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Hearing Loss and Speech Privacy in the Health Care Setting: A Case Study

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Abstract

Ensuring speech privacy has become an important consideration in the design of health care environments. The Healthcare Insurance Portability and Accountability Act requirements include the establishment of reasonable technical and procedural methods to protect patient privacy. However, specific standards for meeting speech privacy requirements are not currently established. This article presents a case study of two clinical environments, one where speech privacy was judged by health care workers to be adequate and one where speech privacy was judged to be inadequate. Careful study of both environments revealed three factors that led to the perception of inadequate speech privacy. First, sound attenuation between adjacent rooms was slightly poorer by 5 dB in the inadequate environments. Second, ambient noise levels were lower by 9 dB in the inadequate environment. Finally, geriatric patients with hearing loss prompted health care workers to increase their speech intensity, decrease language complexity, and decrease the speed at which speech was articulated. These factors made it more probable that speech was overheard and understood. Existing methods to calculate speech privacy in health care settings need to consider the effect of hearing loss on the acoustics of the oral communication transaction.

Key Words: Articulation index, Healthcare Insurance Portability and Accountability Act, privacy index, speech intelligibility index, speech privacy

Abbreviations: AI = articulation index; HIPAA = Healthcare Insurance Portability and Accountability Act; MAF = minimum audible field; PI = privacy index; SII = speech intelligibility index

Sumario

El aseguramiento de la privacidad para el lenguaje se ha convertido en una consideración importante en el diseño de ambiente de atención en salud.

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Los requisitos de la Ley de Responsabilidad y Portabilidad de Seguros de Salud incluyen el establecimiento de métodos técnicos y de procedimiento para proteger razonablemente la privacidad del paciente. Sin embargo, los estándares específicos para cumplir los requisitos de privacidad para el lenguaje no están actualmente establecidos. Este artículo presenta un estudio de caso de dos ambientes clínicos, uno donde la privacidad para el lenguaje se juzgó adecuada por parte de trabajadores de salud, y otro donde se consideró que la privacidad para el lenguaje era inadecuada. Un estudio cuidadoso de ambos ambientes reveló tres factores que condujeron a la percepción de una privacidad inadecuada para el lenguaje. Primero, la atenuación del sonido entre habitaciones adyacentes fue levemente menor de 5 dB para los ambientes inadecuados. Segundo, los niveles de ruido ambiental fueron 9 dB más bajos en el ambiente inadecuado. Finalmente, los pacientes geriátricos con hipoacusia pidieron al personal de salud que aumentaran la intensidad de su lenguaje, que disminuyeran la complejidad del mismo, y que disminuyeran la velocidad a la cuál se articulaba el lenguaje. Estos factores hicieron que fuera posible que el lenguaje se oyera y entendiera mejor. Los métodos actuales para calcular la privacidad en el lenguaje en establecimientos de salud deben considerar el efecto de la hipoacusia en la acústica de la transacción oral de la comunicación.

Palabras Clave: Índice de articulación, Ley de Responsabilidad y Portabilidad de Seguros de Salud, índice de privacidad, índice de inteligibilidad del lenguaje, privacidad para el lenguaje

Abreviaturas: AI = índice de articulación; HIPAA = Ley de Responsabilidad y Portabilidad de Seguros de Salud; MAF = campo audible mínimo; PI = índice de privacidad; SII = índice de inteligibilidad del lenguaje

Whatever I see or hear in the lives of my patients, whether in connection with my professional practice or not, which ought not to be spoken of outside, I will keep secret, as considering all such things to be private.

—Hippocratic oath

There is a long-held ethic in medicine to respect patient modesty and privacy. This follows from the moral principles of upholding human dignity, autonomy, and beneficence (Geiderman et al, 2006; Suter, 2006). Respecting privacy also builds an alliance between health care provider and patient. Patients may be more likely to seek health care services and more forthcoming in revealing potentially important information when they perceive that their privacy is protected. Finally, there are legal requirements and protections for patient confidentiality in health care relationships. Most recently, the Healthcare Insurance Portability and Accountability Act of 1996 (HIPAA) broadened and strengthened the requirement to protect patient health care information in electronic, paper, and oral forms. Under this act, health care providers became responsible for undertaking "reasonable technical and physical safeguards" to maintain patient privacy (Gunn et al, 2004). As a consequence, practitioners and health care agencies alike have established systems for keeping patient records secure, changed the way sign-in sheets are displayed, and modified business agreements with manufacturers, all to ensure that privileged health care information is not available to others.

One aspect of privacy that is quite important, but not often mentioned, is whether discussions between patients and health care providers can be overheard by others outside an examination room. This is the concept of "speech privacy" (Egan, 2007). When others can overhear and understand private conversations, HIPAA privacy standards may be violated. Inadvertently overhearing events in adjacent rooms may also distract physicians and patients. More important, the perceived lack of privacy may affect a patient's willingness to disclose clinically important information.

Research in the area of speech privacy has increased in recent years, with the effort being led by engineers and acousticians. This article will apply these engineering concepts in a problematic real-life health care setting with an added audiologic orientation by including the factor of hearing impairment.

THE PROBLEM

Privacy issues took on new meaning when physicians in a newly constructed clinic building began to complain about overhearing health-related discussions. The physicians specifically complained that they could hear parts of conversations being held in adjoining examination rooms and that examination room conversations could be understood from adjacent hallways.

The facilities engineering section at the clinic contacted an outside firm to evaluate the situation. This firm made acoustic measurements that assessed transmission loss through the walls and recommended some insulation treatments. However, the facilities manager was unsure of the relevance of these measurements and whether the recommended treatment would achieve the desired result. The problem was that the new construction met all existing guidelines, and the requirements for "speech privacy" implemented under HIPAA do not specify what construction standards would be considered "reasonable technical and physical safeguards." As a result, the facilities manager contacted audiologists at the Mayo Clinic Florida for help. We were asked if we could provide more meaningful information on what could be overheard in the new clinic and interpret our findings from a HIPAA perspective.

To begin, we toured the new examination rooms during and after clinic hours. In addition, we toured rooms in an older part of the clinic that physicians agreed had "subjectively acceptable" sound isolation between rooms. Three initial observations were made. First, the newer rooms lacked a heavy cherry paneling found in the older building. The paneling made the older "subjectively acceptable" rooms look dark but certainly contributed to the sound-attenuating characteristics of the walls. Second, the newer examination rooms seemed rather quiet, with very low ambient building noise levels—at least when no one was in the adjacent room. Finally, it was clear that the vast majority of patients visiting physicians in the newer examination rooms were elderly and hard of hearing.

From these initial observations, two possible challenges to speech privacy in the newer examination rooms became clear. First, it could be that the new rooms had poorer sound isolation. Second, hearing-impaired patients may stimulate health care providers to use louder and more clearly articulated speech, making it easier to overhear conversations in adjacent rooms. This was an intriguing possibility—one that was not considered in current standards for assessing speech privacy. This article reviews the approach that was taken to evaluate these privacy concerns and discusses the findings and how audiologic concepts contributed to the understanding of the issues.

BACKGROUND CONCEPTS

Articulation index methods have long been used in architectural acoustics to design workspaces in which occupants may communicate with minimal effort (Egan, 2007). The articulation index (AI) is a numeric value between 0 and 1 that reflects the amount of speech information available to a listener in a particular situation (American National Standards Institute [ANSI], 1969). Conceptually it is calculated as follows:

$$AI = \sum W_i * R_i,$$

where

W_i = the relative proportion of information in a measured bandwidth
R_i = the signal-to-noise ratio in the measured bandwidth

Lower AI values imply that less information is available in the speech signal received by the listener. Higher AI values imply that more information is available. It follows that as AI values approach 1, listeners will be better able to understand what was spoken. Most workplace settings are designed so that AI values of greater than 0.8 commonly occur in everyday listening situations.

Table 1. Relationship between Privacy Index Values and the Expected Confidentiality of Spoken Conversation

Privacy Level	Privacy Index	Description
Confidential Privacy	95% or better	Speech can be detected but not understood; less than 10% word and 5% sentence intelligibility.
Normal Privacy	80% to 95%	Effort is required to understand speech.
Transitional Privacy	60% to 80%	Speech is mostly understood and can be distracting.
No Privacy	less than 60%	Speech is clearly and effortlessly understood.

Note: Based on the American Society for Testing and Materials International's *ASTM E1374 Standard Guide for Open Office Acoustics* and the American National Standards Institute's *ANSI S3.5–1969* (1969).

To design workspaces where privacy is a requirement, the American Society for Testing and Measurement (ASTM) offers a privacy index (PI) calculation based on the AI (*ASTM E1130-02e1* [ASTM, 2002]). Briefly, the PI is defined as follows:

$$PI = (1 - AI) * 100$$

PI values approaching 100 percent imply that very little speech sound information is available to the listener and that it is very unlikely that conversation could be overheard and understood. In contrast, when privacy values approach 0 percent, conversations could be overheard effortlessly. Table 1 presents a description of the relative amounts of speech privacy associated with PI values.

Audiologists commonly use articulation index values to optimize hearing aid fittings and describe the listening capabilities of hearing-impaired listeners (Ching et al, 2001; Souza et al, 2007). However, the effects of hearing loss on communication interactions are seldom considered with architect-designed building spaces. Rather, both AI and PI calculations used in these applications assume excellent hearing (0 dB HL) for all listeners. Consequently, PI calculations contemplate normal or raised talker vocal effort. However, when a health care provider encounters a hearing-impaired patient with moderate-to-severe hearing loss, the first objective is to facilitate patient understanding. As a result, speaking patterns may be altered to be more audible (greater intensity from higher vocal effort) and more intelligible (spoken at a slower rate with more precise articulation). While these changes in speech production may facilitate enhanced patient understanding, an inadvertent result may be that others overhear the conversation. It was decided that changes in speech production would have to be considered in any calculation of speech privacy in our situation.

METHOD AND RESULTS

Two different clinic areas were evaluated. In one area, physicians judged the sound isolation in the examination rooms to be "subjectively acceptable." That is, conversations from adjacent exam rooms were seldom overheard, understood, or distracting. The newly constructed clinic area with the problematic examination rooms was also studied. Rooms in this area were judged to be "subjectively unacceptable," meaning that conversations from adjacent exam rooms could be overheard, could be understood (with some effort), and were distracting.

In each clinical area, one examination room was selected randomly. The examination rooms in each area had similar layouts, as shown in Figure 1. Three listener positions were defined. Position "A" represents the location where a patient, the primary listener, would be sitting during the clinical interview and discussion. Positions "B" and "C" would be locations where others might overhear the physician's comments. For the purposes of this simulation, we focused on how well the physician's utterances could be overheard. However, inspection of Figure 1 would suggest that the patient's utterances might be overheard in the adjacent room (position "B") due to the closer physical proximity of the speaker and the "overhearing" listener.

In each examination room, transmission loss was calculated in 1/3-octave bands using a speech spectrum noise (Frye FP 40-D real-ear analyzer) as the signal. Measurements were made with a precision sound-level meter (Larson Davis Laboratories, model 800B) at positions "B" and "C" in Figure 1. The transmission loss was calculated from the physician's chair to listening positions "B" and "C" in each room.

Up to this point, the procedure was identical to that described in *ASTM E1130-02e1*. It was then assumed that the listener in position "A" required speech spoken at one of four different vocal intensities: normal, raised, loud, and shout, as provided for by "S3—Bioacoustics" in *ANSI S3.5–1997* (ANSI, 1997). This modification does not follow the ASTM standard. It was reasoned that all four vocal intensities might be required in day-to-day clinic operations because it was not unusual for patients with hearing impairment to be present without hearing aids. This assumption was confirmed through informal interviews with health care staff working in this area. Moreover, in some cases, patients may also have co-occurring cognitive impairments, necessitating health care workers to use simple language structures to communicate.

Beyond this modification, the ASTM standard was followed. The calculated transmission loss for positions "B" and "C" in each room was subtracted from the

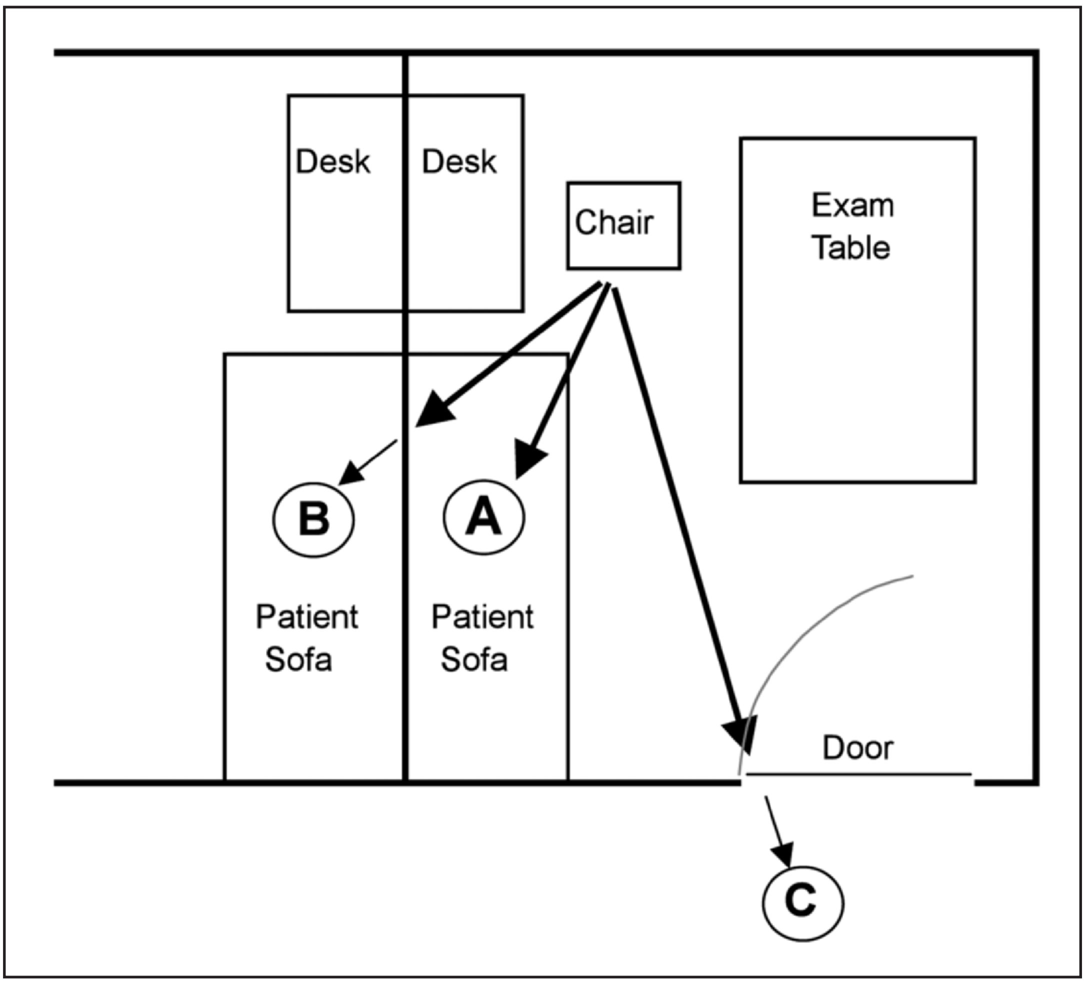

Figure 1. Prototypical layout of "subjectively acceptable" and "subjectively unacceptable" examination rooms. The physician would be sitting in the chair talking to the patient in position "A." A waiting patient would typically be in position "B." Someone walking down the hallway might be in position "C" (a position in the center of the hall and centered in the path from the physician's chair through the center of the closed door). The level of the physician's speech in any 1/3-octave band is determined by the distance between speaker and primary listener (as in "A") and transmission loss afforded by the wall (position "B") or the closed door ("C"). Transmission loss measurements were taken with the sound source in the physician's chair and the sound-level meter at positions "B" and "C" for both examination rooms studied.

speech spectrum associated with each of these four vocal efforts. The results are shown in Figure 2 for the "subjectively acceptable" and "subjectively unacceptable" examination rooms.

AI and PI values were then calculated according to the ASTM standard for speech spoken at each of the four different vocal efforts at positions "B" and "C" for each room. The calculated PI values for rooms adjacent to the examination rooms (position "B") are summarized in Table 2.

For the measurements taken in the subjectively acceptable area, the ASTM standard would suggest "normal privacy" exists, as the PI of 88 percent for normal vocal effort and excellent hearing falls in the normal privacy range of 80–95 percent. This means that effort would be required to understand speech spoken in the adjacent room with normal or raised vocal effort. Further, overheard conversations might not be distracting. In contrast, in the subjectively unacceptable area, privacy would be classified as "transitional privacy," as the PI of 67 percent for normal vocal effort and excellent hearing falls in the transitional privacy range of 60–80 percent. This would mean that conversations occurring in the adjacent room would be considered distracting and would be largely understood with just modest listening effort. At this point, the measurements made according to the ASTM standard confirmed the physicians' subjective impressions of inadequate privacy offered in the newer examination rooms. Even in the acceptable room, however, the criterion for "confidential privacy," as defined in the ASTM standard, was not met.

The Effect of Hearing Loss on Speech Privacy Calculations

All listeners might not agree with the conclusions based on the above PI values. The ASTM standard assumes excellent hearing on the part of the listener—that

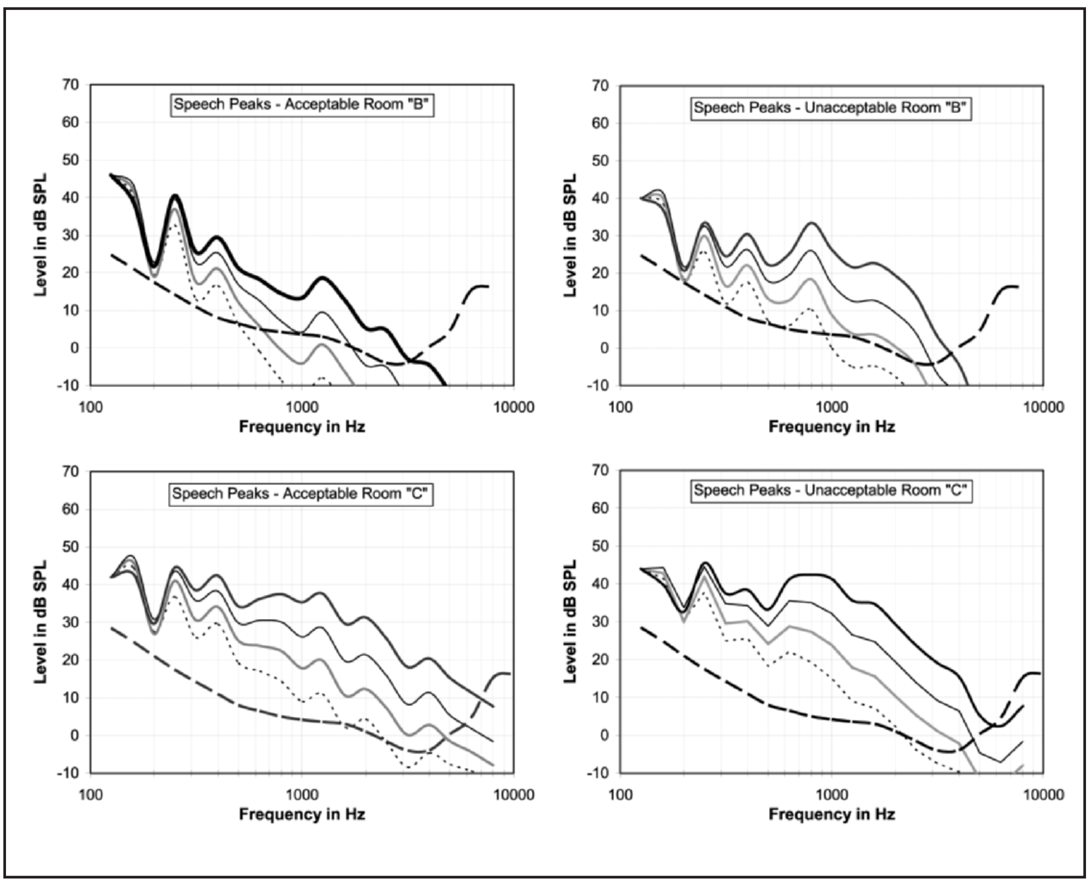

Figure 2. Speech peaks for four vocal efforts ("normal," "raised," "loud," and "shout": dotted, light, heavy, and thick gray lines, respectively), at positions "B" and "C" for subjectively acceptable rooms (left column) and subjectively unacceptable rooms (right column). Minimum audible field curve is superimposed for reference purposes. A 15 dB pad was added to the estimated long-term speech spectrum to represent the speech peaks, as provided for in ANSI S3.5 (ANSI, 1997). Fewer speech peaks are audible in the subjectively acceptable room position "B."

is, all listeners have pure-tone thresholds of 0 dB HL. If instead of excellent hearing, it was assumed that listeners have "average" normal hearing (which we defined as a pure-tone average of 12.5 dB HL, the midpoint of the typically assumed normal range of 0–25 dB HL), "normal speech privacy" would exist in the subjectively acceptable and unacceptable examination rooms. That is, speech would probably not be understood from the adjacent room, at least with normal levels of vocal effort.

By assuming greater levels of hearing loss, speech privacy improves. If all "overhearing" listeners had a "borderline" hearing loss (which we defined as a pure-tone threshold of 25 dB HL) or greater, "confidential speech privacy" would occur in both listening settings. So, not surprisingly, the presence of hearing loss in the "overhearing" listener at position "B" has a positive effect on speech privacy.

Estimating speech privacy becomes more complicated when one assumes the listener in position "A" has a hearing loss or other difficulty understanding speech. The resulting increase in the vocal effort of the speaker adversely affects speech privacy. Virtually no room offered better than "transitional speech privacy" when speech was spoken at loud or shout levels of vocal effort—at least not without some hearing loss assumed on the part of the overhearing listener. Loud speech could certainly commonly occur when a health care worker is speaking to a patient with hearing impairment. Speech privacy in this situation simply does not occur.

The situation for overhearing private conversations in the hallways adjacent to each examination room was more problematic, as shown in Table 3. Confidential speech privacy was not accomplished in either location as there are no PI values 95 percent or higher. In the subjectively acceptable area, "normal" speech privacy was achieved with normal vocal effort under the ASTM standard. No speech privacy is offered under the ASTM standard when raised vocal effort was used in either location. Again, if some hearing loss is assumed for the overhearing listener, speech privacy index values improve. Listeners with pure-tone averages greater than 25 dB HL would probably not understand conversations in adjacent hallways when normal vocal efforts are used. However, with increased vocal effort, speech privacy deteriorates.

To estimate what the speech privacy values might represent in terms of understanding short passages of conversational discourse, the speech intelligibility index, or SII (ANSI, 1997), was used to estimate the percentage of intelligibility of speech in each listening situation. These results are summarized in Tables 4 and 5. Recall that the ASTM standard assumes that confidential privacy occurs when sentence intelligibility is less the 5 percent. This standard is based on the *ANSI S3.5–1969* calculation of the AI. Our calculations suggest that confidential speech privacy occurred when less than 3 percent of conversational discourse could be understood at the listener's location using the *ANSI S3.5–1997* calculation.

Table 2. Privacy Index Values in Rooms Adjacent to the Examination Room (Position "B"), in the Areas Where Speech Privacy Was "Subjectively Acceptable" and "Subjectively Unacceptable"

Listener Hearing Acuity	Subjectively Acceptable Area Vocal Effort				Subjectively Unacceptable Area Vocal Effort			
	Normal	Raised	Loud	Shout	Normal	Raised	Loud	Shout
Excellent	88%	76%	58%	40%	67%	51%	34%	25%
Normal	89%	84%	73%	57%	84%	72%	56%	41%
Borderline	95%	93%	91%	86%	97%	94%	87%	74%
Slight–Mild Loss	97%	96%	95%	94%	99%	97%	94%	85%

Note: Results are stratified by speaker vocal effort and listener hearing level: "Excellent" = 0 dB HL pure-tone thresholds; "Normal" = 12.5 dB HL pure-tone thresholds; "Borderline" = 25 dB HL pure-tone thresholds; and "Slight–Mild Loss" = 30 dB HL pure-tone thresholds. Privacy index (PI) values greater than or equal to 95% (dark shading) are considered to offer "confidential" privacy. PI values less than 80% (light shading) offer transitional or no privacy. The values that fall between the two are in the 80–94% range and are classified as normal privacy.

Table 3. Privacy Index Values in Hallways Adjacent to the Examination Room (Position "C"), in Areas Where Speech Privacy Was "Subjectively Acceptable" and "Subjectively Unacceptable"

Listener Hearing Acuity	Subjectively Acceptable Area Vocal Effort				Subjectively Unacceptable Area Vocal Effort			
	Normal	Raised	Loud	Shout	Normal	Raised	Loud	Shout
Excellent	80%	60%	39%	20%	59%	41%	23%	14%
Normal	81%	62%	42%	24%	67%	50%	32%	21%
Borderline	88%	77%	58%	40%	86%	75%	57%	41%
Slight–Mild Loss	94%	88%	72%	55%	94%	86%	71%	55%

Note: Results are stratified by speaker vocal effort and listener hearing level: "Excellent" = 0 dB HL pure-tone thresholds; "Normal" = 12.5 dB HL pure-tone thresholds; "Borderline" = 25 dB HL pure-tone thresholds; and "Slight–Mild Loss" = 30 dB HL pure-tone thresholds. The shaded areas represent privacy index (PI) values less than 80% and fall into the transitional privacy and no privacy categories. The unshaded values fall in the normal privacy category (PI of 80–95%). There were no values in the confidential privacy category (PI of 95% or higher).

Table 4. Estimated Percentage of Continuous Discourse Understood by Listeners in Rooms Adjacent to the Examination Room (Position "B"), in Areas Where Speech Privacy Was "Subjectively Acceptable" and "Subjectively Unacceptable"

Listener Hearing Acuity	Subjectively Acceptable Area Vocal Effort				Subjectively Unacceptable Area Vocal Effort			
	Normal	Raised	Loud	Shout	Normal	Raised	Loud	Shout
Excellent	9%	23%	44%	67%	32%	51%	71%	84%
Normal	7%	12%	25%	46%	11%	25%	44%	65%
Borderline	1%	3%	5%	12%	1%	3%	11%	29%
Slight–Mild Loss	1%	1%	2%	4%	0%	1%	4%	16%

Note: "Excellent" = 0 dB HL pure-tone thresholds; "Normal" = 12.5 dB HL pure-tone thresholds; "Borderline" = 25 dB HL pure-tone thresholds; and "Slight–Mild Loss" = 30 dB HL pure-tone thresholds. Dark shading indicates less than 3% and confidential privacy. Lightly shaded values fall in the transitional privacy and no privacy categories. Values in between fall in the normal privacy category. Calculations are based on speech intelligibility index values, following the American National Standards Institute's *ANSI S3.5–1997* (1997).

Table 5. Estimated Percentage of Continuous Discourse Understood by Listeners in the Hallway Adjacent to the Examination Room (Position "C"), in Areas Where Speech Privacy Was "Subjectively Acceptable" and "Subjectively Unacceptable"

Listener Hearing Acuity	Subjectively Acceptable Area Vocal Effort				Subjectively Unacceptable Area Vocal Effort			
	Normal	Raised	Loud	Shout	Normal	Raised	Loud	Shout
Excellent	17%	40%	63%	85%	41%	63%	82%	90%
Normal	17%	39%	62%	83%	32%	53%	73%	87%
Borderline	8%	21%	43%	66%	10%	23%	44%	66%
Slight–Mild Loss	3%	10%	28%	51%	3%	12%	29%	51%

Note: "Excellent" = 0 dB HL pure-tone thresholds; "Normal" = 12.5 dB HL pure-tone thresholds; "Borderline" = 25 dB HL pure-tone thresholds; and "Slight–Mild Loss" = 30 dB HL pure-tone thresholds. Shaded values fall in the transitional privacy and no privacy categories. Unshaded values fall in the normal privacy category. There were no values in the confidential privacy category. Calculations are based on speech intelligibility index values, following the American National Standards Institute's *ANSI S3.5–1997* (1997).

The values in Tables 4 and 5 reveal the threat to privacy that may occur when room acoustics are not optimal. In the subjectively unacceptable room, persons with 0 dB HL thresholds should be able to understand 32 percent of sentence-based utterances occurring in the adjacent room when the speaker is using normal vocal effort. Understanding increases to 51 percent with raised vocal effort. These results imply that routine conversations could be overheard and understood when listeners have excellent hearing.

In contrast, in the subjectively acceptable area, a listener with excellent hearing should only be able to understand 9 percent of the ongoing conversation when normal vocal effort is used, which is classified as "normal" privacy. Even here, however, speech understanding could increase to 23 percent when the speaker in the adjacent room raises his or her voice by as little as 6 dB (raised vocal effort). This degree of level change could certainly occur when speaking to a hearing-impaired patient. It may also occur as a result of changes in the emotional content of the spoken utterance. It follows that the very parts of the speech message that would be considered most worthy of privacy may be more accessible for someone to overhear even in rooms that subjectively appear to provide acceptable speech privacy.

So why do physicians not perceive a privacy problem in subjectively acceptable rooms? In part, the answer may be found in Figure 3. In this figure, the noise floors measured in the acceptable and unacceptable rooms are displayed along with the minimum audible field curve and the average speech spectrum from the ANSI standard. The ambient mechanical noise in the examination rooms will have the effect of elevating the hearing thresholds of patients with excellent or "normal" hearing. The noise levels were higher in the subjectively acceptable rooms by about 9 dB, with critical noise peaks in the speech range. The effect was smaller in the subjectively unacceptable room, although even there, the noise floor was over 10 dB above the minimum audible field curve in the speech range. In effect, listeners with excellent hearing probably perceived speech from adjacent rooms as if they had "normal" hearing. The masking effect would be slightly greater in the subjectively acceptable room. The result is that when normal or raised local effort is used in the subjectively acceptable room, the achieved speech privacy is at or just below "confidential" levels. The irony is that the effort undertaken to make the newer examination rooms free of mechanical ambient noise (largely from air-conditioning) actually decreased speech privacy.

DISCUSSION

There is currently a great deal of research in the area of speech privacy, in part due to increasing scrutiny of health care privacy issues in the information age. In this regard, HIPAA is an important step forward but is by no way definitive in defining what is acceptable speech privacy. Our experiences demonstrate the complexity of determining how much sound isolation is adequate for establishing speech privacy in a medical setting. Subjectively, a quieter room would appear to offer more intimacy and speech privacy. Thus an effort to decrease mechanical noise in examination rooms is a worthy goal. However, in our example, the effort to decrease ambient noise contributed to decreased speech privacy. It is already well established that the amount of transmission loss between rooms and ambient noise floors both affect the audibility of speech sounds that may be overheard in adjacent rooms. In our example, the difference in transmission loss

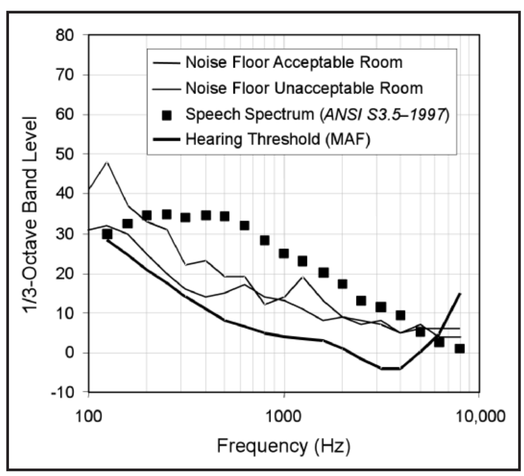

Figure 3. Comparison of noise floors in subjectively acceptable and unacceptable rooms. Noise floor overall level in the acceptable room was 35 dBA. In the unacceptable room the noise floor overall level was 26 dBA. Minimum audible field (MAF) curves have been superimposed for reference purposes.

between the subjectively acceptable and subjectively unacceptable rooms was only 5 dB. However, changing the transmission characteristics of the walls by 5 dB would not completely equate acceptable and unacceptable rooms. The higher noise floor in the subjectively acceptable room decreased the overall signal-to-noise ratio for overheard speech by an additional 9 dB. It was the combination of sound isolation and ambient noise that produced speech privacy.

At some point, building walls with desirable sound-attenuation characteristics through the speech range may become cost prohibitive. The current ASTM standard allows for the use of noise masking when sound isolation between rooms is not adequate or not possible—as in open-space office plans. Thus two obvious solutions to the exam room problem would be to improve the sound isolation in the examination rooms and simultaneously increase the ambient noise floors in the rooms, perhaps through low levels of white noise or other pleasant sounds.

The hallway situations are more problematic from an acoustic point of view but perhaps easier to manage. There is no real reason for anyone to loiter in the hallways. So by controlling patient access to hallways, greater levels of privacy may be afforded. Ambient masking sounds might also be helpful. Doors with better sound-attenuating characteristics would also help.

These modifications become expensive, particularly when newly built rooms must be retrofit to exceed current building codes. This leads to the important issue of what level of privacy should exist in a health care setting and when safeguards are "reasonable." To some extent, this has been treated in the past based on cultural expectations. Consider, for example, the situation of talking to a patient in an open intensive care unit where only privacy curtains separate patients. Actively listening to a private conversation in this setting would not be considered socially appropriate. Conversation participants would most probably expect others to "actively ignore" the discussion. We would like to think that, in general, most listeners would not try to overhear a confidential conversation because they share a sense of modesty and desire for privacy. Hopefully this is the case whether accessible conversations occur at an adjacent restaurant table or in the adjacent examination room. Yet how can we be sure? A listener who does actively "eavesdrop" would not likely acknowledge it openly due to the social taboo.

Intentionally listening to overhear private conversations certainly does occur. Health care organizations that rely on the ethics of patients to "not listen" are not taking reasonable precautions to protect patient modesty and privacy. Hence the HIPPA statute, although vague in the specifics, clearly asserts that physical and not cultural boundaries define speech privacy.

It is possible to build examination rooms with psychologically acceptable levels of sound isolation and speech privacy, as suggested by our physicians' judgment that some rooms were subjectively acceptable. However, subjective judgments remain based on cultural expectations. Even in subjectively acceptable rooms there can be privacy issues if the speaker is using a raised voice and the listener in an adjacent room has good hearing. The amount of sound isolation required to make well-articulated, loud speech inaudible to the normally hearing listener in an adjacent room may be prohibitively costly. Similarly, adding over 30 dB of noise might create sufficient masking but may well be disruptive to conversations with patients who have normal hearing and may be distracting for health care workers. With this in mind, one suggestion we made was to consider making simple assistive listening devices (such as a generic personal amplifier) available to patients present with communicatively significant hearing loss. An assistive listening device would allow the health care provider to use a normal level of speech, thus decreasing the amount of sound that invades the adjacent room or hallway. This is a simple application of how an audiologic perspective can contribute positively to a larger health care problem.

However, the larger issue brought to focus by this article is that currently evolving speech privacy standards do not consider the effects of hearing loss and cognitive impairment on the acoustics of everyday communicative interactions. Speech that is linguistically simple, well articulated, and presented with greater levels of vocal effort commonly occurs in some health care settings. To be valid, methods that seek to quantify speech privacy for HIPAA purposes must take into account changes in speech production and linguistic complexity where hearing or cognitively impaired patients seek medical treatment.

The study of speech privacy is flourishing. At the time of this writing, the current ASTM standard for objectively determining speech privacy is *ASTM E1130-02e1* (2002). This standard uses an older method for calculating the articulation index (ANSI, 1969). An updated version using the current ANSI standard for the SII (ANSI, 1997) is currently in review (ASTM, 2007). There are small calculation differences in the amount of speech privacy afforded by the two different methods of calculating the AI. The measurements described in this article conformed to the current ASTM standard when calculating privacy index values. However, the SII was used to estimate the percent of speech understanding of continuous discourse. Both of these methods may underestimate the intelligibility of speech at low intensity levels or poor signal-to-noise ratios (Gover and Bradley, 2004). As a consequence, alternative methods for characterizing speech privacy have been developed at the Canadian National Research Council. Bradley and Gover (2006) offer an excellent review of these methods. Nevertheless, we have not found a method that explicitly addresses the acoustic changes in spoken communication that occur when a health care provider is talking to a hearing-impaired patient. Since hearing impairment is a common physical problem, evolving concepts of health-care-related speech privacy must consider the effects of hearing loss on the acoustics of everyday communication transactions.

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