REVIEW ARTICLE

PSYCHIATRIC COMPUTER INTERVIEWS: HOW PRECISE, RELIABLE AND ACCEPTED ARE THEY?

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Abstract

Objective: **Computer-assisted personal interviewing has been developed to help health care providers in gathering and processing information from the patients for diagnosis, treatment and intervention. Psychiatric service providers and patients, however, doubt this instrument in terms of the preciseness and reliability of the instruments because generally, psychiatric interviews rest on the interviewers' skills to create trust between patients and providers in order to go in-depth on sensitive issues. In this review, the existing literatures on the issue of reliability and precision of psychiatric computer interviews on patients' sensitive issues will be evaluated based on my work and experience in psychiatric care.** *Methods:* **Literature search on psychiatric computer interviews, which include patients and mental health professionals' attitude, which may include sensitive issue was conducted.** *Results:* **Patients prefer computer interviews rather than human interviews for revealing their sensitive issues while mental health professionals value human interviews and judgment more than computers. Computers have limitations in understanding human natural language, human interaction and non-verbal communication.** *Conclusion:* **It is recommended that the use of psychiatric computer interviews should be used under supervision of mental health professionals.** *ASEAN Journal of Psychiatry, Vol. 13 (1): January – June 2012: XX XX.*

Keywords: Psychiatric Computer Interviews, Precision, Reliability, Acceptability

Introduction

Introduction to the Psychiatric Computer Interview Process and Methods

Psychiatric care providers are becoming increasingly aware that computers provide an opportunity to elicit information directly from patients by means of self-administered questionnaires. Nearly 40 years ago Slack et al., [1] discovered that patients could operate a computer themselves without prior training, and could answer questions which were displayed to them. Since then, psychiatric computer interviews were developed and reported in depressed [2] and alcoholic patients [3] and determined that patients could understand the procedure and answer questionnaires by themselves while their answers were close to those obtained by conventional means.

The first generation of computer interviews were so-called "patient-directed." The subject sat at the terminal and typed in answers for him/herself [4-7]. These systems used by psychiatric patients were also found to be easy to use [8] accurate [3, 9] and well-accepted [10].

Psychiatric Interview and Diagnoses

Mental disorders have been found to be common in the general population. The World Health Organization (WHO) reported in 2001 [11] that about 450 million people worldwide suffer from some form of mental disorder or brain condition, and that one in four people meet criteria at some point in their life. In addition, the co-occurrence of two or more psychiatric diagnoses ('psychiatric comorbidity') has been reported to be very frequent. Approximately 50% of mental health illness patients have at least one psychiatric comorbidity [12], whereas 21% have at least 3 or more [13].

Psychiatric diagnoses are not easily made because patients sometime do not want to share or talk about their experiences which result in suffering and shame. Therefore, only mental health providers who have competent skills and experience would clarify this issue thoroughly.

Identification of Psychiatrically Sensitive Issues

Taking psychiatric history may not be easy and straightforward. Patients' real problems sometime are hidden or covered by their intentional (conscious) or unintentional (unconscious) psychological defense mechanisms, which mean that they may need more than one session of the interview to uncover and understand the whole picture. The hidden information is usually the experiences that patients feel pain, suffering, shame, or re-traumatized especially, when they reveal, try to think or try to talk about it in front of others. These issues include emotional issues, sexual issues, suicidal behaviors and alcohol or illicit drug uses. Therefore, in this study all of these issues will be called sensitive issues.

To uncover sensitive information, psychiatric providers must use their skills and experiences to create trust and build rapport with the patients by putting patients and interviewers at ease, finding patients' pain and expressing compassion, evaluating patients' insight and becoming an ally, showing expertise, and establishing authority as a physician and a

therapist and balancing the roles of empathic listener, expertise and authority [14]. Therefore, since most of the psychiatric interviewing techniques to elicit patient's history of illness in-depth rely on human interaction and rapport, it is hard for mental health professionals to rely on computers.

It is generally acceptable that eliciting patient's information is sometime complicated. Since the demand of psychiatric service is increased by the number of patients who need services, psychiatric computer interviews have been developed in order to help mental health providers to reduce their interviewing workloads.

Psychiatric Computer Interview Models (Structure, Dialogue, Checklist)

Computer interviews that have been generally used in psychiatry could be classified into three modules; (1) Structured interview; (2) Dialogue interview; and (3) Screening (checklist) interview.

Structured computer interviews for diagnosis have been developed by referring to the DSM *(Diagnostic and Statistical Manual of Mental Disorder)* criteria or ICD *(International Statistical Classification of Diseases and Related Health Problems)*. In a screening page, it contains a few short answer questions for patient demographic data such as age, height and weight. This is followed by general psychiatric screening questions and specific psychiatric criteria for diagnosis. Questions are presented in multiple choice forms and close-ended forms which include Y/N and rating scales. Each answer will determine the branch or track for the next question from its database and the scores will be summed for the result [8]. Some instruments are modularized so providers can pick and choose sections they are interested in. CIDI-auto 2.1, CAPI, SCID-I-RV, SCID-CV, and PROQSY are examples of these tools. Most of the structured psychiatric computer interviews are standardized and used as a gold standard for psychiatric diagnosis in many research.

The dialogue interview contains open-ended questions and closed-ended questions with rating scales. Patients respond to the opened-ended questions by explaining in words or by typing. Some computer dialogue interviews could interact with patients' responses by speaking or showing statements that they acknowledge patient's answers while encouraging discourse by delaying the time or pause for patients to respond [1]. Questions will be ordered from non-specific to specific symptoms and the answers will determine the branch or track for the next question. The answers and scores will be summarized for a final result.

The screening (checklist) interview contains psychiatric screening tools such as hopelessness scale, YMRS for mania, HAM-D or BDI for depression, Self esteem rating scale, and others. In the screening interview, patients are asked to complete or rate their symptoms on a computer's screen. When they finish, the scores will be summed and reported as positive or negative screening results. In addition, computer interview technology for screening has been developed in audio-CASI (computer assisted self-interviewing). This technology has been developed to help respondents who are not literate by reading the presented questions on the computer's screen to the respondents through headphones while respondents answer the questions via microphone beneath or inside the computer's monitor [15].

Due to the non-specific result of the opened-ended questions and the complicated evaluation of the result [16], computer interview dialogues are not as interesting as structural computer interviews or checklist interviews. However, since artificial intelligence has been implied in medical technologies, dialogue interviews which could give more detail and explore answers more in-depth may become interesting again in the near future.

In other words, even though we have computer interview technologies available, how confident are we that this technology can elicit patients' sensitive issues? To answer this important question, this paper will review various computer interviews for specific sensitive issues, compare the effectiveness of the computer versus face-to-face interviews and evaluate the attitude of the stakeholders which are the patients and the mental health care providers.

Methods

A literature search was conducted using Scopus, Cochrane reviews, PubMed, Psych INFO, and Medline in order to identify pertinent literature. Some of the key words used in various combinations consisted of "psychiatric", "computer interview", "ACASI", sensitive issues", "substance abuse", "alcohol abuse" "suicide", "adolescent risk behaviours", "emotion", "sexual", "reliable", "precision", "attitude", "mental health professional", "patient" , "ethics" and "future research". The aim of the literature search was to identify the use of psychiatric computer interviews in patient's sensitive issues while explore reliability and precision of the computer technologies and the acceptance among mental health professionals and patients. In addition, the last part of the review also concluded the future directions of computer interviews.

Results

Sensitive issues are the issues that patients feel reluctant to reveal in front of others. Therefore, some researchers are curious how patients would react or responds if they were asked these questions from impersonal sources, i.e., a computer. The following paragraph will review the computer interviews used in exploring sensitive issues from each perspective.

Emotional Problem

Slack et al. [17] compared computer dialogue interviews with doctor interviews for emotional problems. Thirty-two enrolled participants were interviewed by both a doctor and a computer in different periods (morning vs afternoon) and in a different sequence (doctor first vs computer first). For the computer interview, the questions regarding their feeling and mood would be shown on the cathode-ray screen. Participants respond to the computers with a typewriter-like' keyboard and speak into a microphone beneath

the screen. The number of words was counted as a primary outcome while other circumstances such as afternoon/morning sessions or sequence of the interview were considered as a secondary outcome.

The results showed that subjects used more words when talking to doctors more than computers in both morning/afternoon sessions and in any sequence. Twenty-nine of the subjects had at least one general emotional problem. Within fourteen who had sadness from computer interviews, thirteen were affirmed by doctors. This indicated good reliability of the results. However, the weakness of the human interview was doctors were affected by the periods of the day while the computers were not. Furthermore, the authors concluded that subjects who had more words when talking to computers before talking to a doctor might assume that patient-computer dialogue could facilitate subsequent dialogue with a therapist. However, this study used only male subjects whose ages were 18-26 years-old, so it might not represent the overall population. Others studies form Matheson et al. [18] and Joinson et al. [19] compared computer interviews to face-to-face interviews reported that computers could elicit patients' information because computers enhanced private self- awareness while reducing public self-awareness. These two factors could lead to self-disclosure [20] because an increase in self-awareness makes people introspective about themselves whereas decreased public awareness makes patients who have low self-esteem or who are emotionally sensitive to rejection are encouraged to have more confidence to reveal themselves. Thus, in other word, self-disclosure related to an increase in accuracy of reports of history among psychiatric patients and descriptions of their problems [21]. Therefore, due to the mediated awareness by computers, even patients who are sensitive can reveal more personal information.

Sexual Problems

As mentioned above, people who hesitate when they are asked about the most intimate area of their lives (especially regards to sexual behavior) will often report on it inaccurately,

especially females who may underreport their problems [22-24]. Millstein et al., [25] compared interactive computer interview with face-to-face interview and self-administered questionnaires. One hundred and eight patients who joined the study were divided into 3 groups. Patients were asked about their general health status and past health history before leading to questions about specific sexual behaviors such as holding hands, hugging, kissing, masturbation, oral sex, and sexual intercourse. Sexual behavior reports were measured as a primary outcome while difficulty or embarrassment in participating in each type of interview was evaluated as a secondary outcome.

The results showed that patients who were in face-to-face interviews reported to be more engaged in sexual behaviors than in self-reports and computer interviews. Most subjects reported that face-to-face interviews facilitated their ability to express and to be understood.

However, this superior pattern of face-to-face versus computer interviews is not consistent. CASI and audio-CASI (ACASI) studies showed mixed results. Some researchers reported that patients who were interviewed by computers revealed more sexual behaviors and risky sexual behaviors (e.g. had sex with sex workers) than patients who were interviewed by doctor [15, 26, 27]. Potdar et al. [28] reported that the Audio-CASI approach failed to yield higher responses compared to the face-to-face interviews. Furthermore, Mensch et al., [29] insisted face-to-face mode produced more consistency with sexual transmitted disease laboratory screening and clinical diagnosis than ACASI and self-report modes. Therefore, in sexual behaviors interviews, computers may not be appropriate for all situations.

Suicide and Para-suicide Behavior

For suicidal and para-suicidal behaviors, many reports of computer interviews showed impressive results. Greist et al., [2] found some patients only confided suicidal ideas to the computer while most of them preferred to report to a computer over a clinician interview. Erdman

et al. [30], and, Greist et al., [2] reported computers performed well in accurately identifying attempters from non-attempters and accurately assigning probabilities of future suicidal behaviors. Study from Petrie et al., [31] used computer checklist interviews to evaluate hopelessness, depression, suicidal ideation and self-esteem in admitted patients who had attempted suicide. Her results revealed that computerized assessment was preferred by patients, who had higher levels of suicidal ideation, hopelessness and, lower levels of self-esteem. This may be because patients who have low self-esteem were very sensitive and easily got embarrassed in front of others. Therefore, this method was suited to them because they could avoid human reactions when they were interviewing.

Moreover, computer assessments for suicide showed superior results when they were used in specific groups of patients, for example, in HIV patients. The touch–screen, based computer-assessment was implied to assess suicidal ideation in HIV patients [32]. Suicidal ideation and the frequency of suicidal thought questions were incorporated in patient's routine self-reports. Fourteen percent of patients endorsed some level of suicidal ideation whereas three percent admitted suicidal ideation nearly every day. The suicidal ideations of the patients correlated with their underlying depression and substance use disorders. Although computer interviews have had good results and acceptance among patients who have suicidal ideas, it can be only an assisted interview tool to help providers screen or assess patients because suicidal ideation can cause death to the patients so it is considered a psychiatric emergency. It is necessary for patients who claim that they have suicidal ideas to have further interviews or evaluations by mental health care providers.

Alcohol Use and Drug Abuse

A major problem of evaluating drug and alcohol use in patients is it is hard to collect accurate and complete data from respondents. Personal interviews themselves are costly while respondents are guarded and sensitive. Moreover, it is often difficult to establish rapport with the patient or make the patient concerned about their drug or alcohol use. Computer interviews also have been introduced to these patients; however, the results were uncertain. Bernadt et al. [4] compared computer interview with a nurse and a doctor interview in alcoholic inpatients showed that in detecting the amount of alcohol consumed, computers did not elicit higher consumption than human interviewers. This assumption was corresponding to Skinner et al. [33] that there were no significant differences between the methods of interviews: computer interview, oral interview and self-reports for levels of alcohol, tobacco and drug consumption while Single et al. [34] and Erdman et al. [35] reported that patients with problems with alcohol use reported disagreement among different methods of interviews more than patients who used marijuana, tobacco or other illicit substances.

However, this conclusion was contrary to Lucas et al. [3] that patients reported significantly greater amounts of alcohol consumption to the computer than they reported to the psychiatrists. Meanwhile, Erdman et al. [30] reported that patient's reports were found to be closer in agreement between computer and human interviews for alcohol-related disabilities, which generated dichotomous data (of a yes/no variety) than for the amount of alcohol consumed. He concluded that with the dichotomous data patients had a better agreement than with interval data (ie. how much, how often). Since patients with substance use disorder usually give unreliable and inconsistent information in every method of interview, therefore, repeating interviews in subsequent occasions together with randomly biological tests will help providers gather more accurate information.

Risky Behavior in Adolescents

Adolescent morbidity and mortality are largely associated with high-risk behaviors including violence, suicide, sexual activity, pregnancy, bullying, and drug abuse. Adolescents who have risky behaviors choose to hide these issues from adults or their parents but will discuss and share them with their friends. Therefore, researchers hypothesize that computer-friendly technologies

may help health care providers uncover these problems. A study from Turner et al. [36] comparing audio computer-assisted self-interviewing (ACASI) to the paper-pencil self-report found that males aged 15 to 19 were much more likely to report risky behaviors when they were interviewed with ACASI technology than when reported via traditional means.

The percentage of adolescent reports were found to be higher for injected drug uses, cocaine use and sexual activity with drug uses than the estimate derived from the federal government's 1995 National Household Survey on Drug Abuse [37].

For sexual behaviors, ACASI produced highly significant increase in reports of male-male sexual relationship but had little effect on male-female sexual relationship report.

For violent behaviors, respondents who were interviewed in ACASI mode were more likely to reveal that they had had carried a gun, a knife or razor more than in paper self-reports. This study is corresponding to Paperny et al. [38] who reported that computer-assisted interviews elicit more positive responses to sensitive high-risk problems of adolescents than a matched written questionnaire. However, in this study, only one group of adolescents who were interviewed by computer interviews was assigned to discuss with the doctors about their printout results even though nearly all of the subjects were willing to share the printout result with the pediatrician who should facilitate clinical evaluation.

Chisolm et al. [39] used the Health e-Touch system to evaluate youth in terms of substance use, depression and suicidal thoughts reported that although adolescents were satisfied with the technologies, satisfaction does not show statistical correlation with the report of risky behaviors. The authors also mentioned that the reports of risky behavior from adolescents needed further evaluation by physicians because the screened positive results may include false positives and the physician is the only person who can make a final decision for those screened positive on whether the screening result is valid or whether follow-up care is needed. The authors suggested this because in their study they found that 35% of participants reported to the computers that they had suicidal idea, depression and substance use. This prevalence was far more than the usual prevalence of depression which is 5-10% plus prevalence of suicidal attempt which was 11.3/100,000 [40] plus prevalence of substance disorder which was approximately 10% [41] Therefore, increased reports from adolescents for risky behaviors may not be the true numbers.

Positively screened adolescents need to be verified by a physician. Although it seems that computers can elicit sensitive problems from the patients, the doubt about preciseness and reliability of the elicited information from the computer still exists.

Criteria for Comparison of Computer Interviews with Face-to-Face Interviews in Terms of Preciseness and Reliability

Preciseness means the quality of being reproducible in amount or performance. Reliability means the quality of being dependable or consistent. According to these definitions, one may conclude that computer interviews are 100% reliable; computers never forget to ask a question, give the same pattern of responses to a client, and always ask the same questions in the same way [42]. Even using structured interviews, clinicians accidentally omit up to 5% of required questions [43]. In addition, computer interviews do not get tired, angry, or bored. It is always willing to listen and give the same response irrespective of the time of day whereas a human providers' response may vary based on their energy level, diurnal variation, the information that they receive from patients or their personal issues [35].Therefore, the quality and standard which is given by the computers sometimes is higher and more accurate.

Using this definition, in order to reach more preciseness, computers should get enough information when they are used for interview in each time. Thus many circumstances such as participants, interviewing topics and programmed computer interviews could

influence the preciseness of computer interviews' results. Young people and adults may report more experiences to computers than to interviewers on sensitive topics such as sexual experience and substance misuse [36] because the computer provides a sense of privacy and sense of control where older people or people who have computer aversion or technophobia may report less experiences and have negative attitude to computer interviews [44].

In terms of topics, patients who are interviewed with computers report more stigmatizing behaviors [35, 36, 38] such as illicit drug (except alcohol) uses, sexual relationships, especially male-male sexual relations and suicidal behaviors while face-to-face interviewing elicits more in-depth "psychological distress" in any issues such as sexual problems, alcohol uses, suicide etc. This indicates that computer interviews may not be preferable in all interview situations. In terms of the program for interviews, one study from Dove et al. 1977 [45] showed that properly designed questions could make patients more eager to answer further questions and to talk about themselves because it can induce a mood of introspection and facilitate expression. When the patients explain or give more information about them, the preciseness of the interview is increased because computers can gather enough information to form a diagnosis. Furthermore, a new technology, an audio program, for example, can facilitate and help patients who are illiterate to have more response with graphics and presentations on the computer screen which create enjoyment and ease and thus make patients feel more comfortable and increase their interview cooperation.

On the other hand, although human error in interviews may be somewhat higher, the error is still in an acceptable range [8, 25]. Furthermore, a face-to-face interviewvhas higher benefits because it allows more extensive probing and clarification of the subject's responses [25]. The interviewer can go beyond the limiting structure of a psychological instrument and explore in-depth the patient's difficulties and specific issues. In addition, the flexibility of the human interview can pursue a vast range of patient facts and adjust the interview inquiry to the uniqueness of each patient and can turn in a hundred different directions, following leads in a way that computer procedures cannot [46].

Attitude and acceptance of patients could encourage the cooperation and compliance which lead to more accurate information in the interview while the providers' attitude could facilitate the use and development of computer interview software. Therefore, exploring the attitude of stakeholders is important to predict the present and future use and development of computer interviews.

Patients' Attitude

From many reviews, in sensitive areas as shown in many studies above, some patients find it easier to provide information to the computer, are often more honest with the computer, and often prefer the computer over the clinicians because computer interviews also have the potential for being less uncomfortable or embarrassing to them, especially when sensitive information such as thoughts of suicide [30], sexual behaviors [15, 26, 27], or other psychological problems [20] are being revealed. In addition, in patients' perceptions, even the best clinicians will react emotionally to some of their feelings and statements which may lead to inadvertent communication. However, this interpretation of clinician's reactions may also come from patient's thought distortion from their own psychiatric illness. For example, patients who are narcissistic may be sensitive to rejection, disapproval or indifference of the interviewers. Therefore, if these people's thoughts are not recognized as important by the clinicians, they might not cooperate with the interviewers.

Furthermore, even if the clinician is non-judgmental, a patient may feel embarrassed because status differences exist between a professional and someone who is seeking help. This situation could consequently inhibit a patient's honesty and openness. To sum up, clearly majority of respondents report positive attitudes. Even then, some individuals do not like the idea of a computer interview and many

individuals who are receptive to computer interviews would not want them used in every circumstance [8, 47, 48].

Health Professional Attitude

The most common impediment to the acceptance of computer interviews among professionals is the loss of human interaction using computers and therefore skepticism of the judgments of the computer compared to human judgment. Secondarily, the lack of computer skills of health care providers can also be an impediment.

In terms of the impersonal nature of computers, it is interesting that these concerns are invoked much more frequently by professionals than by patients even though the consistent finding of many researchers is that computer interviewing is highly acceptable to patients [8, 48].

In the providers' view, the impersonal nature of computers may impede rapport building, which, therefore, leads to unsuccessful interviews and unsuccessful information gathering. Moreover, some providers think that using a computer in the interview seems to be a fraud to the individual because it implies that the computer understands the person by showing an acknowledging sentence to him or her, even though it is not [49]. Computers have difficulty in understanding other circumstances apart from structured and verbal information, which they are programmed. Here, human interviewers have a great advantage over them in the number of informational modes because of the human ability in the use of natural language and nonverbal information may point to areas where the useful information is and which is the proper direction to go. Furthermore, computers are relatively unable to tailor the wording of questions. Some variation is possible, but the computer is still extremely limited compared with the flexibility and spontaneity of human language [50]. In addition, computer judgment has less value than clinical judgment because first, clinical judgment of physicians can indicate a failure to standardize medical diagnosis. Therefore all clinical judgments could be considered a standard. Second, clinical

judgments are necessary when assessing something, which is impossible to describe in a standardized fashion [51]. This means that if there are any conflicts between computers and human judgment, human judgment is used as a standard. Lastly, the low computer skills of health care providers, in terms of their proficiency of use would impede the application of the computer interviews in their clinical settings and future research [52].

Much of the developmental work in computer interviewing reveals that patients prefer computer interviews rather than human interviews for revealing their sensitive issues. However, computer interviews are not appropriate for all patients and for all conditions since some patients raised that they still needed to talk or discuss with their providers who could evaluate their interview results and, in some conditions due to the inflexibility of computers, they cannot select to probe or extract other relevant issues beside their programmed questions. Moreover, computers are extremely weak in value of clinical evaluation and judgment while a clinical judgment is always of higher value than computer judgment. Furthermore, there is not enough study to support that computer interviews gather genuine high quality or high quantity data since there may be some false positive values integrated in increased report data from computer interviews. Therefore, the use of psychiatric computer interviews should be recommended to use undersupervision of mental health professionals.

Hope for the Future

There are two contrary theories about the future of computer interviews. The first theory believes that the programmed computer interviews may be useful if the programs are smaller and more comprehensive. Thus, the narrower the task, the greater the strengths are of the computer interviews. Even if it is possible to write computer interviews that cover a large content area well, there may be problems in getting it used because different clinicians will still want to tailor the program to meet their own particular requirements. Obviously, the larger and more comprehensive a program is, the more difficult it

is to modify so it is our belief that smaller scale interviews are more likely to be successful than larger interviews, and one ultimate goal is to integrate these smaller components into more comprehensive packages [53]. This belief regarding computer interviews parallels experience in the development of mental health information systems. Hedlund et al. [54] have noted that large mental health information systems have been generally unsuccessful, and the trend has been toward more narrowly focused systems. However, this assumption should be weighted with flexibility because if the interview is to be focused, it still cannot overcome its present limitations, which leads to a problem of clinician acceptance.

The second theory believes that computer dialogue interviews may offer a useful application if it has more flexibility and it resembles the real doctor-patient interview rather than structured interviews. In the future, artificial intelligence (AI) could be a tool of choice to implement this kind of program [49]. However, if dialogue will be used, the content will be large because the AI will be programmed to communicate both verbal and non-verbal language while it needs to come up with many choices and directions of responses with a level of appropriate language in each person in order to make patients feel like they are in a real interview with a human. Therefore, further research in both models are needed in order to conclude which one is more beneficial.

References

1. Slack WV, Slack CW. Patient-Computer Dialogue. New England Journal of Medicine. 1972;286(24):1304-9.

2. Greist JH, Klein MH, Van Cura LJ. A computer interview for psychiatric patient target symptoms. Arch Gen Psychiatry. 1973 Aug;29(2):247-53.

3. Lucas RW, Mullin PJ, Luna CB, McInroy DC. Psychiatrists and a computer as interrogators of patients with alcohol-related illnesses: a comparison. The British Journal of Psychiatry. 1977 August 1, 1977;131(2):160-7.

4. Bernadt MW, Daniels OJ, Blizard RA, Murray RM. Can a Computer Reliably Elicit an Alcohol History? British Journal of Addiction. [Article]. 1989;84(4):405-11.

5. Levine S, Ancill RJ, Roberts AP. Assessment of suicide risk by computer-delivered self-rating questionnaire: preliminary findings. Acta Psychiatr Scand. 1989 Sep;80(3):216-20.

6. Lewis G, Pelosi AJ, Glover E, Wilkinson G, Stansfeld SA, Williams P, et al. The development of a computerized assessment for minor psychiatric disorder. Psychological Medicine. 1988;18(03):737-45.

7. Wyndowe J. The microcomputerized Diagnostic Interview Schedule: Clinical use in an out-patient setting. The Canadian Journal of Psychiatry / La Revue canadienne de psychiatrie. 1987 Mar;32(2):93-9.

8. Carr AC, Ghosh A, Ancill RJ. Can a computer take a psychiatric history? Psychol Med. 1983 Feb;13(1):151-8.

9. Duffy JC, Waterton JJ. Under-reporting of alcohol consumption in sample surveys: the effect of computer interviewing in fieldwork. Br J Addict. 1984 Sep;79(3):303-8.

10. Greist JH, Klein MH, editors. Computer programs for patients, clinicians, and researchers in psychiatry. Norwood, NJ: Technology in mental health care delivery systems.; 1980.

11. World Helath Organization. The World Health Report 2001 - Mental Health: New Understanding, New Hope. Geneva, Switzerland.: World Helath Organization; 2001.

12. Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, et al.

Lifetime and 12-Month Prevalence of DSM-III-R Psychiatric Disorders in the United States: Results From the National Comorbidity Survey. Arch Gen Psychiatry. 1994 January 1, 1994;51(1):8-19.

13. Andrews G, Slade T, Issakidis C. Deconstructing current comorbidity: data from the Australian National Survey of Mental Health and Well-Being. The British Journal of Psychiatry. 2002 October 1, 2002;181(4):306-14.

14. Sadock BJ, Sadock VA. Kaplan & Sadock's Synopsis of Psychiatry: Behavioral Sciences/Clinical Psychiatry. 10th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2007.

15. Newman JC, Des Jarlais DC, Turner CF, Gribble J, Cooley P, Paone D. The Differential Effects of Face-to-Face and Computer Interview Modes. American Journal of Public Health. 2002 2002/02/01;92(2):294-7.

16. Robins LN, Wing J, Wittchen HU, Helzer JE, Babor TF, Burke J, et al. The Composite International Diagnostic Interview: An Epidemiologic Instrument Suitable for Use in Conjunction With Different Diagnostic Systems and in Different Cultures. Arch Gen Psychiatry. 1988 December 1, 1988;45(12):1069-77.

17. Slack WV, Slack CW. Talking to a computer about emotional problems: A comparative study. Psychotherapy: Theory, Research & Practice. 1977;14(2):156-64.

18. Matheson K, Zanna MP. The impact of computer-mediated communication on self-awareness. Computers in Human Behavior. 1988;4(3):221-33.

19. Joinson AN. Self-disclosure in computer-mediated communication: The role of self-awareness and visual anonymity. European Journal of Social Psychology. 2001;31(2):177-92.

20. Franzoi SL, Davis MH. Correction to Franzoi and Davis. Journal of Personality and Social Psychology. 1985;49(1):176.

21. Gibbons FX, Smith TW, Ingram RE, Pearce K, Brehm SS, Schroeder DJ. Self-awareness and self-confrontation: Effects of self-focused attention on members of a clinical population. Journal of Personality and Social Psychology. 1985;48(3):662-75.

22. Brewer DD, Potterat JJ, Garrett SB, Muth SQ, Roberts JM, Kasprzyk D, et al. Prostitution and the sex discrepancy in reported number of sexual partners. Proceedings of the National Academy of Sciences. 2000 October 24, 2000;97(22):12385-8.

23. Laumann EO. The social organization of sexuality: Sexual practices in the United States. Chicago: University of Chicago Press; 1994.

24. Smith TW. Discrepancies between men and women in reporting number of sexual partners: A summary from four countries. Biodemography and Social Biology. 1992 1992/09/01;39(3-4):203-11.

25. Millstein SG, Irwin Jr CE. Acceptability of computer-acquired sexual histories in adolescent girls. The Journal of Pediatrics. 1983;103(5):815-9.

26. Turner CF, Ku L, Rogers SM, Lindberg LD, Pleck JH, Sonenstein FL. Adolescent Sexual Behavior, Drug Use, and Violence: Increased Reporting with Computer Survey Technology. Science. 1998 May 8, 1998;280(5365):867-73.

27. Le LC, Blum RW, Magnani R, Hewett PC, Do HM. A pilot of audio computer-assisted self-interview for youth reproductive health research in Vietnam. Journal of Adolescent Health. 2006;38(6):740-7.

28. Potdar R, Koenig MA. Does Audio-CASI Improve Reports of Risky Behavior? Evidence from a Randomized Field Trial

Among Young Urban Men in India. Studies in Family Planning. 2005;36(2):107-16.

29. Mensch BS, Hewett PC, Jones HE, Luppi CG, Lippman SA, Pinho AA, et al. Consistency in Women's Reports of Sensitive Behavior In an Interview Mode Experiment, São Paulo, Brazil. International Family Planning Perspectives. 2008;34(4):169-76.

30. Erdman HP, Greist JH, Gustafson DH, Taves JE, Klein MH. Suicide risk prediction by computer interview: a prospective study. J Clin Psychiatry. 1987 Dec;48(12):464-7.

31. Petrie K, Abell W. Responses of parasuicides to a computerized interview. Computers in Human Behavior. 1994;10(4):415-8.

32. Lawrence ST, Willig JH, Crane HM, Ye J, Aban I, Lober W, et al. Routine, Self-Administered, Touch-Screen, Computer-Based Suicidal Ideation Assessment Linked to Automated Response Team Notification in an HIV Primary Care Setting. Clinical Infectious Diseases. 2010 April 15, 2010;50(8):1165-73.

33. Skinner HA, Allen BA, McIntosh MC, Palmer WH. Lifestyle assessment: applying microcomputers in family practice. BMJ. 1985 1985-01-19 00:00:00;290(6463):212-4.

34. Single E, Kandel D, Johnson BD. The reliability and validity of drug use responses in a large scale longitudinal survey. Journal of Drug Issues. 1975;5(4):426-43.

35. Erdman H, Klein M, Greist J. The reliability of a computer interview for drug use/abuse information. Behavior Research Methods. 1983;15(1):66-8.

36. Turner CF, Miller HG, Catania JA, Cooley PC, Biemer P, Chromy JR. Improving AIDS Behavioral Studies Using T-ACASI. [Unpublished research proposal to the National Institutes of Health for grant R01-MH056318]. In press 1995.

37. Miller PV. Review: Is "Up" Right? The National Household Survey on Drug Abuse. The Public Opinion Quarterly. 1997;61(4):627-41.

38. Paperny DM, Aono JY, Lehman RM, Hammar SL, Risser J. Computer-assisted detection and intervention in adolescent high-risk health behaviors. J Pediatr. 1990 Mar;116(3):456-62.

39. Chisolm DJ, Gardner W, Julian T, Kelleher KJ. Adolescent Satisfaction with Computer-Assisted Behavioural Risk Screening in Primary Care. Child Adolesc Ment Health. 2008 Nov 1;13(4):163-8.

40. Centers for Disease Control and Prevention National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System (WISQARS). 2011.

41. Substance Abuse and Mental Health Services Administration. Results from the 2009 National Survey on Drug Use and Health. Summary of National Findings (Office of Applied Studies, NSDUH Series H-38A, HHS Publication No SMA10-4586Findings). Rockville, MD2010.

42. Colby KM. Computer psychotherapists. In: Sidowski JB, editor. Technology in mental health care delivery systems. Norwood, N.J: Ablex; 1980.

43. Fairbairn AS, Wood CH, Fletcher CM. Variability in answers to a questionnaire on respiratory symptoms. Br J Prev Soc Med. 1959 Oct;13:175-93.

44. Spinhoven P, Labbe MR, Rombouts R. Feasibility of computerized psychological testing with psychiatric outpatients. Journal of Clinical Psychology. 1993;49(3):440-7.

45. Dove GA, Clarke JH, Constantinidou M, Royappa BA, Evans CR, Milne J, et al. The therapeutic effect of taking a patient's

history by computer. J R Coll Gen Pract. 1977 Aug;27(181):477-81.

46. Cronbach LJ, Gleser GC. Psychological tests and personnel decisions. Campaign: University of Illinois Press; 1957.

47. Dignon AM. Acceptability of a computer-administered psychiatric interview. Computers in Human Behavior. 1996;12(2):177-91.

48. Erdman HP, Klein MH, Greist JH. Direct patient computer interviewing. Journal of Consulting and Clinical Psychology. 1985;53(6):760-73.

49. Weizenbaum J. Computer power and human reason: From judgment to calculation. Oxford, England: W. H. Freeman & Co; 1976.

50. Bloom SM, White RJ, Beckley RF, Slack WV. Converse: a means to write, edit, administer, and summarize computer-based dialogue. Comput Biomed Res. 1978 Apr;11(2):167-75.

51. Lewis G. Assessing psychiatric disorder with a human interviewer or a computer. Journal of Epidemiology and Community Health. 1994 April 1, 1994;48(2):207-10.

52. Menachemi N, Langley A, Brooks R. The Use of Information Technologies Among Rural and Urban Physicians in Florida. Journal of Medical Systems. 2007;31(6):483-8.

53. Blois MS. Clinical Judgment and Computers. New England Journal of Medicine. 1980;303(4):192-7.

54. Hedlund JL, Vieweg BW, Cho DW. Mental Health Computing in the 1980s. Computers in Human Services. 1985 1985/01/18;1(1):3-33.

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