Applicability of Telemedicine for Assessing Patients With Schizophrenia: Acceptance and Reliability

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Background: Telemedicine holds promise for providing expert psychiatric consultation to underserved populations, but has not been quantitatively studied in schizophrenia or any other major mental disorder. This study was conducted to assess the reliability and acceptance of videoconferencing equipment in the assessment of patients with schizophrenia.

Method: We assessed reliability of the Brief Psychiatric Rating Scale (BPRS), Scale for the Assessment of Positive Symptoms (SAPS), and Scale for the Assessment of Negative Symptoms (SANS) under three conditions: (1) in person, (2) by videoconferencing at low (128 kilobits per second [kbs]) bandwidth, (3) by videoconferencing at high (384 kbs) bandwidth. All 45 patients met DSM-IV criteria for schizophrenia. All patients and the two interviewers rated various aspects of the study interviews against previous live psychiatric interviews.

Results: Total scores on both the BPRS and SAPS were assessed equally reliably by the three media. Total score on the SANS was less reliably assessed at the low bandwidth, as were several specific negative symptoms of schizophrenia that depend heavily on nonverbal cues. Video interviews were well accepted by patients in both groups, although patients in the high bandwidth group were more likely to prefer the video interview to a live interview.

Conclusion: Global severity of schizophrenia and overall severity of positive symptoms were reliably assessed by videoconferencing technology. Higher bandwidth resulted in more reliable assessment of negative symptoms and was preferred over low bandwidth, although patients' and raters' acceptance of video was good in both conditions. Videoconsultation appears to be a reliable method of assessing schizophrenic patients in remote locations who have limited access to expert consultation.

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Telemedicine is the delivery of health care via telecommunications technology, especially by the use of videoconferencing, to address problems in geographical areas in which distance or maldistribution of resources precludes access to high quality health care.[1–5] Although this technology has been available in mental health care for more than 4 decades, today it remains rarely used for assessment or treatment of psychiatric disorders.[5]

With economic pressures to provide high quality psychiatric care at low cost, especially in remote areas, interest in videoconsulting has recently been revived.[4] Yet, to date, only a handful of studies have assessed the clinical effectiveness of this technology in a quantitative and rigorous manner in well-characterized psychiatric patients.[2,6–8] Baer et al.[7] recently demonstrated excellent reliability and acceptance of this method with a group of patients with obsessive-compulsive disorder (OCD), a DSM-IV anxiety disorder. Although there are anecdotal reports of the usefulness and acceptability of telemedicine among patients with psychotic disorders,[2,8,9] there have been no quantitative studies among such carefully diagnosed populations.[5]

If telemedicine methods are to be successful in reaching currently underserved populations in mental health, their reliability and acceptance among patients with major psychiatric disorders must be adequately demonstrated. We therefore conducted a study of patients with well-characterized DSM-IV schizophrenia to determine the reliability and acceptability of telemedicine at various levels of video image quality, as compared with live simultaneous interviews. Our major research question was whether video assessments of schizophrenic patients are comparable in reliability with live interviews. A second important technical question was whether the movement-detection of the lower bandwidth (128 kilobits per second [kbs]) provides sufficient reliability for both positive and

negative psychotic symptoms of schizophrenia, or whether higher (384 kbs or more) and more expensive bandwidth is required to obtain sufficiently reliable and satisfactory results.

METHOD

The reliability testing paradigm developed by Baer et al.[7] to assess agreement among the rating conditions was used. In this paradigm, reliability is first established by using the standard simultaneous face-to-face interview technique as a baseline. In the video interviews, one rater at the remote site asks assessment questions of the patient via videoconferencing equipment, while the other rater sits at the local site along with the patient. Both raters score the patient's responses, and any significant decrement in their agreement index (as measured by the intraclass correlation coefficient) is attributed to loss of information in the telecommunication medium.[7]

Procedure

Forty-five subjects meeting DSM-IV criteria for schizophrenia were recruited from inpatient and partial hospitalization units of the Bipolar and Psychotic Disorders Program at McLean Hospital, Belmont, Mass., and all provided written consent to participate in this study. First, reliability was established in live simultaneous interviews with 15 patients for the Brief Psychiatric Rating Scale (BPRS),[10] the Scale for the Assessment of Positive Symptoms (SAPS),[11] and the Scale for the Assessment of Negative Symptoms (SANS)[12] (Live group). Then, to assess reliability of the videoconsulting method, the remaining 30 patients were interviewed and rated on these same three instruments using video technology. The lower transmission bandwidth of 128 kbs was used for one experimental group (N = 15) (Low group), while the second experimental group (N = 15) was interviewed at the higher 384-kbs bandwidth (High group).* The greater the bandwidth, the more information transmitted and the better the image quality obtained in the videoconference, especially when movement is present. In addition, evaluation and satisfaction questionnaires were filled out immediately after each interview by the patient and the raters in which they were asked to rate various aspects of the interview on a 5-point scale (ranging from "much below average" to "much better than average"), as compared with their previous experience of live psychiatric interviews (one patient in the High group did not complete these questions).

Equipment

Two PictureTel 4000 Model 400 units (PictureTel Inc., Danvers, Mass.) were located at Harvard-affiliated hospitals (McLean Hospital and Massachusetts General Hospital), separated by approximately 20 miles. The public telephone network's Integrated Systems Digital Network (ISDN) telephone lines were used to establish dial-up connections between the two sites. The system's video input device consisted of a digital camera that has both near and far end controls with scanning and zooming capabilities. The video output device was a 27-inch color television monitor. The system contains a "picture in the picture" feature in which the image of the person on the far side occupies most of the screen but the participant's own image also appears in a window at the bottom of the screen. The window feature was disabled for these interviews, on the basis of our experience that patients are typically uncomfortable seeing themselves on the screen. A videocassette recorder (VCR) allowed the recording of each session. The audio input-output equipment consisted of a high quality microphone and speaker built into the control keyboard.

RESULTS

No significant differences existed among the groups of patients evaluated with regard to demographic and patient characteristics. The mean ± SD age in years of the patients was 39.9 ± 12.4, 40.0 ± 14.3, and 37.3 ± 6.5 for the Live, Low, and High groups, respectively. The number of men was 60% in the Live and Low groups and 53% in the High group (N.S.). Mean BPRS total scores were 29.2 ± 9.0, 31.3 ± 8.0, and 32.7 ± 10.5 for the Live, Low, and High groups, respectively.

Intraclass correlation coefficients for assessments among the various media are summarized in Table 1.

A majority of patients rated all aspects of the videoconsultation experience as "above average" in comparison with past live interview experience, with no significant differences between the Low and High groups.

Patients in the 384-kbs bandwidth (High) group (9/13, 69.2%) were more likely to prefer the video experience to live interview than patients in the 128-kbs bandwidth (Low) group (5/14, 35.7%) ($\chi^2 = 3.0$, df = 1, p = .08). One patient in each group reported preference for paper-and-pencil assessment.

Raters administering each set of scales also were asked to compare the video experience (128 and 384 kbs) with a typical live interview in terms of comfort, ease of express-

*In the course of digital videoconferencing, the image is compressed, transmitted, and decompressed. Image quality is a function of the correctness of the algorithm used for the compression-decompression processing and of the availability of bandwidth, which is essentially transmission capacity in a unit of time. In this work, the PictureTel SG3 proprietary algorithm was used for image processing. Three discrete bandwidths were available: 128 kbs, 256 kbs, and 384 kbs representing connection made by one, two, or three ISDN lines, respectively. Naturally, best image quality may be obtained using 384-kbs bandwidth; this is also the most expensive connection.

Table 1. Comparison of Agreement by Intraclass Correlation Among Various Media Used to Assess Schizophrenic Symptoms of a Variety of Rating Scales

Rating Scale	Assessment Medium for Each Group		
	In-Person vs. In-Person (Live)[a]	Remote Video @ 128 kbs vs. In-Person (Low)[a]	Remote Video @ 384 kbs vs. In-Person (High)[a]
Brief Psychiatric Rating Scale	.96	.84	.90
Symptom 1-Somatic Concerns	.78	.94	.61
Symptom 2-Anxiety	.93	.87	.92
Symptom 3-Emotional Withdrawal	.01	.46	.54
Symptom 4-Conceptual	.82	.79	.89
Symptom 5-Guilt Feelings	.87	.74	.93
Symptom 6-Tension	.65	.21	.05[c]
Symptom 7-Mannerisms and Posturing	…[b]	.68	…[b]
Symptom 8-Grandiosity	.89	.76	.80
Symptom 9-Depressive Mood	.90	.92	.89
Symptom 10-Hostility	…[b]	.67	.50
Symptom 11-Suspiciousness	.89	.53[c]	.81
Symptom 12-Hallucinatory Experience	.77	.94	.84
Symptom 13-Motor Retardation	.76	.51	.75
Symptom 14-Uncooperativeness	.80	.01[d]	.71
Symptom 15-Unusual Thought Content	.19	.51	.86
Symptom 16-Blunted Affect	.82	.68	.60
Symptom 17-Excitement	.95	…[b]	.85
Symptom 18-Disorientation	.77	.07[c]	…[b]
Scale for Assessment of Positive Symptoms	.94	.97	.97
Hallucinations subscale	.91	.99	.98
Delusions subscale	.96	.97	.93
Bizarre behavior subscale	.69	.25	.30
Positive formal thought disorder subscale	.95	.88	.74[c]
Scale for Assessment of Negative Symptoms	.92	.67[c]	.85
Affective flattening or blunting subscale	.93	.53[d]	.67[c]
Alogia subscale	.58	.34	.23
Avolition or apathy subscale	.90	.50[c]	.85
Anhedonia-asociality subscale	.90	.82	.77
Attention subscale	.95	.80[c]	.93

[a]N per group = 15.
[b]Unable to calculate intraclass correlation due to zero variance in one or both groups.
[c]Intraclass correlation is significantly lower than that for "In-Person vs. In-Person" condition ($p < .05$ by Z-test, one-tailed).
[d]Intraclass correlation is significantly lower than that for "In-Person vs. In-Person" condition ($p < .01$ by Z-test, one-tailed).

ing one's self, and usefulness; in all cases, mean scores were either "average" or "above average."

DISCUSSION

We compared in a systematic, controlled manner the reliability of remote video assessments to that of live interviews with schizophrenic patients and found that in-person interviews, remote video at 128 kbs, and remote video at 384 kbs were equally reliable in assessing both global severity of schizophrenia and a summary score of positive symptoms of schizophrenia. However, assessment of a summary score of negative symptoms of schizophrenia was less reliable at 128 kbs (Low group) than for either of the Live or High groups. In addition, assessment of specific subscales of both positive and negative symptoms was less reliable with video assessment when nonverbal cues were required to rate the item or symptom, as is the case for most negative symptoms of schizophrenia (SANS total, affective blunting, avolition-apathy, and attention subscales). By comparison, our previous research[7] with patients with obsessive-compulsive disorder assessed at 128 kbs found near perfect reliability (i.e., intraclass correlation of .99) for both video and in-person agreement on the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS), which is primarily rated by verbal information. We think that the higher reliability for the Y-BOCS scale is very likely attributed to its total reliance on verbal report for scoring questions, whereas the schizophrenia scales relied on both verbal reports and observation.

Advantages of the lower bandwidth of 128 kbs include lower transmission costs, reduced equipment size, simplicity of operation, and easy interface with computers.[4] However, its major disadvantage is that at low transmission rates (128 kbs) shadowy "echoes" can appear during movement of the subject, due to limited image processing capabilities. This may explain why negative symptoms were assessed less reliably at this bandwidth; it is possible that movement artifact in the image was misinterpreted as slowed movements indicative of motor slowing. Positive symptoms of schizophrenia, on the other hand, are largely dependent on verbal responses and can apparently be reliably assessed at this bandwidth. However, the distinction

between information gathered by observation and verbal report in schizophrenia is not clear and requires further investigation.

Improved reliability with the higher 384-kbs bandwidth supports this hypothesis; at the higher 384-kbs bandwidth, motion "echoes" are much less noticeable, so less information is lost. To further examine this hypothesis, a sample of interviews was rerated using only their audio track; we found that subscales relying mainly on verbal information could be rated with reliability comparable with that of the video and live assessments, while those subscales found to have poorer reliability at the 128-kbs bandwidth also yielded lower reliability estimates with the audio alone rating (i.e., SANS total, attention subscale).

In summary, selection of a videoconsulting system and bandwidth will depend on several factors: (1) Systems using the higher 384-kbs bandwidth are more likely to be accepted by the patients owing to reduced movement artifact and may provide more reliable assessment of specific psychiatric symptoms, especially those involving movement disorders and nonverbal cues; these systems are more expensive in equipment and transmission costs. (2) Systems using the lower 128-kbs bandwidth appear to support assessment of global severity of serious psychiatric illness, but insufficient reliability for fine-grained analysis of symptoms involving movement disorder or other motor movements, and lower, but still acceptable patient comfort with the medium; these systems are lower in equipment and transmission costs. In the case of underserved populations, the use of 128-kbs video and the resulting reliable global assessment can represent a significant improvement in mental health care delivery. Acceptance of the assessment medium was good for both conditions, and 14 (51.8%) of the 27 patients with schizophrenia reported preferring the video interview to a live interview. Approximately one third of schizophrenic patients (35.7%) assessed at the 128-kbs (Low) bandwidth preferred the video interview to a live interview, a proportion almost identical to the 2 (33.3%) of 6 OCD patients who preferred the video interview.[7] In addition, on all questions regarding the video experience, the schizophrenic patients reported equal or more positive experiences compared with responses of our previous sample of OCD patients. These findings suggest that acceptance of the technology may be similar across psychiatric disorders.

Further studies are needed to confirm our findings. Future research with psychiatric populations should evaluate the use of structured clinical diagnostic interviews, consultations, and the use of this technology for differential diagnosis. Specifically, our results are generalizable only to the situation when the diagnosis of schizophrenia has already been established prior to the telemedicine evaluation; future research will be required to assess the reliability of telemedicine evaluation compared with in-person assessment for establishing the diagnosis of schizophrenia when the patient's diagnosis is not previously known.

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