. Sacco.
DR. SACCO: Unfortunately, that does not match

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when we used the verbal scores and what's shown.
DR. GOODMAN: Because, the oral includes the nonvoting members, the 11 reflects the voting members.
DR. SACCO: I see.
DR. GOODMAN: But I see you're still sharp, Dr. Sacco, even late in the afternoon. We appreciate that. Okay. Same question, but for the different range. How confident are you that there's adequate evidence to determine whether or not a unilateral cochlear implant improves health outcomes for adults with hearing loss who have demonstrated a test score of greater than 50 percent to, up to and including 60 percent. Greater than

50 to less than or equal to 60 percent.
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: I'll note, by the way, that in the record and in the formal report, the voting and nonvoting scores will show up separately. Do press firmly. They're in, Ms. Ellis?
MS. ELLIS: Yes, they're all in.
DR. GOODMAN: And the chair sees a 2.36 score, which would deem we will not proceed to that question regarding the actual impact in health outcomes. So that is question one, and now we will do the name and vote. Dr. Satya-Murti.

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DR. SATYA-MURTI: Satya-Murti, two.
MS. ATKINSON: Atkinson, two.
DR. CHEN: Chen, two.
DR. ENG: Eng, three.
DR. GRIFFIN: Griffin, four.
DR. HARTMAN-STEIN: Hartman-Stein, three.
DR. MUSHLIN: Mushlin, one.
DR. SACCO: Sacco, two.
DR. SCHWARTZ: Schwartz, two.
MS. SCORZA: Scorza, three.
DR. STEINBROOK: Steinbrook, two.
DR. RAAB: Raab, four.
DR. NIPARKO: Niparko, four.
DR. RAO: Rao, four.
DR. GOODMAN: Thank you all. Let's proceed to Question 2.A, 2.A only. The question is similar, except now we're asking about the actual impact, and so because we scored above 2.5 on the 40 to 50 range on the last question, we move to question 2.A. So, how confident are you that a unilateral, i.e., first, cochlear impact does in fact improve health outcomes for adults with hearing loss of greater than 40 and less than or equal to 50 percent loss?
(The panel voted and votes were recorded by staff.)

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DR. GOODMAN: All 11 are in and I see a score of 2.9, Ms. Ellis.
MS. ELLIS: Yes, that is correct.
DR. GOODMAN: Very good. Okay. Let's do the voting, the names and votes.
DR. SATYA-MURTI: Satya-Murti, two.
MS. ATKINSON: Atkinson, three.
DR. CHEN: Chen, one.
DR. ENG: Eng, four.
DR. GRIFFIN: Griffin, four.
DR. HARTMAN-STEIN: Hartman-Stein, four.
DR. MUSHLIN: Mushlin, two.
DR. SACCO: Sacco, two.
DR. SCHWARTZ: Schwartz, four.

MS. SCORZA: Scorza, four.
DR. STEINBROOK: Steinbrook, two.
DR. RAAB: Raab, four.
DR. NIPARKO: Niparko, five.
DR. RAO: Rao, four.
DR. GOODMAN: Thank you very much. We're going to proceed to questions 3.A and 3.B now, and I'll ask the Tufts team to get ready to give us the high points, not necessarily the details, the high points here, and question 3.A and 3.B concern the use of bilateral cochlear implants as compared to unilateral

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cochlear implant with regard to improving health outcomes. So again, this is bilateral versus unilateral for improving health outcomes. I see Dr. Raman, and Dr. Raman, please speak clearly into the mic, I'm still having a problem with the noise on my left side.
DR. RAMAN: We identified three studies of B quality -- we identified many B quality studies, and they all showed improved outcomes with regard to sound localization, speech perception scores as evidenced by open-set sentences, sentence tests at a modest level, and then they all showed improved binaural processing measures. There were three B quality studies on the outcomes of quality of life and they were rated, the evidence was rated low for the quality of life, but the evidence for speech outcomes was moderate, and the overall evidence across the outcomes was rated low.
DR. GOODMAN: The overall evidence across the outcomes was rated?
DR. RAMAN: Low, including all speech and health-related quality of life outcomes combined.
DR. GOODMAN: And these were bilateral versus unilateral.
DR. RAMAN: Yes.
DR. GOODMAN: Okay. Anything else to add at this point?

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DR. RAMAN: No.
DR. GOODMAN: Okay, thank you. Do any of our presenters have anything to add with regard to this particular body of evidence of bilateral versus unilateral, anything about the quality of the evidence or direction of the evidence that we want to recap at this point? Seeing none -- Dr. Schwartz.
DR. SCHWARTZ: So what we have here is from the technology assessment systematic review, moderate evidence according to them for certain factors, there's moderate evidence for some and there's not evidence for others, but our question asks is there adequate evidence to demonstrate whether or not it's useful. So I'm interpreting this as I don't necessarily need evidence in every category of evidence if there's enough evidence in one category, and that may or may not be sufficient for

any person here. Is that fair?
DR. GOODMAN: Well, I think it refers, and I may be missing your point, but we're referring to impact on health outcomes, and the outcomes can be --
DR. SCHWARTZ: Any one of those three categories.
DR. GOODMAN: Correct, that was as much guidance as we got from CMS on this issue. But I'm glad you raised it, Dr. Schwartz, because if there's any further

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discussion about whether it's doing well for one outcome but not another, that might be interesting to record, but I appreciate your asking that.
Does the panel have any further questions germane to 3.A, 3.B here? I don't see any, and I didn't see any of the presenters offering any further evidence on that. So let's get ready to vote here, and I will state the question again: How confident are you that there is adequate evidence, and again, this is the evidence adequacy question, not what the evidence says question, how confident are you that there's adequate evidence to demonstrate whether or not the use of bilateral cochlear implants as compared to a unilateral cochlear implant improves health outcomes? Scale of one to five, one is no confidence, five is high confidence.
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: All 11 are in, the mean is 2.9. As such, we will proceed to question 3.B, but first the names and votes. Dr. Satya-Murti.
DR. SATYA-MURTI: Satya-Murti, two.
MS. ATKINSON: Atkinson, three.
DR. CHEN: Chen, two.
DR. ENG: Eng, three.
DR. GRIFFIN: Griffin, three.

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DR. HARTMAN-STEIN: Hartman-Stein, three.
DR. MUSHLIN: Mushlin, four.
DR. SACCO: Sacco, two.
DR. SCHWARTZ: Schwartz, four.
MS. SCORZA: Scorza, three.
DR. STEINBROOK: Steinbrook, three.
DR. RAAB: Raab, four.
DR. NIPARKO: Niparko, three.
DR. RAO: Rao, four.
DR. GOODMAN: Thank you all. Next, we will now proceed to 3.B, given that 3.A came out as a 2.9. Same comparison, bilateral as compared to unilateral, but we're asking about the confidence that the use of bilateral cochlear implants compared to a unilateral cochlear implant does improve health outcomes. How confident are you that the use of bilateral cochlear implants as compared to a unilateral cochlear implant improves health outcomes, one, low confidence, five, high confidence?

(The panel voted and votes were recorded by staff.)
DR. GOODMAN: It's like taking the last step up to the peak of Mt. Everest, that last step is the toughest.
DR. SCHWARTZ: Is that based on experience?
DR. GOODMAN: It will never be, just what I've

00211

heard, but thank you. All right. The mean score is 2.8. Dr. Satya-Murti, your vote?
DR. SATYA-MURTI: Satya-Murti, two.
MS. ATKINSON: Atkinson, three.
DR. CHEN: Chen, two.
DR. ENG: Eng, three.
DR. GRIFFIN: Griffin, three.
DR. HARTMAN-STEIN: Hartman-Stein, three.
DR. MUSHLIN: Mushlin, three.
DR. SACCO: Sacco, two.
DR. SCHWARTZ: Schwartz, four.
MS. SCORZA: Scorza, three.
DR. STEINBROOK: Steinbrook, three.
DR. RAAB: Raab, four.
DR. NIPARKO: Niparko, four.
DR. RAO: Rao, four.
DR. GOODMAN: Thank you. As is noted on our score sheet, if the answer to question 3.B is at least 2.5, which in this case it is, we are to continue on to questions four through nine. So 2.8 still looks higher than 2.5 to me, so we will go to question four, and I will ask the Tufts team if at this point they can weigh in on this question. This is having to do with sequential bilateral cochlear implant patients as compared to unilateral. This is Dr. Raman.

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DR. RAMAN: We identified one B quality study for sequential bilateral implant. The study provided improved speech perception in noise but had some inconsistent results in quiet. There was improved sound localization in the study. With regard to health quality, health-related quality of life, there were inconsistent outcomes of various types. So we rated this as low for sequential bilateral implant, but when we come back and look at simultaneous, it became low, and this study included only a subset of population less than 40 percent.
DR. GOODMAN: Dr. Raman, I didn't hear everything, so tell us again with regard to those three ranges, what you can say about any or all of the three ranges.
DR. RAMAN: We identified only one B quality study that included all patients less than 40 percent test scores, so there are no studies that we looked at for the scores greater than 40 and less than or equal to 50, or greater than 50 and less than or equal to 60.
DR. GOODMAN: None?

DR. RAMAN: None.
DR. GOODMAN: Anything else? Does any presenter have anything to add to what was just said, additional relevant evidence or anything else we mentioned today on the evidence? Dr. Tyler, again, sequential bilateral
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versus unilateral.
DR. TYLER: So, it was just stated that there was insufficient evidence on some of the quality of life scales to show an improvement on some of the sub-factors on the quality of life, and I'll just point out that some of the quality of life scales depend on the specific question that you ask, and one wouldn't expect an improvement of hearing to show an improvement on some of the questions in some of the quality of life scales. For example, how did they do with dressing themselves, so it would depend on the questions whether you expect to see an improvement on sequential implants or not.
DR. GOODMAN: Well, do you have anything specific to offer along those lines? You stated sort of a hypothesis about the applicability or not for the quality of life measure for this question; do you see anything particular?
DR. TYLER: There are quality of life scales published using, in the two Noble, et al. publications that I indicated, showing that people with sequential bilateral implants indeed do show a good overall improvement in their quality of life.
DR. GOODMAN: And were those in the peer reviewed literature that we surveyed today?
DR. TYLER: I believe they were, I'm not sure.
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They were in my review that I submitted.
DR. GOODMAN: Thank you, Dr. Tyler. Does the Tufts team have anything on that issue? Dr. Raman.
DR. RAMAN: We did not rate the quality of the studies, we included the studies, but the rating was lower because only one quality B study was there available for sequential bilateral.
DR. GOODMAN: And it used what?
DR. RAMAN: It used less than 40 percent test scores and showed improved sound localization and speech perception in noise. It did not show much benefit in speech perception in quiet, and they were not consistent gains in quality of life.
DR. GOODMAN: Not consistent gains.
DR. RAMAN: In overall quality of life.
DR. GOODMAN: So overall may include some dimensions that may not have been affected by improved hearing.
DR. RAMAN: Yes.
DR. GOODMAN: Thank you for the clarification, we appreciate that. Panel, questions or points on this issue? Dr. Steinbrook.

DR. STEINBROOK: I just may be confused given the number of studies and the ways they're being split up, but am I hearing correctly the technology assessment, that

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on this particular question, specifically that first category, less than 40 percent, we've got one study which is relevant, and it's low?

DR. RAMAN: It's actually insufficient for that particular sequential, the evidence is rated insufficient, but when we combined it with other bilaterals together, because there were more studies in simultaneous, the rate increased it to low.

DR. SCHWARTZ: I think that's because in the definition of sufficiency, if there's only one study they classify it as insufficient. So the study can be good, it's a B study, but since there's only one of them, it becomes insufficient; is that correct?

DR. RAMAN: Yes, for the sequential bilateral implant.

(Inaudible colloquy, multiple speakers.)

DR. GOODMAN: Okay. Dr. Schwartz, you always have great comments but sometimes they're on top of others, and we will miss the alacrity with which you're delivering them. Dr. Steinbrook, why don't you repeat what you think you just heard?

DR. STEINBROOK: I think I have learned that there was one study as determined through the technology assessment directly relevant to this first item, being less than 40 percent, which was graded as a B study.

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However, because it was one study, given the prespecified criteria for grading body of evidence, that became insufficient.

DR. GOODMAN: I saw heads nodding from the Tufts people. Further points or questions pertaining to this evidence question number four? Seeing none, let's get our notepads then, and this is going to be three parts, and again, this is an evidence adequacy question, and we'll start with the less than 40 group.

So, how confident are you that there is adequate evidence to determine whether or not a sequential cochlear bilateral implantation as opposed to a cochlear implantation improves health outcomes for adults with hearing loss with a demonstrated test score in the range of less than or equal to 40 percent? Please vote on that first.

(The panel voted and votes were recorded by staff.)

DR. GOODMAN: All votes are in, and I see a 2.9 in that, is that correct?

MS. ELLIS: 2.09.

DR. GOODMAN: Pardon me. Yes, 2.09, call it 2.1, all right. Ms. Ellis, since Dr. --

MS. ELLIS: I have his vote and will state it.

Dr. Saty Satya-Murti, one.
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MS. ATKINSON: Atkinson, one.
DR. CHEN: Chen, two.
MS. ELLIS: Dr. Eng, four.
DR. GRIFFIN: Griffin, three.
DR. HARTMAN-STEIN: Hartman-Stein, two.
DR. MUSHLIN: Mushlin, three.
DR. SACCO: Sacco, one.
DR. SCHWARTZ: Schwartz, two.
MS. SCORZA: Scorza, two.
DR. STEINBROOK: Steinbrook, two.
DR. RAAB: Raab, three.
DR. NIPARKO: Niparko, three.
DR. RAO: Rao, three.
DR. GOODMAN: Thank you very much. We will now proceed to the second range, which is the greater than 40, less than or equal to 50 percent range, and we'll ask you to vote on that one. How confident are you that there is adequate evidence to determine whether or not a sequential bilateral cochlear implantation as compared to a unilateral cochlear implantation improves health outcomes in adults with hearing loss in that range, greater than 40, less than or equal to 50?
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: We've got them all. I see 1.5 as
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the mean score, thank you. Same question, this is 4.C now, same question -- oh, pardon me, we've got to read them off, I keep forgetting. Ms. Ellis.
MS. ELLIS: Dr. Satya-Murti, one.
MS. ATKINSON: Atkinson, two.
DR. CHEN: Chen, one.
MS. ELLIS: Dr. Eng, four.
DR. GRIFFIN: Griffin, one.
DR. HARTMAN-STEIN: Hartman-Stein, one.
DR. MUSHLIN: Mushlin, two.
DR. SACCO: Sacco, one.
DR. SCHWARTZ: Schwartz, one.
MS. SCORZA: Scorza, two.
DR. STEINBROOK: Steinbrook, one.
DR. RAAB: Raab, two.
DR. NIPARKO: Niparko, two.
DR. RAO: Rao, three.
DR. GOODMAN: Thank you all. Now we'll proceed to 4.C, same question, the range is greater than 50, less than or equal to 60 percent. Adequacy of evidence, sequential bilateral compared to unilateral, test score greater than 50, less than or equal to 60 percent.
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: All 11 votes are in, we have a
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mean of 1.4. Ms. Ellis, starting with Dr. Satya-Murti.
MS. ELLIS: Dr. Satya-Murti, one.
MS. ATKINSON: Atkinson, two.
DR. CHEN: Chen, one.
MS. ELLIS: Dr. Eng, three.
DR. GRIFFIN: Griffin, one.
DR. HARTMAN-STEIN: Hartman-Stein, one.
DR. MUSHLIN: Mushlin, one.
DR. SACCO: Sacco, one.
DR. SCHWARTZ: Schwartz, one.
MS. SCORZA: Scorza, two.
DR. STEINBROOK: Steinbrook, one.
DR. RAAB: Raab, two.
DR. NIPARKO: Niparko, two.
DR. RAO: Rao, three.
DR. GOODMAN: Thank you all. None of the scores for 4.A, B or C were 2.5 or greater, my recollection is that A was 2.1, B was 1.5, C was 1.4, and in that case we will not address question five. Correct, Ms. Ellis, we won't address question five?
MS. ELLIS: Right.
DR. GOODMAN: Therefore we'll move on to question six now, in question six now we're looking at, rather than looking at sequential, we're looking at simultaneous bilateral cochlear implantation versus

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unilateral cochlear implantation for those three ranges. Dr. Raman, please, and Dr. Raman, I'll ask you one more time, as close as you can to the microphone, please, so I can hear.
DR. RAMAN: We identified three studies, three B quality studies which included subjects with less than 50 percent scores, and evaluated most of the subjects. We do not know the mean scores and we do not know the percentage of people for less than 40 percent, or greater than 40 percent and less than 50 percent, so we safely assumed that the majority of the patients had at least less than 40 percent test scores, and those three studies showed improved sound localization, improved speech recognition test scores, improved other measures. Only one of the three studies evaluated health-related quality of life and this study showed gains in two domains and did not, showed no difference for one domain, and we rated the overall evidence as low, but however, rated the evidence for speech perception, sound localization and binaural processing measures as moderate evidence. Thank you.
DR. GOODMAN: Can you repeat the last sentence, one was moderate, what was that?
DR. RAMAN: The sound localization, binaural processing measures and speech perception test scores was moderate, they showed consistent improvement in all three

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studies.
DR. GOODMAN: Thank you. Does any presenter

have anything material to add to this particular question, question six, and again, this is the simultaneous bilateral versus unilateral? Does anyone on the panel have any question or point of clarification before we undertake a vote for those three ranges on this question? Again, this is the simultaneous versus unilateral. Ms. Atkinson.

MS. ATKINSON: Can you clarify one more time what you rated as low?

DR. RAMAN: The overall evidence for, because we have only one study that evaluated quality of life, that technically becomes insufficient, but since there was significant improvement in the sound localization, speech processing scores and binaural processing measures, we only tended towards grading as low as to strength of evidence. However, we do not know the proportion of patients with bilateral implants for the test scores greater than 40 percent and less than or equal to 50 percent, but we assume that the majority of the patients had at least preimplant scores of less than 40 percent, this is basically an assumption.

DR. GOODMAN: Thank you. So again, this is the distinction between grading out individual studies versus

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the body of evidence. Any further questions? I don't see any, so let's vote on question six, and again, we've got three ranges here, the first one is going to be less than or equal to 40 percent, this is an evidence adequacy question. How confident are you that there's adequate evidence to determine whether or not a simultaneous bilateral cochlear implantation as compared to a unilateral cochlear implantation improves health outcomes for adults with demonstrated test score of, A, 40 percent or less? This is an evidence adequacy question first, 40 percent or less.

(The panel voted and votes were recorded by staff.)

DR. GOODMAN: We're waiting on one vote, and there it is. So the mean here is 3.1, that's 3.09. Miss Ellis, do you have Dr. Satya-Murti's vote?

MS. ELLIS: Dr. Satya-Murti, two.

MS. ATKINSON: Atkinson, three.

DR. CHEN: Chen, two.

MS. ELLIS: Eng, four.

DR. GRIFFIN: Griffin, four.

DR. HARTMAN-STEIN: Hartman-Stein, four.

DR. MUSHLIN: Mushlin, three.

DR. SACCO: Sacco, three.

DR. SCHWARTZ: Schwartz, four.

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MS. SCORZA: Scorza, three.

DR. STEINBROOK: Steinbrook, three.

DR. RAAB: Raab, three.

DR. NIPARKO: Niparko, four.

DR. RAO: Rao, four.
DR. GOODMAN: Thank you. Same question, different range, the range is now greater than 40 percent and less than or equal to 50 percent. How confident are you that there is adequate evidence to determine whether or not a simultaneous bilateral cochlear implantation as compared to a unilateral cochlear implantation improves health outcomes for adults with hearing loss in that range of greater than 40, less than or equal to 50 percent?
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: All votes are in, a mean of 2.2.
Ms. Ellis.
MS. ELLIS: Satya-Murti, one.
MS. ATKINSON: Atkinson, three.
DR. CHEN: Chen, one.
MS. ELLIS: Eng, three.
DR. GRIFFIN: Griffin, two.
DR. HARTMAN-STEIN: Hartman-Stein, three.
DR. MUSHLIN: Mushlin, two.
DR. SACCO: Sacco, one.

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DR. SCHWARTZ: Schwartz, four.
MS. SCORZA: Scorza, three.
DR. STEINBROOK: Steinbrook, one.
DR. RAAB: Raab, three.
DR. NIPARKO: Niparko, three.
DR. RAO: Rao, three.
DR. GOODMAN: Thank you very much. Let's proceed to the third range under question six, this is the range of greater than 50 and less than or equal to 60 percent, greater than 50 and less than or equal to 60 percent, and again, this is an evidence adequacy question, simultaneous bilateral compared to unilateral, simultaneous bilateral compared to unilateral in the 50 to 60 percent range, greater than 50 percent and less than or equal to 60 percent.
(The panel voted and votes were recorded by staff.
DR. GOODMAN: All votes are in, the mean is 1.3 rounded, results. Ms. Ellis.
MS. ELLIS: Satya-Murti, one.
MS. ATKINSON: Atkinson, two.
DR. CHEN: Chen, one.
MS. ELLIS: Eng, two.
DR. GRIFFIN: Griffin, one.
DR. HARTMAN-STEIN: Hartman-Stein, one.

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DR. MUSHLIN: Mushlin, one.
DR. SACCO: Sacco, one.
DR. SCHWARTZ: Schwartz, one.
MS. SCORZA: Scorza, two.
DR. STEINBROOK: Steinbrook, one.
DR. RAAB: Raab, two.

DR. NIPARKO: Niparko, two.
DR. RAO: Rao, two.
DR. GOODMAN: Thank you all. We're going to proceed now to question seven. The only part of question seven that we're going to address is question 7.A, which is less than or equal to 40 percent, because the ranges for B and C scored less than 2.5 percent on question six. So question seven, Tufts team, I guess we already discussed that, that's correct, so this is linked to question six.
This has to do with our confidence regarding the actual finding with regard to the evidence, simultaneous bilateral again versus the unilateral, only for the range of less than 40 percent, so please be prepared to vote.
The question, again, is how confident are you that a simultaneous bilateral cochlear implantation compared to a unilateral cochlear implantation improves health outcomes for adults with hearing loss with test scores in the less than 40 percent range, less than or equal to 40 percent

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range?
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: We're only going to do 7.A this time. The votes are in, the mean is 2.8 for 7.A.
MS. ELLIS: Satya-Murti, one.
MS. ATKINSON: Atkinson, three.
DR. CHEN: Chen, two.
MS. ELLIS: Eng, four.
DR. GRIFFIN: Griffin, three.
DR. HARTMAN-STEIN: Hartman-Stein, four.
DR. MUSHLIN: Mushlin, three.
DR. SACCO: Sacco, two.
DR. SCHWARTZ: Schwartz, four.
MS. SCORZA: Scorza, two.
DR. STEINBROOK: Steinbrook, three.
DR. RAAB: Raab, three.
DR. NIPARKO: Niparko, five.
DR. RAO: Rao, four.
DR. GOODMAN: Thank you. That completes question seven. We're now going to proceed to question eight, I believe, yes. Question eight has to do with the adequacy of the evidence for simultaneous bilateral compared to sequential cochlear implantation for those three ranges, simultaneous bilateral versus sequential

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cochlear implantation. From the Tufts group, this is Dr. Raman.
DR. RAMAN: Although we had studies that, there were two studies that included subjects with both sequential and simultaneous implant, there was no direct comparison in these studies evaluating the outcomes, so specifically we do not have any direct evidence for this question of comparison between simultaneous cochlear

implants versus sequential implants.
DR. GOODMAN: No evidence for any of the three ranges?
DR. RAMAN: The studies did not have a direct comparison.
DR. GOODMAN: Thank you very much. Any presenter have anything to add for this issue, simultaneous bilateral versus sequential? Dr. Tyler is going to approach the microphone.
DR. TYLER: I will just say that there's lots of data on both, I just don't think anybody has made a comparison because to some degree it doesn't really matter for clinical purposes, people do well with both simultaneous and sequential.
DR. GOODMAN: Thank you for the clinical insight but we still need to answer the evidence question, but we appreciate your point. Panel, any points to be made on

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this, the simultaneous versus the sequential? All right, let's vote on it, starting with the less than 40 percent range. How confident are you that there is adequate evidence, this is an evidence adequacy question, to determine whether or not a simultaneous bilateral cochlear implantation as compared to a sequential cochlear implantation improves health outcomes for adults with hearing loss with a demonstrated test score of 40 percent or below, 40 percent or less, one through five?
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: All votes are in, the mean is 1.4.
MS. ELLIS: Satya-Murti, two.
MS. ATKINSON: Atkinson, one.
DR. CHEN: Chen, one.
MS. ELLIS: Eng, four.
DR. GRIFFIN: Griffin, one.
DR. HARTMAN-STEIN: Hartman-Stein, one.
DR. MUSHLIN: Mushlin, one.
DR. SACCO: Sacco, one.
DR. SCHWARTZ: Schwartz, one.
MS. SCORZA: Scorza, one.
DR. STEINBROOK: Steinbrook, one.
DR. RAAB: Raab, two.
DR. NIPARKO: Niparko, one.

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DR. RAO: Rao, one.
DR. GOODMAN: Thank you. We will proceed with question 8.B. Now the range is greater than 40 and less than or equal to 50 percent, evidence adequacy. How confident are you that there's adequate evidence regarding whether or not a simultaneous bilateral cochlear implantation as compared to a sequential cochlear implantation improves health outcomes for adults with hearing loss in the range of greater than 40 and less than or equal to 50 percent?

(The panel voted and votes were recorded by staff.)
DR. GOODMAN: All votes are in, the mean is 1.2.
Ms. Ellis.
MS. ELLIS: Dr. Satya-Murti, one.
MS. ATKINSON: Atkinson, one.
DR. CHEN: Chen, one.
MS. ELLIS: Eng, three.
DR. GRIFFIN: Griffin, one.
DR. HARTMAN-STEIN: Hartman-Stein, one.
DR. MUSHLIN: Mushlin, one.
DR. SACCO: Sacco, one.
DR. SCHWARTZ: Schwartz, one.
MS. SCORZA: Scorza, one.
DR. STEINBROOK: Steinbrook, one.

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DR. RAAB: Raab, one.
DR. NIPARKO: Niparko, one.
DR. RAO: Rao, one.
DR. GOODMAN: Thank you. We will proceed to question 8.C, same question, now the range is greater than 50 and less than or equal to 60 percent, adequate evidence, simultaneous bilateral versus sequential, improved health outcomes, range of 50 to 60 percent, greater than 50, less than or equal to 60 percent.
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: All votes are in, the mean is 1.2.
MS. ELLIS: Satya-Murti, one.
MS. ATKINSON: Atkinson, one.
DR. CHEN: Chen, one.
MS. ELLIS: Eng, three.
DR. GRIFFIN: Griffin, one.
DR. HARTMAN-STEIN: Hartman-Stein, one.
DR. MUSHLIN: Mushlin, one.
DR. SACCO: Sacco, one.
DR. SCHWARTZ: Schwartz, one.
MS. SCORZA: Scorza, one.
DR. STEINBROOK: Steinbrook, one.
DR. RAAB: Raab, one.
DR. NIPARKO: Niparko, one.

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DR. RAO: Rao, one.
DR. GOODMAN: This is Dr. Schwartz.
DR. SCHWARTZ: Can I make one clarification comment?
DR. GOODMAN: Sure.
DR. SCHWARTZ: Because I think if I were going to, if my wife looked at my voting on the past several questions, she would be totally confused. And I think the thing is, there was only one study for sequential, there were several studies for simultaneous, there were no studies comparing the two. So the question comes down to there wasn't, the way I look at it, there wasn't adequate

evidence for sequential but there's also not adequate evidence to say there's any difference, and this is one of those things, is the absence of evidence interpreted as, the absence of evidence of effect interpreted as evidence of absence of effect or not. And I think, you know -- to clarify my voting, there wasn't adequate evidence, but there's no reason to believe that doing the procedure on the second side at the same time or the first time is going to be any different from a clinical perspective, so I just wanted that entered into the record.
DR. GOODMAN: That's exactly why we run these meetings this way, because we vote and we also have discussion on the issues. And I know, indeed, that CMS

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CAG takes into account these very comments. But we do appreciate, and we appreciate your wife's patience with you, you did answer that question.
Okay. That is all for question eight, and we don't need to deal with question nine because not any of the ranges scored as high as 2.5, not close actually. Now this is going to be a little out of order here. Question ten is actually a discussion question about evidence gaps and we have already discussed that in part, but we're going to revisit it in some summary form. I want to move to question 11, if you don't mind, which is another voting question.
Question 11 is a little bit different, this has to do with generalizability of our findings with regard to the evidence, sometimes we call it external validity, and there are two kinds of external validity about which we care here. Keep in mind that we have looked at the body or bodies of evidence, how great or lesser they may be, and now we want to make sure that we thought through the applicability of those bodies of evidence to the Medicare patient population in particular, and to community-based settings. And I will turn to the Tufts team to see if they've got any summary comments to make regarding generalizability to Medicare beneficiaries and to communities. And this is Dr. Chung.

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DR. CHUNG: Yes. First of all, we did not rate a body of evidence specific for this question because this is generalizability, so I'm just going to summarize the range of the mean age across the studies that we evaluated.
DR. GOODMAN: And the reason you're going to do that, of course, is that the age-related findings may pertain to our question about the Medicare beneficiaries.
DR. CHUNG: That's correct.
DR. GOODMAN: Thank you. Please do.
DR. CHUNG: So for all the studies evaluated in key question two, the mean baseline age of the study participants ranged from 37 to 74 years old, and there is only one study that had a baseline mean age of 74 years

old. And there were seven C quality studies that specifically analyzed age, the elderly age, well, older age greater than 65 years old as a predictor of postoperative health outcomes. We did not present it to you as a result because they were all quality C. And in the key question three, the mean baseline age of study participants ranged from 46 to 64 years old, and there was only one study with mean age of 64. That's all.

DR. GOODMAN: Thank you, Dr. Chung. Any comments from our presenters regarding the question of

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generalizability to the Medicare population and/or to community-based settings, anything you would like to say about looking across the body or bodies of evidence, the extent to which they apply to or involved Medicare-aged beneficiaries, or Medicare-eligible beneficiaries I should say, populations, and work in communities? I don't see any comments from our presenters. Do the panelists want to comment on either of these before we vote? Dr. Niparko first, and then Dr. Schwartz.

DR. NIPARKO: Well, we do have to keep in mind that a lot of clinical data have been excluded today because of screening criteria for the technology assessment in particular so it's a little difficult to answer this, including information prior to 2004, which did not necessarily restrict itself to under 40 percent, so we did not hear a lot of these clinical data presented here today. But I will emphasize, I will repeat that age effects in the adult population seemed to be very modest as a predictor.

DR. GOODMAN: Right. Just to follow up, Dr. Niparko, do you think we heard anything today that would contradict any statement made about age effects, was there any piece of evidence that told us, this really does act differently in an older population?

DR. NIPARKO: I would just like to underscore

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the comments that went in the other way, which is that function in geriatric populations may be a key question here in pre-senility, pre-dementia, it raises a whole list of issues that in fact are just now starting to be systematically addressed with respect to the impact of hearing loss on those particular concerns, and so it may be that we have underestimated the potential benefit based on that absence of information right now. But I do want to underscore that the quality of life effects, the health utility effects of the intervention as reported in at least three publications prior to 2004 have not been aired here today.

DR. GOODMAN: Good, thank you for that point. Dr. Schwartz.

DR. SCHWARTZ: Just a question. So, we have no evidence, no data at all, I won't even say evidence, we

have nothing to guide us on whether these studies that you reviewed were done in academic centers or in communities or in both.
DR. GOODMAN: Dr. Raman.
DR. RAMAN: All studies were conducted in academic centers. We do not have any study that reported data of all the procedures being done in the community setting or any follow-up in the community setting.
DR. SCHWARTZ: And with the studies that were
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done in the previous review, were they done in the community setting, and were the results comparable.
DR. GOODMAN: This is a question for Dr. Niparko?
DR. SCHWARTZ: Yeah, or anybody else who knows.
DR. NIPARKO: I'm going to have to say I have limited assessment, I have limited knowledge of assessments that have looked at center effects. We do not see major center effects, however.
DR. GOODMAN: Thank you. Dr. Griffin, and then Dr. Steinbrook.
DR. GRIFFIN: I want a clarification. So the community-based settings means where the procedure is being done, it's being done at a specialized or academic versus a community?
DR. GOODMAN: That's typically how it is. It's not a fair thing to say that whenever something is done in an academic setting it can't be representative of the community setting. Medicare, CMS wants to get at this question because it well understands that certain kinds of studies are carefully controlled under idealized conditions, narrowly selected patients, and generate data that may not sufficiently resemble the rest of the world. In some instances that makes a big difference, in other instances it does not. So what we're looking for here is
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any inkling or insight anyone has had with regard to some difference between what we've heard reported today and what might be happening in the real world.
Dr. Steinbrook.
DR. STEINBROOK: I just wanted to clarify something with regard to the TA assessment. In terms of studies, post-2004 studies which were, did not have people over the age of 65 or Medicare beneficiaries, did you exclude them?
DR. RAMAN: No, we did not exclude them specifically for the age base, but we did include, however, a minimum sample size was well established for the unilateral, and then bilateral was less because of the fewer U.S. attempts.
DR. STEINBROOK: So it was only because of sample size?
DR. RAMAN: Yes.
DR. STEINBROOK: Thank you.

DR. GOODMAN: Were there further questions by the panel? Dr. Tyler, would you approach the microphone?
DR. TYLER: So, with respect to your question ten, since I'm somewhat in disagreement with the conclusions --
DR. GOODMAN: Dr. Tyler, excuse me. We're actually on question 11 now.

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DR. TYLER: Oh, in 11.
DR. GOODMAN: And then we're going to turn to ten.
DR. TYLER: Okay. I'm going to say that I think that the generalizability of your conclusions I have difficulty with, because I don't agree with your conclusions. But I would say that there's at least two published sets of data that I was involved in before this cutoff date of 2005 and one since this date that included the VA population and an older population, and in all three of those studies I believe there was clear evidence to suggest that people that get one or two cochlear implants benefit substantially in their quality of life scores from receiving their cochlear implants.
DR. GOODMAN: Thank you. I'm not sure if that was relevant to question 11, but thank you for your comment in any case. Dr. Firszt.
DR. FIRSZT: I just wanted to remind you also that in Dr. Gifford's presentation, she showed the lack of effect of age for both word sentences and sentences in noise in her presentation, that was the Carlson 2010 study, and I'm not sure that's in the Tufts review or not.
DR. GOODMAN: Thank you. She did make that point, you're correct. Dr. Griffin.
DR. GRIFFIN: I guess we did hear that this

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takes a lot of infrastructure, that people come back for several visits in the first year, they have the device programmed, and it's not just a matter of having a surgeon that can put in the device. I mean, are there likely to be big differences in centers where people are putting these in?
DR. GOODMAN: Dr. Weber, do you have an answer to this question?
DR. WEBER: Yes, I have an answer to Dr. Griffin. There are many centers that are either academic or private practice that perform cochlear implant surgery in adults. Many centers do not perform hundreds a year, all right? Many centers perform less than that. But there is good evidence from both centers that are in private practice versus academic centers that the results are comparable and the same. Thank you.
DR. GOODMAN: Thank you. Do any of our speakers have anything to add on this issue of the extent to which the evidence about which we heard today is applicable to the Medicare population, more or less, and whether it is

applicable to community-based settings as opposed to some settings that would not represent how the real world works, any other comments on that by our presenters? I don't see any. Dr. Mushlin.
DR. MUSHLIN: I was just going to make, remind,

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or maybe make the comment or the observation that I think the major concerns about generalizability have been in the realm of randomized controlled trials where not only the setting is differently frequently, but also the conditions of the randomized control trial make it difficult to extrapolate to the usual population. One would expect that the threats to generalizability would be less in this situation since the evidence synthesis that we've heard was based entirely on observational study designs.
DR. GOODMAN: Thanks, Dr. Mushlin. Yes, it's true that many RCTs are designed and implemented in ways that are unlikely to represent the real world. It's also true that some observational studies may fail to represent the real world very well as well, if I may put it that way. So just because these are largely observational studies does not necessarily mean that they represent the real world well, but it's a question we need to throw at you at this point. Any other comments on this? Okay. Let's vote first on 11.A, which has to do with the generalizability to the Medicare patient population. How confident are you that these conclusions, i.e. the conclusions you have reached heretofore, are generalizable to the Medicare patient population, where one is a low confidence vote and five is a high confidence vote, a scale of one to five, generalizability to the Medicare

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patient population?
(The panel voted and votes were recorded by staff.)
DR. GOODMAN: All votes are in, with a mean of 3.6. Ms. Ellis.
MS. ELLIS: Satya-Murti, two.
MS. ATKINSON: Atkinson, four.
DR. CHEN: Chen, two.
MS. ELLIS: Eng, five.
DR. GRIFFIN: Griffin, four.
DR. HARTMAN-STEIN: Hartman-Stein, five.
DR. MUSHLIN: Mushlin, three.
DR. SACCO: Sacco, four.
MS. ELLIS: Schwartz, four.
MS. SCORZA: Scorza, three.
DR. STEINBROOK: Steinbrook, four.
DR. RAAB: Raab, four.
DR. NIPARKO: Niparko, five.
DR. RAO: Rao, five.
DR. GOODMAN: Thank you all. Let's go to 11.B, same question, but now for the community-based settings. How confident are you that these conclusions are

generalizable to community-based settings, on a scale of one to five?
(The panel voted and votes were recorded by
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staff.)
DR. GOODMAN: All votes are in and the mean is 2.7.
MS. ELLIS: Satya-Murti, one.
MS. ATKINSON: Atkinson, three.
DR. CHEN: Chen, four.
MS. ELLIS: Eng, five.
DR. GRIFFIN: Griffin, one.
DR. HARTMAN-STEIN: Hartman-Stein, four.
DR. MUSHLIN: Mushlin, three.
DR. SACCO: Sacco, two.
MS. ELLIS: Schwartz, one.
MS. SCORZA: Scorza, three.
DR. STEINBROOK: Steinbrook, three.
DR. RAAB: Raab, four.
DR. NIPARKO: Niparko, four.
DR. RAO: Rao, four.
DR. GOODMAN: Thank you all very much. So insofar as the voting questions are concerned, we've completed those, and let's move to question ten, which is a discussion question, and fortunately we've already had quite a bit of discussion on this one, but I do want to make sure that we cover and recap the main points. And question ten has to do with evidence gaps, evidence gaps, and I'll just read it into the record. What significant
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evidence gaps exist regarding the clinical criteria of individuals who should receive cochlear implants, either unilateral or bilateral? So this has the clinical criteria of individuals who should receive these. Let me state that we're interested in hearing your views on that, but let's not restrict your views to the particular wording of the question. If there are other evidence gaps that need to be addressed here, for consideration by CMS and for patients and providers and industry, we would like to hear those as well. So, we'll open the discussion and then I'll remind you that when we're done with this discussion, I'm going to one more time go down the table and ask for a final comment which will probably be something on the order of what's the most significant evidence gap that needs to be filled or addressed, or something like that, so this is your second to last opportunity to weigh in on this.
So let's open the discussion on the significant evidence gaps, and I thought I saw a hand. Dr. Steinbrook, Dr. Mushlin, Ms. Atkinson.
DR. STEINBROOK: Two comments, one very specifically. I thought it was interesting that it seems to me that the sequential bilaterals are done far more frequently than the simultaneous bilaterals, but it was

the view of the group that that was precisely up to where
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there was less evidence. So to the extent that that's important, that would seem to be an obvious place to get more information.
And I would have to say more generally, I don't usually say these sorts of things, but I think that what Dr. Schwartz said, that we shouldn't view a lot of this absence of evidence as necessarily a viewpoint, certainly on my part, that this doesn't work and it isn't beneficial for a lot of patients, but it's all the more reason to get the right evidence, so that groups like this can say what the evidence says, and we're not in a position to say what the evidence might say if it was eventually collected.
DR. GOODMAN: Great. Dr. Mushlin, Ms. Atkinson and Ms. Scorza next, and then Dr. Sacco.
DR. MUSHLIN: Yeah. I could have raised this at the end, you know, at the final comments, but it might be other people might have a different view on it and I would like to hear it if that's the case. I don't see any reason to restrict a technology assessment to recent data. I think that it does the panel a disservice to do so. I think, furthermore, the authors are going to end up with a product that is not entirely useful, I think it's less likely to be published, and I would just in -- you know, I don't see the reason for it.
One, when one does a technology assessment, one
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wants to take the entire body of published data and draw conclusions from that, and I think that it's, regardless of what decisions have been made before, I think the entirety of the evidence that should be brought to the floor, put on the table and available for deliberation.
So that's my observation and I would encourage, if other people agree, I would encourage us to have that kind of, you know, that kind of evidence synthesis part of it.
These comments don't reflect or don't cover, you know, the direct question of what additional evidence one would want to collect, but I think it's quite germane to this.
DR. GOODMAN: Thank you, Dr. Mushlin, points well taken. Ms. Atkinson.
MS. ATKINSON: I think the biggest, one of the gaps is the issue of dementia and functional status and looking at studying that, at what point do you say this person isn't appropriate. And we have clearly stated that we've found people who improved their dementia when their hearing is improved, and I think we've all seen that in clinical practice, but combining that with ADL and IADL, at what point do they really improve in their ADLs? Cleary if we have a person who can't perform ADLs, with a cochlear implant is that going to change, probably not, but we don't have the evidence.
DR. GOODMAN: Thank you, Ms. Atkinson. Ms.
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Scorza.
MS. SCORZA: My comment would be a takeoff on Ms. Atkinson's. My recommendation would be that we really need to take a better look at outcomes data and standardization of nomenclature, are we all measuring the same thing, and it's obvious that we're not because we're just not.
Also, we need to look at the applicability. The question had come up whether, I'm not exactly sure who said it, but whether or not someone can drive a car or whether someone can put clothes on or can paint a wall. You might wonder, what does that have to do with cochlear implants? Well, it may have a lot to do with it. If it has a reflection on their cognitive ability to think and process and use higher level functions, and that's never mentioned, that may, you know, influence your data, so we need to have more consistency in the type of tools to develop this burgeoning area.
DR. GOODMAN: Thank you, Ms. Scorza. Dr. Sacco.
DR. SACCO: I was going to emphasize that, you know, one of the biggest issues I had in understanding this literature is the lack of outcomes. You know, it's one thing to specifically evaluate just hearing outcomes, but I would urge new data to cover larger health-related quality of life outcomes that may be disease-specific.

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And there was some mention by the experts of some new type of questionnaires that will evaluate disease-specific outcomes for this hearing loss. I think we owe a service, I mean, there's 28 million people, we've heard, people with profound, and even more with other evidence of hearing loss, so there's obviously more to do in the United States.
I think having a prospective registry would be critical, along with it being standardized, systematic and correctly applied to definitions that everyone can agree to. And I as a neurologist would specifically urge for cognition, both at baseline but as an outcome, because I think that everybody heard that there may even be some beneficial effects on cognitive outcomes that would actually establish hearing loss improvement even further.
DR. GOODMAN: Excellent, thank you, Dr. Sacco. Dr. Stein.
DR. HARTMAN-STEIN: Along the same lines, I had a thought about a very specific quality of life outcome that nobody mentioned that has come up in the literature on treating depression in dementia patients, and that is looking at the caregiver's quality of life. Because if you have ever been around people with a lot of hearing loss and you're taking care of them, it's highly stressful on you, and that has implications in a public health way.

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It's not just, you know, trivial pursuit here. It can cause a great deal of stress, it can cause, you know,

physical problems and emotional problems in a caregiver. So for the people who are researchers out there designing such studies, I think that should be looked at, you know, in community-based populations.

DR. GOODMAN: Thanks, Dr. Hartman-Stein, I think you're the first to mention the caregiver issue today, a point well made. Other points with regard to the evidence gaps, whether it's clinical indications or others, evidence gaps that ought to be addressed here by, whether it's CMS or the broader community industry? Dr. Griffin.

DR. GRIFFIN: Just another mention of quantifying safety in these evidence reports, I think that's really important to always, just like when there's a clinical trial there needs to be a paragraph about the safety outcomes, so I think in these reports we really need to hear about safety.

DR. GOODMAN: Several people have raised that and you were one of the first, and that is, the panel would want to know a lot more about the risks as well as the benefits here, and whenever we look at the evidence we always want to look at the evidence on both and how, the tradeoffs, the balance between those. Point well made. Dr. Rao.

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DR. RAO: I just wanted to reinforce the outcome issue and to look at the World Health Organization. What we're trying to look at with cochlear implant is participation, the last level in community, so look at measures, and we've heard that maybe presurgical you have a mini-mental status and you look at the cognition, but I can't stress enough how important it is to look at all of the rehab measures that CMS requires of rehab. Some of these may very well be applicable to this population over time after the surgery.

DR. GOODMAN: Excellent point. Other points to be made on evidence gaps by our panel at this point? Okay, panel, just again, fair warning. Before we close, I'm going to ask each of you to say in a sentence or a bullet point the single most important aspect of evidence or gap in evidence that needs to be addressed to better inform Medicare and other decision-makers with regard to the adoption and use of cochlear implantation. That's going to be the closing question. Before we go to that, and I know that some of you have addressed it, I'm going to ask you to recap it. I'm also going to ask you not to repeat what somebody else said before you, so no dittos are going to be allowed, but you can elaborate or say more about a point if you would like. Before we do that, however, I want to make sure

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that our speakers today, who have been superb and highly informative, we very much appreciate this, if there's anything else that our speakers want to say about this issue, cochlear implantation, with regards to the evidence

questions or gaps in evidence, anything else that you want to have entered into the record for consideration, and it looks like Dr. Firszt is approaching the microphone.
DR. FIRSZT: Just a quick comment, that I think there would be a lot more information for you about safety if the TA had gone earlier than 2004, because a lot of the safety studies were covered very early in cochlear implantation.
DR. GOODMAN: Thank you. Other points to be made? Again, with regard to the cutoff time for the TA, I'm glad you raised that. The earlier examination of this by the Agency looked as carefully as it could at the evidence available to date, it found some evidence stronger than others. From 2005 forward it was looking for more evidence, and the TA as well as the questions today wanted to focus on those additional types of evidence, particularly for the ranges that were not looked at before. But Dr. Firszt, your point and the point of Dr. Griffin and Dr. Mushlin and others is very well taken, that time and budget permitting, which isn't always the case, this panel is making very clear that it wants to see

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the whole body of evidence and not just a partial one, to better inform its deliberations. I hope I captured that appropriately.
Any other comments by our invited speakers?
Okay. So no one can walk away and say they didn't have a chance. That's good.
All right. Starting with Dr. Rao, Dr. Rao, I know it's kind of hard to sum things up and integrate under the curve post four o'clock, and I know we're going to hear about it probably at about five in the morning, but Dr. Rao, in one sentence or one bullet point as we say, what's the single most important evidence gap or evidence need that you think needs to be addressed here?
Dr. Rao.
DR. RAO: Functional outcomes, the sequelae, where the recap is in what you're measuring.
DR. GOODMAN: Excellent point, thank you, sir.
Dr. Niparko.
DR. NIPARKO: The disability risks, general health effects and cost of hearing loss that is unaddressed.
DR. GOODMAN: Did you say and cost of hearing loss?
DR. NIPARKO: The cost of hearing loss that is unaddressed.

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DR. GOODMAN: Unaddressed, thank you for the point, thank you, sir. Dr. Raab.
DR. RAAB: I read a lot about the value of bilateral but I don't see quality metrics that reflect that value that's discussed.
DR. GOODMAN: Thank you for that point.

Dr. Steinbrook.
DR. STEINBROOK: Simply to include more patients in the less severe, the 40 to 60 range, so that the answers that should be there can be gotten.
DR. GOODMAN: Thank you, Dr. Steinbrook. Ms. Scorza.
MS. SCORZA: I think we need to identify safety measures and develop more precise and applicable outcome measures.
DR. GOODMAN: Excellent, thank you. Dr. Sacco.
DR. SACCO: Larger numbers in community settings with cognition measured.
DR. GOODMAN: Thank you very much. Dr. Mushlin.
DR. MUSHLIN: The problem as I see it isn't so much dependent variable, although I think the things that have been said are correct about the need to include other variables. The real issue is adequacy of data and study designs, a real call for taking advantage of coverage with evidence generation.

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DR. GOODMAN: Thank you, Dr. Mushlin.
Dr. Hartman-Stein.
DR. HARTMAN-STEIN: Perhaps more precise quality of life measures that include the caregiver's report.
DR. GOODMAN: A point taken before, but so glad you're underlining it. Dr. Griffin.
DR. GRIFFIN: I think in addition to the outcomes of efficacy and safety, we also need a better understanding of who's going to benefit and where is the unmet need, where are the people that should be getting these that aren't and how do we identify them.
DR. GOODMAN: Excellent, thank you. Dr. Chen.
DR. CHEN: The importance of looking at the selection criteria for patients for a cochlear implant, and the list includes financial burden, social support, as well as their other chronic diseases that they need to examine.
DR. GOODMAN: Great, thank you. Ms. Atkinson.
MS. ATKINSON: What's left? Seriously, everything's been covered other than we definitely need to include the Medicare population.
DR. GOODMAN: Excellent, thank you. Before I turn it back over to Dr. Rollins, just a few summary comments. I know that the body of evidence that we examined here today was not the universe of available

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evidence but it was quite a bit of it, and that large sample of available evidence we found largely in most instances to be insufficient, inadequate in many ways. And I think that the scoring illustrated the panel's impression that for most of these aspects of cochlear implantation the bodies of evidence are far from adequate. Now, we owe the Medicare beneficiary population much better in materials of evidence, and the "we" for the

"we owe" includes industry, providers, patient groups and payers, including CMS. We need a lot more input on research, research design. The researchers need to weigh in on what we can practically accomplish to provide the needed evidence. One of the great values of these MedCAC meetings, we hope, is to help look carefully at the evidence and use that process to identify evidence gaps, and this panel has done a superb job in doing that, and I won't go back over the long list of things we've identified as evidence gaps, they're quite apparent, and there was a large amount of consensus on what those are. So again, we owe the Medicare population much more. It's clear that this problem is prevalent and is going to increase, the incidence of this thing is going to go way up here, including to most of us who are baby boomers, if we haven't experienced it yet, we're about to. The technology is moving along at a pretty good clip, but

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technical wizardry no longer carries the day, the evidence does insofar as its impact on benefits and risks for the population that we care about. So we owe Medicare beneficiaries much more than what we've done, a lot of work needs to be done here, and this MedCAC panel has identified those evidence gaps quite clearly from a diverse set of experts. Thank you all very much. Thank you to the presenters, who did a superb job in laying out these issues and being able to answer questions on short notice. Thanks as well to the Tufts team that had the very difficult job in a relatively short period of time to try to learn from what's largely a sparse diffuse body of evidence. Thank you all. Back to you, Dr. Rollins.

DR. ROLLINS: Thanks, Cliff. I would like to thank the members of the MedCAC committee as well as the presenters, the speakers, and all the persons who participated in today's discussions. We learned a lot and that information will be reviewed, we will review the transcript and put strategies in place to try to achieve those goals.

And as I said earlier, there are three vehicles by which we can have the opportunity to review additional data, a CED which we talked about extensively this afternoon, the FDA category B IDE trials, as well as CMS

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clinical trials. So there are still opportunities to address this issue of expanding indications for our patients who do have this problem. So as I said, please contact us if you're interested in participating in studies so we can expand indications and do what's right for the Medicare population. Thank you.

DR. GOODMAN: The meeting is adjourned.

(Whereupon, the meeting adjourned at 4:14 p.m.)