The Diagnostic Accuracy of Telegeriatrics for the Diagnosis of Dementia via Video Conferencing

Melinda Martin-Khan[1], Leon Flicker[2], Richard Wootton[3], Poh-Kooh Loh[2 4], Helen Edwards[5], Paul Varghese[6], Gerard J. Byrne[7], Kerenaftali Klein[8], Leonard C. Gray[1 9]

[1]Centre for Research in Geriatric Medicine, The University of Queensland, Woolloongabba, QLD

[2]University of Western Australia, Perth, WA

[3]Centre for Integrated Care and Telemedicine, University Hospital of North Norway, Tromso, Norway

[4] Royal Perth Hospital, Perth, WA

[5]School of Nursing and Midwifery Institute of Health and Biomedical Innovation, Queensland University of Technology, Brisbane, QLD

[6]Princess Alexandra Hospital, Queensland Health, Woolloongabba, QLD

[7]School of Medicine, University of Queensland, Herston, QLD

[8]Queensland Clinical Trials & Biostatistics Centre, The University of Queensland, Woolloongabba, QLD

[9]Centre for Online Health, The University of Queensland, Herston, QLD

Running Title

Telehealth Cognition Study

Keywords

Telemedicine; Remote Consultation; Dementia; Alzheimer Disease; Diagnostic Accuracy.

Corresponding Author

Melinda Martin-Khan, Centre for Research in Geriatric Medicine, The University of Queensland, Building 33, Level 2, Princess Alexandra Hospital, Ipswich Road, Woolloongabba QLD 4102

Ph: 07 31765530; Fax: 07 31766945; Email: m.martinkhan@uq.edu.au

Conflict of Interest

None

Abstract

INTRODUCTION: The suitability of video conferencing (VC) technology for clinical purposes relevant to geriatric medicine is still being established. This project aimed to determine the validity of the diagnosis of dementia via VC.

METHODS: This was a multi-site, non-inferiority, prospective cohort study. Patients, aged 50 years and over, referred by their primary care physician for cognitive assessment, were assessed at four memory disorder clinics. All patients were assessed independently by two specialist physicians. They were allocated one face-to-face (FTF) assessment (Reference standard – usual clinical practice) and an additional assessment (either usual FTF assessment or a VC assessment) on the same day. Each specialist physician had access to the patient chart and the results of a battery of standardised cognitive assessments administered FTF by the clinic nurse. Percentage agreement (P_0) and the weighted kappa statistic with linear weight (K_w) were used to assess interrater reliability across the two study groups on the diagnosis of dementia (cognition normal, impaired or demented).

RESULTS: The 205 patients were allocated to group: Videoconference (n=100) or Standard practice (n=105). 106 were male. The average age was 76 (SD9, 51-95) and the average Standardised Mini-Mental State Examination Score was 23.9 (SD4.7, 9-30). Agreement for the Videoconference group (P_O= 0.71; k_w = 0.52; p<0.0001) and agreement for the Standard Practice group (P_O= 0.70; k_W = 0.50; p<0.0001) were both statistically significant (p<0.05). The summary kappa statistic of 0.51 (p=0.84) indicated that VC was not inferior to FTF assessment.

CONCLUSIONS: Previous studies have shown that preliminary standardized assessment tools can be reliably administered and scored via VC. This study focused on the geriatric assessment component of the interview (interpretation of standardized assessments, taking a history and formulating a diagnosis by medical specialist) and identified high levels of agreement for diagnosing dementia. A model of service incorporating either local or remote administered standardized assessments, and

remote specialist assessment is a reliable process for enabling the diagnosis of dementia for isolated older adults.

Full Text

INTRODUCTION

The use of videoconferencing (VC) may provide a way to link a specialist physician with a patient in a remote location for the purpose of diagnosing dementia and obviate the need for either to travel long distances[1]. Evidence suggests that 50–80% of new dementia cases are missed in primary care and many cases are missed altogether, with some older people never receiving a formal diagnosis[2]. Older adults with complex memory problems benefit from comprehensive cognitive assessment provided by specialists such as geriatricians, psycho-geriatricians or neurologists who often work in major population centres. Access to assessment can be problematic for patients living in remote areas[2, 3].

The remote diagnosis of dementia requires a reliable technical solution to each element of the assessment process: preliminary investigations such as imaging and blood tests; standardised assessment tools; and specialist interview. Electronic transfer of imaging and blood test reports is current practice in many health services. Multiple studies have shown the reliability of administering a range of standardised assessment tools via VC[4-8]. In addition, a study examined the reliability of diagnosing dementia via VC by combining the administering of assessment tools and the geriatric assessment interview[9]. An alternative model is a combination of remote and local expertise: an outline of the medical history and battery of standardised cognitive assessments are undertaken by a nurse or other clinician at the remote site who then relays this information to the specialist physician prior to the VC interview. This latter service model, which may be more time efficient for the specialist physician, has been widely used in other specialities and is particularly efficient for satellite clinics or hospitals with trained staff[10]. Early studies of the use of VC for diagnosis of dementia or cognitive impairment in older adults have yielded consistently encouraging results with good levels of agreement on diagnosis (Overall Percentage Agreement = 0.65 – 1.0)[9, 11, 12]. However, these studies were limited by small sample sizes, and restrictive inclusion criteria[13]. A

definitive study, with a patient sample which included cases with more complex diagnostic issues, was required to provide clinicians with confidence in the use of VC for initial assessment interviews of patients with memory disorders. Accordingly, the aim of this study was to determine the validity of the diagnosis of dementia via VC using inter-rater agreement.

METHODS

Study Design

This was a prospective cohort study in which patients referred to a Memory Disorders Clinic underwent independent, sequential assessment by two memory disorder specialist physicians in video-conference (VC) and in face-to-face (FTF) modes. All patients were allocated one FTF assessment (Standard clinical practice) and an additional assessment (either standard FTF assessment or a VC assessment). Participants were randomly allocated to receive either paired FTF assessments (FF) in the standard clinical practice group or paired FTF and VC assessments (FV = FTF/VC; VF=VC/FTF) in the video group. Where the patient was allocated to receive a VC consultation, the order of FTF and VC was randomly allocated. Levels of agreement between study groups were then compared.

This study was approved by local human ethics committees at each of the four clinics, all in Australia, and The University of Queensland.

Diagnostic criteria

Patients' cognitive function was defined in accordance with the DSM-IV diagnosis of dementia (290.0-294.8), by the following three mutually exclusive options: 'Normal cognitive function' (No evidence of impairment meeting any of the criteria related to DSM-IV cognitive disorder); 'Cognitive impairment no dementia' (Evidence of impairment meeting some, but not all, DSM-IV criteria for dementia, including amnestic disorder and cognitive impairment not otherwise specified); or 'Dementia meeting DSM-IV criteria' (all criteria meet)[14]. Secondary questions were the agreement of classification of diagnostic sub-type and the identification of further investigative or management

options (such as additional investigations, medication recommendations or allied health referral). Each specialist physician applied the diagnostic criteria during the assessment interview and completed the data collection sheet immediately following the assessment.

Avoidance of Bias

To avoid selective enrolment of subjects, specialist physicians agreed to consider all referred patients for the study. At each site, a research assistant/nurse was actively involved in enrolment and in the conduct of the study; a log was maintained to record information about all eligible patients. The consenting process was consecutive and carried out on the basis of a priori protocols. Specialist physicians were blinded to format of interview, and order of assessment (i.e., physician allocation to complete the first or second interview). Each nurse (from all sites) was trained by the same neuropsychologist in the administration and scoring of the assessment tools.

Pre-Interview Preparation

Participants were initially seen by a clinic nurse who administered cognitive assessment tools which included the Standardised Mini-Mental State Examination (SMMSE)[15]; Rowland Universal Dementia Assessment Scale (RUDAS)[16, 17], Clock Face Test (CFT)[18], Letter Naming (F, A, S) Verbal Fluency Test (FAS) and Naming Animals Verbal Fluency[19] and the Geriatric Depression Scale – 15 questions (GDS-15)[20]. A second staff member met with the carer and administered the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE)[21], Neuropsychiatric Inventory – Short form (NPI-Q)[22] and Disability Assessment for Dementia (DAD)[23]. These completed assessments, plus any additional investigations (such as CT brain scans, blood tests) were provided to each specialist physician prior to the interview.

Telemedicine Specialist Assessment

For VC assessment, the patient was shown to a clinic room by the nurse and introduced to the specialist physician via video. All paired assessments occurred on the same day. The protocol

excluded any physical examination for both study groups, other than observation of gait and other evident physical features[24].

Each specialist physician was blinded to the findings of the other specialist physician with whom they were paired until a team case conference was held for the patient at the end of the clinic day, and after the data from the assessments had been gathered, and a determination of the diagnosis had been made by the specialist physician. The need for additional neuroimaging, laboratory investigations or detailed neuropsychological testing was determined at the case conference. One of the two specialist physicians was allocated responsibility for managing each patient's follow-up. To maintain clinical attention from both interviewers, specialist physicians were blinded to the allocation of this responsibility until the conclusion of the case conference.

Consensus diagnosis by independent panel

Subsequently, two independent experienced specialist physicians reviewed a copy of each clinical file to establish a consensus diagnosis of dementia. They were provided with the pre-interview workup data, notes from the initial assessment interviews undertaken by both specialist physicians, and all additional relevant aspects of the patient clinical file (including: results of referral to a neuropsychologist; magnetic Resonance Imaging (MRI) reports; and both the team case conference and the family case conference discussion outcomes). A consensus decision making process was followed. All disagreements were settled by discussion with a third independent specialist.

Study Participants

Eligible subjects were 50-years of age or older with undiagnosed cognitive problems following an initial assessment by a primary care physician and were referred for comprehensive cognitive assessment at one of four Memory Disorder Clinics (MDCs). All participants and caregivers were approached for written consent to participate in the study. If the potential patient was unable to provide informed consent because of perceived cognitive impairment, consent was sought from a

secondary decision maker. Patients were excluded if they had previously been treated by one of the specialists or aged less than 50 years.

Procedure for allocation to study group

Allocation to study group was carried out using a balanced block design of size eight which was generated by a qualified statistician (EB) using an electronic random number generator, stratified according to study group (Standard Clinical Practice; Video), order of interview format (FTF or VC first), order of specialist physician assessment (Physician 1, Physician 2 for first or second interview) and blocked according to clinic site. Assignments were concealed in opaque, sealed envelopes that were numbered consecutively within each stratum.

Equipment

Each site was supplied with two sets of VC equipment. Each set included a television screen, a CODEC device, and a microphone. The CODEC device had the capacity to operate at 384kbit/s using ISDN, and screen quality was similar at each site. A Liberator Simulator with 8 BI ports (SI/8B0P/01) was used at each site to connect the units at an ISDN connection speed of 384 kbit/s. This connection speed (384 kbit/s) and mode (ISDN) were selected on the basis of previous research validating diagnosis via VC using this speed and mode [25].

Statistical Analysis

This study tests whether the percentage agreement between clinicians in the intervention group (FV/VF) does not lie beyond the lower limit of an acceptable range (a one-tailed area of clinical indifference) when compared with the standard clinical practice group (FF)[26]. The sample size calculation and the analytical methods are those used in equivalence studies: in that the absolute value of the difference that could be found between two study groups, while still concluding that the two interventions are equivalent, is determined *a priori*. In this study, the question of interest only relates to whether VC is 'not worse' (i.e. not inferior) than a FTF assessment, so the lower limit is the only margin of interest, hence the term 'non-inferiority study' applies.

The outcome of interest was the difference in percentage agreement (P_o) between paired assessments of the video group (VF/FV) and the standard clinical practice group (FF), for the question: ”Does the patient have dementia?” scored as ‘Normal Cognition’(0); ‘Cognitive Impairment not meeting DSMIV Criteria for dementia’(1) and ‘Yes, Meeting DSM-IV Criteria for dementia’(2). The sample size of 100 subjects per study group was identified to provide the study with power exceeding 80% to detect a non-inferiority margin of 16% for agreement between FF and FV/VF groups for diagnosing dementia based on an assumption of prevalence of dementia of 70% and diagnostic agreement in standard clinical practice (FF) of 74%, allowing a two-sided type 1 error rate of 5%. Analysis was completed by MMK and KK using SPSS 18.0 and SAS Enterprise Guide 4.2.

Characteristics of enrolled versus non-enrolled subjects were compared. Balance between groups was examined using demographic data and SMMSE scores.

Percentage agreement (P_0) and the weighted kappa statistic with linear weight (K_w) were used to assess interrater reliability across the two study groups. In the standard clinical practice group, diagnoses made at the first interview were checked against those made at interview two. In the video group, diagnoses made in the FTF interview (regardless of order of assessment) were compared with diagnoses made via VC, regardless of order of assessment. Weighted kappa was used to measure agreement as it enables degrees of disagreement to be considered. For example, disagreement resulting in the use of the two extreme responses (‘Normal Cognition’, and ‘Yes, Meeting DSM-IV Criteria for dementia’) is weighted more heavily than disagreement between adjoining options (‘Normal Cognition’, and ‘Cognitive Impairment’).

A summary kappa score was calculated by combining the two independent weighted kappa estimates. The extent to which the interrater reliability in the two groups was the same was examined using the Chi-square test[27]. The null hypothesis was that the two weighted kappa statistics were equal.

Potential factors related to increasing the chance of disagreement in the diagnoses at the paired interviews were explored against available demographic and clinical assessments using logistic regression.

Interrater agreement between each assessment interview and the consensus diagnosis by the panel (CDP) was explored using weighted kappa with linear weight and their 95 % confidence intervals.

Role of the Funding Source

The present study was funded by the National Health and Medical Research Council of Australia (NHMRC), grant no 456135. MM-K was funded by an NHMRC PhD scholarship. The NHMRC is a competitive peer reviewed grant process. Accordingly, the study protocol was reviewed extensively prior to the grant being awarded.

RESULTS

Study Population

Of the 270 consecutive patients available for the study, 210 (78%) consented to participate and underwent allocation to group – 108 in the standard clinical practice group and 102 in the video group – between January 10, 2007 and May 19, 2009. The remaining 60 patients were not enrolled because they declined to participate (30 patients), they were not eligible (1 patient) or there were protocol issues preventing complete assessment such as lack of availability of two doctors to carry out the assessments on the same day (29 patients).

All participants received dual assessments. In the standard clinical practice group, 105 subjects (97%) were included in the analysis, and three were excluded post-assessment based on age (2 cases) and non-adherence to study protocol (1 case). In the video group, 100 (98%) were included in the analysis, and two were excluded post-assessment based on age (1 case) and technical problems with the VC (1 case) (Figure 1).

[INSERT FIGURE 1]

Baseline characteristics for the sample, enrolled and non-consenting, were similar (Table 1). The baseline characteristics of the two groups were similar (Table 2). With respect to the video group, consideration of the levels of agreement based on order of assessment (VC/FTF and FTF/VC) was carried out. If the two sub-groups were not significantly different, they could be combined for the purpose of analysis. The weighted kappa statistics with linear weight for the VC/FTF sub-group and the FTF/VC sub-group were 0.56 (95% CI: 0.34-0.77) and 0.50 (CI: 0.32-0.68) respectively. The summary kappa statistic was 0.52 (CI: 0.38-0.66;) indicating that the two kappa statistics were not significantly different[27], and hence analysis as a group was acceptable (Video group = FV/VF).

[INSERT TABLE 1]

[INSERT TABLE 2]

Agreement between the two study group

Overall agreement for the standard clinical practice group (n=105) was 74 (70%; CI: 0.62, 0.79), with a weighted kappa of 0.5 (CI: 0.36-0.65). Overall agreement for the video group (n=100) was 71 (71%; CI 0.62, 0.8), with a weighted kappa of 0.52 (CI: 0.39, 0.66). The difference in agreement between the clinical practice group (P_0= 70%) and the video group (P_0 =71%) was 1% (0.01; CI -0.12, 0.13) with a weighted kappa of 0.51(CI: 0.41, 0.62), implying that there was no substantial difference between the methods of assessment.

[INSERT TABLE 3]

Agreement with the consensus diagnosis by panel was explored in relation to the primary question of whether each participant had dementia. We found no statistically significant difference in interrater agreement between the standard clinical practice group and the video group. There was no statistically significant disagreement on diagnosis with the clinical reference standard for either

standard clinical practice or video groups in relation to Alzheimer's Disease, Vascular dementia or cognitive impairment (p<0.01).

There was little disagreement between raters, but most disagreement, if present, was between the diagnosis of cognitive impairment or dementia (Standard (FF): n=22; Video: n = 19). Most disagreements resulted from one specialist physician diagnosing 'Mild Cognitive Impairment' and the other specialist physician diagnosing either Alzheimer's disease and/or Vascular dementia.

Factors impacting agreement

Logistic regression was used to predict disagreement between pairs of doctors on the question of the presence of dementia. Among the variables explored, SMMSE score was found to be significantly related to the disagreement in the diagnoses of the paired interviews. Odds of the chance of disagreement, across both study groups, increased by 1.12 (p-value < 0.01) by the unit increment of the SMMSE score (i.e. the higher the SMMSE the more disagreement. Dementia sub-type diagnosis (Alzheimer's type, or vascular) was not a predictor of disagreement.

DISCUSSION

This was a prospective cohort, non-inferiority study demonstrating that the VC version of the consultation was not inferior to the FTF version, using percentage agreement (P_o) for the primary outcome: "Does the patient have dementia?". We observed no difference in levels of agreement for assessments completed using VC compared with those using FTF. The summary kappa p-value for comparing the agreements in each group showed that the level of agreement was unlikely to have occurred by chance. The lower limit of the confidence interval for the difference in percentage agreement between the two groups was greater than the pre-specified level of clinical indifference, indicating that VC assessment is not inferior to FTF assessment.

This study, which evaluated the reliability of the diagnosis of dementia via video consultation in older adults referred for cognitive assessment, builds on the findings of previous studies[8, 9, 11, 12, 28].

Previous trials did not randomly allocate to the type of interview. All the trials had small sample sizes, the largest being 42[11], and therefore insufficiently powered to provide a definitive conclusion. It is important to acknowledge that this suitably powered study supports the findings of previous studies.

This study was conducted with a protocol which involved providing each specialist physician with the preliminary screening completed by the clinic nurse. This model is appropriate for implementation at an established telehealth clinic where the investment in training the nurse assessor is justified. The use of a local clinic nurse to administer the tools reduces the cost of the most expensive ongoing aspect of telehealth: the specialist physician's time. While this is a useful clinic model[11, 12, 29], there was a project specific benefit to adopting this approach. It served to reduce the confounding effects of different approaches to administering screening tools across sites and between physicians, and variation in performance from the patient because of repeated assessments (carried out on the same day). This was appropriate as separate studies have independently validated the administration and scoring of range of cognitive assessment tools via VC[4-6, 8, 30-32] .

In contrast to a regular telehealth clinic, there may be an occasion for a stand-alone assessment. In this situation, training a local clinic nurse is not feasible or justified. An earlier study by Loh used a fully remote clinic model, where the assessment tools administered and the specialist interview were all completed via VC (N=20)[9, 28]. The diagnosis was found to be reliable. Based on the evidence now available, we expect that a specialist physician can diagnose dementia via VC whether using: validated for VC instruments for cognitive assessment administered by the specialist remotely; or cognitive assessment tools administered by a trained clinic nurse in-person. The reliability of the administration of standardised assessment tools needs to be independently confirmed prior to incorporating the tool into a VC assessment protocol. At present, the following tools have been identified as validated cognitive assessment tools for VC: MMSE[5, 8, 30, 33-35]; the GDS[5, 8, 30]; BPRS[5]; FAS[6]; RUDAS[4] ; and the CAMCOG[31]. The scoring of the clock drawing test when carried out via VC was

found to be not as reliable[6, 34, 35]. Previous studies have reported that patients and their families are comfortable with the technical and physical aspects of participating in a clinical assessment interview when it is carried out via VC[8, 12, 29, 36] (It is noted that when the connection is less than 384 kbit/s there were concerns about clarity[8, 30]). The study sample described here was not reflective of patients who would have benefited from a VC assessment in the usual course of their care (travel to the memory clinic appointment was not challenging as they were community dwelling participants at an urban clinic) so an assessment of user satisfaction would have added little to our study. Studies of user satisfaction (patient, family and clinician) completed by people where the telehealth service is the usual care pathway and is connected to a tangible benefit would be useful to guage overall acceptability.

It is likely that subjects with an unambiguous diagnosis (dementia; not dementia) were less likely to be included in the study population because most patients referred to the Memory Clinic have some degree of diagnostic uncertainty. Therefore, the patient sample consisted of patients with cognitive symptoms or impairment requiring specialist assessment and diagnosis. In this study, with a rigorous protocol, agreement was 70% and 71% respectively. The use of an equally sized standard clinical practice group (FF) is therefore integral to the interpretation of the results.

Limitations of this study included a range of experienced and relatively newly qualified specialist physicians for the paired assessments. This may have increased the levels of disagreement, although this was not apparent. It is also likely that by the nature of the study clinicians may have spent more time and taken more care than they would commonly use in routine clinical practice. Assessments were carried out by physicians from varying specialities, but all had an interest in cognitive assessment. Specialities included geriatrics, psychogeriatrics, neurology and general medicine.

CONCLUSION

For older patients referred for cognitive assessment, the use of VC as a means of connecting a patient and their caregiver with a specialist physician for the purpose of assessment is a reliable tool for assisting in the diagnostic process. The results of this study can be readily generalised to patients with less complex issues of cognition (that is definitely normal cognition or clear dementia). Therefore, for all older adults, diagnosis by video conference can be considered reliable after preliminary assessments have been performed. However, the results of this study cannot be generalised to a wider group of clinicians, such as primary care physicians.

ACKNOWLEDGEMENTS

Ms Elaine Beller, for her statistical support in the early stages of the planning and implementation of this project.

Memory Clinic staff and patients, for their willingness to be a part of this research project, at Bentley Hospital and Mercy Hospital Western Australia (Site Coordinators Professor Leon Flicker and Doctor Poh-Kooh Loh), Princess Alexandra Hospital Queensland (Site Coordinator A/Professor Paul Varghese) and Royal Brisbane and Women's Hospital Queensland (Site Coordinators A/Professor Gerard Byrne and Doctor Kana Appadurai).

The present study was funded by the National Health and Medical Research Council (NHMRC), grant no 456135. MM-K was funded by an NHMRC PhD scholarship.

REFERENCES

1. Landers S, Why health care is going home. *The New England Journal of Medicine* 2010; **363**: 1690.
2. Hansen E, Hughes C, Routley G, et al., General practitioners' experiences and understandings of diagnosing dementia: Facts impacting early diagnosis. *Social Science and Medicine* 2008; **67**: 1776-1783.
3. Teel CS, Rural practitioners' experiences in dementia diagnosis and treatment. *Aging and Mental Health* 2004; **8**: 422-429.
4. Wong L, Martin-Khan M, Rowland J, et al., Reliability of the Rowland Universal Dementia Assessment Scale (RUDAS) via video conferencing. *International Journal of Geriatric Psychiatry* 2011; **26**: 988-989.
5. Grob P, Weintraub D, Sayles D, et al., Psychiatric assessment of a nursing home population using audiovisual telecommunication. *Journal of Geriatric Psychiatry and Neurology* 2001; **14**: 63-65.
6. Cullum CM, Weiner MF, Gehrmann HR, et al., Feasibility of telecognitive assessment in dementia. *Assessment* 2006; **13**: 385-390.
7. Ball C and McLaren P, The tele-assessment of cognitive state: a review. *Journal of Telemedicine and Telecare* 1997; **3**: 126-131.
8. Saligari J, Flicker L, Loh PK, et al., The clinical achievements of a geriatric telehealth project in its first year. *Journal of Telemedicine and Telecare* 2002; **8**: 53-5.
9. Loh PK, Donaldson M, Flicker L, et al., Development of a telemedicine protocol for the diagnosis of Alzheimer's disease. *Journal of Telemedicine and Telecare* 2007; **13**: 90-94.
10. Patterson V, Teleneurology. *Journal Of Telemedicine And Telecare* 2005; **11**: 55-59.
11. Martin-Khan M, Varghese P, Wootton R, et al., Successes and failures in assessing cognitive function in older adults using video consultation *Journal of Telemedicine and Telecare* 2007; **13**: 60-63.
12. Shores MM, Ryan-Dykes P, Williams RM, et al., Identifying undiagnosed dementia in residential care veterans: comparing telemedicine to in-person clinical examination. *International Journal of Geriatric Psychiatry* 2004; **19**: 101-108.
13. Martin-Khan M, Wootton R, Whited J, et al., A systematic review of studies concerning observer agreement during medical specialist diagnosis using videoconferencing. *Journal of Telemedicine and Telecare* 2011; **17**: 350-357.
14. American Psychiatric Association and American Psychiatric Association Task Force on DSM-IV, eds. Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). 4th ed. 1994, American Psychiatric Association: Washington, DC
15. Vertesi A, Lever JA, Molloy DW, et al., Standardized Mini-Mental State Examination. Use and interpretation. *Canadian Family Physician MÃ©decin De Famille Canadien* 2001; **47**: 2018-2023.
16. Rowland JT, Basic D, Storey JE, et al., The Rowland Universal Dementia Assessment Scale (RUDAS) and the Folstein MMSE in a multicultural cohort of elderly persons. *International Psychogeriatrics* 2006; **18**: 111-120.
17. Storey JE, Rowland JTJ, Basic D, et al., The Rowland Universal Dementia Assessment Scale (RUDAS): a multicultural cognitive assessment scale [corrected] [published erratum appears in INT PSYCHOGERIATR 2004 Jun;16(2):218]. *International Psychogeriatrics* 2004; **16**: 13-31.
18. Shulman KI, Clock-drawing: is it the ideal cognitive screening test? *International Journal of Geriatric Psychiatry* 2000; **15**: 548-561.
19. Dells D, Kaplan E, and Kramer J, Dells Kaplan Executive Functioning System. Examiner's Manual. 2001, San Antonio: The Psychological Corporation.

20. Sheikh J and Yesavage J, Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version, in *Clinical Gerontology: A Guide to Assessment and Intervention*, Brink T, Editor. 1986, The Howorth Press: New York. p. 165-173.
21. Jorm AF, A short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE): development and cross-validation. *Psychological Medicine* 1994; **24**: 145-153.
22. Kaufer D, Cummings J, Ketchel P, et al., Validation of the NPI-Q, a brief clinical form of the neuropyschiatric inventory. *The Journal of Neuropsychiatry and Clinical Neurosciences* 2000; **12**: 233-239.
23. Gelinas I, Gauthier L, McIntyre M, et al., Development of a functional measure for persons with Alzheimer's disease: the disability assessment for dementia. *American Journal of Occupational Therapy* 1999; **53**: 471-481.
24. Martin-Khan M, Varghese P, and Gray L, Physical examination and diagnosis of dementia for video consultation. *Journal of American Geriatric Society* 2008; **56**: 947-949.
25. Zarate CA, Jr., Weinstock L, Cukor P, et al., Applicability of telemedicine for assessing patients with schizophrenia: acceptance and reliability. *The Journal of Clinical Psychiatry* 1997; **58**: 22-25.
26. O'Reilly R, Bishop J, Maddox K, et al., Is telepsychiatry equivalent to face-to-face psychiatry? Results from a randomized controlled equivalence trial. *Psychiatric Services (Washington, D.C.)* 2007; **58**: 836-843.
27. Fleiss JL, Statistical methods for rates and proportions. 1981: John Wiley & Sons, Inc.
28. Loh PK, Maher S, Goldswain P, et al., Diagnostic accuracy of telehealth community dementia assessments. *Journal of the American Geriatrics Society* 2005; **53**: 2043-2044.
29. Russell T, Truter P, Blumke R, et al., The diagnostic accuracy of telerehabilitation for nonarticular lower-limb musculoskeletal disorders. *Telemedicine Journal And E-Health: The Official Journal Of The American Telemedicine Association* 2010; **16**: 585-594.
30. Loh PK, Ramesh P, Maher S, et al., Can patients with dementia be assessed at a distance? The use of Telehealth and standardised assessments. *Internal Medicine Journal* 2004; **34**: 239-242.
31. Ball C and Puffett A, The assessment of cognitive function in the elderly using videoconferencing. *Journal of Telemedicine and Telecare* 1998; **4**: 36-38.
32. Ball C, Tyrrell J, and Long C, Scoring written material from the Mini-Mental State Examination: a comparison of face-to-face, fax and video-linked scoring. *Journal of Telemedicine and Telecare* 1999; **5**: 253-256.
33. Ball C, Scott N, McLaren P, et al., Preliminary evaluation of a lowcost video-conferencing (LCVC) system for remote cognitive testing of adult psychiatric patients. *British Journal of Clinical Psychology* 1993; **32**: 303–307.
34. Montani C, Billaud N, Tyrrell J, et al., Psychological impact of a remote psychometric consultation with hospitalized elderly people. *Journal Of Telemedicine And Telecare* 1997; **3**: 140-145.
35. Montani C, Billaud N, Couturier P, et al., Telepsychometry: a remote psychometry consultation in clinical gerontology: preliminary study. *Telemedicine Journal* 1996; **2**: 145–50.
36. Poon P, Hui E, Dai D, et al., Cognitive intervention for community-dwelling older persons with memory problems: telemedicine versus face-to-face treatment. *International Journal of Geriatric Psychiatry* 2005; **20**: 285-286.

Table 1 Comparison of demographic & clinical assessment information for consenting and non-consenting patients

		Enrolled Sample (N=205)	Non-Enrolled Sample (N=65)
Demographic Details	Age	75.6 (51-95; SD 9.2)	71.7 (31-94; SD 14.0)
	Male[!]	106 (52%)	23 (35%)
	Female[!]	99 (48%)	42 (65%)
	CALD[ϕ]	14 (7%)	1(3%)
	SMMSE Score < 24	78 (38%)	31 (48%)
Assessment Scores	SMMSE[*]	23.9 (9-30; SD 4.7)	22.65 (3-30; SD 5.6)
	RUDAS[#]	23.8 (8-30; SD 4.8)	22.2 (6-30; SD 5.1)
	IQCODE[^]	4.0 (2.5 – 5.0; SD 0.6)	3.8(2.8-5; SD 0.7)

[ϕ]CALD: Culturally and Linguistically Diverse (People with a first language other than English)

[*]SMMSE is scored out of 30. Cut point for SMMSE is <24 for dementia. SMMSE: Standardised Mini Mental State Examination

[#]RUDAS is scored out of 30. Cut point for RUDAS is <24 for dementia. RUDAS: Rowland Universal Dementia Assessment Scale

[^]IQCODE is scored out of 5. Scoring: 1 = considerable improvement in cognitive function; 3 = no change in cognitive function; 5 = considerable deterioration in cognitive function. IQCODE: Informant Questionnaire on Cognitive Decline in the Elderly

[!]Gender was the only data item that was statistically significantly different between enrolled and non-enrolled sample (p-value: 0.02).

Table 2 Comparison of demographic & clinical assessment information for sample groups (FF and FV/VF)

		FF Group (n=105)	VF/FV Group (n=100)
Demographic Details	Age	75.4 (54-91; SD 8.7)	75.8 (51-95; SD 9.7)
	Male	55 (52%)	51 (51%)
	Female	50 (48%)	49 (49%)
	CALD[ϕ]	11 (11%)	3 (3%)
	SMMSE Score <24	39 (37%)	39 (39%)
Assessment Scores	SMMSE	24.1 (10-30; SD 4.3)	23.6 (9-30; SD 5.1)
	RUDAS	22.0 (8-30; SD 4.8)	21.7 (8-30; SD 4.8)
	IQCODE	4.0 (2.5-5; SD 0.6)	4.0 (2.8-5; SD 0.6)

[ϕ]CALD: Culturally and Linguistically Diverse (People with a first language other than English)

Table 3 Responses of pairs of doctors with respect to the presence of dementia (shaded boxes indicate cases of complete agreement between doctors)

			Interview 2				
			Normal	Cognitive Impairment	Dementia Present	Total	Overall Agreement n (%)
Group FF	**Interview 1**	**Normal**	3	6	1	10	3 (3%)
		Cognitive Impairment	1	30	12	43	30 (29%)
		Dementia Present	1	10	41	52	41 (39%)
	Total		5	46	54	105	**74 (70%)**
			Face-to-face Interview				**Overall**
			Normal	**Cognitive Impairment**	**Dementia Present**	**Total**	**Agreement n (%)**
Group FV/VF	**Video Conference Interview**	**Normal**	2	2	1	5	**2 (2%)**
		Cognitive Impairment	7	29	9	45	29 (29%)
		Dementia Present	0	10	40	50	**40 (40%)**
	Total		9	41	50	100	**71 (71%)**

Figure 1 STARD flow diagram - Recruitment and allocation to assessment group