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CAMDEX

A Standardised Instrument for the Diagnosis of Mental Disorder in the Elderly with Special Reference to the Early Detection of Dementia

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A new interview schedule for the diagnosis and measurement of dementia in the elderly is described. The schedule named the Cambridge Mental Disorders of the Elderly Examination (CAMDEX), consists of three main sections: (1) A structured clinical interview with the patient to obtain systematic information about the present state, past history and family history; (2) a range of objective cognitive tests which constitute a mini-neuropsychological battery; (3) a structured interview with a relative or other informant to obtain independent information about the respondent's present state, past history and family history. The CAMDEX is acceptable to patients, has a high inter-rater reliability and the cognitive section has been shown to have high sensitivity and specificity.

Introduction

Attempts have been made in the past to assess and characterise patients suffering from dementia in late and middle life. They have aimed at resolving three related, but relatively distinct, problems:

(1) To diagnose dements reliably either by the use of operational criteria such as those set down in DSM-III (American Psychiatric Association 1980) or by using standardised methods of interview and examination such as the Present State Examination (PSE) of Wing *et al* (1974) or its derivatives.

(2) To develop valid and reliable measures of the severity and extent of cognitive impairment which constitutes a central feature in established cases of dementia.

(3) To devise reliable means of rating behaviour and adaptation in everyday life that are as objective and precise as the situation permits and independent of clinical diagnosis or severity of dementia as judged from performance on standardised tests.

As a result of these enquiries, a number of scales useful for certain specific purposes have been developed. For example, standardised diagnostic interviews such as the Psychogeriatric Assessment Schedule (PAS) of Bergmann *et al* (1975) are capable of separating groups of patients into 'demented' and 'non-demented' or 'functional' groups. This makes them valuable for certain kinds of scientific enquiry: for example, clinical trials or epidemiological studies in the community to provide a basis for social and health care planning. A large number of cognitive tests have come into existence which are of two broad types. Mental state examinations are capable of differentiating between the presence or absence of significant cognitive impairment while tests which derive from the psychometric tradition such as the Kendrick Battery (Kendrick, 1972; Kendrick & Moyes, 1979) permit an assessment of severity of cognitive impairment. There are also many useful behaviour rating scales which can detect problems in the activities of daily living. One of these scales, the widely used Dementia Scale of Blessed *et al* (1968) shows a good correlation with Alzheimer neuropathology, while the rating scale of Roberts & Caird (1976) has been found to correlate with computed tomography (CT) scans.

However, one source of difficulty and confusion has been the failure to differentiate between the type of information which each of these three approaches can validly yield. In consequence, a scale or interview developed to answer one type of question has been inappropriately used to answer another. For example, behavioural scales alone have been employed as measures of dementia or the results of cognitive tests have been used to establish a diagnosis. Such misconceptions are liable to introduce error and confusion, into research endeavours and clinical practice alike.

We believe that the three approaches to characterising the demented patient are complementary. All three are required to obtain a

complete picture of the disorder. The central objective of the endeavour to be described in this paper was to incorporate these different kinds of measure within a single compact, integrated instrument that has an acceptable measure of reliability and validity.

Developments in the diagnosis of dementia

Although operational criteria for the diagnosis of dementia such as those provided in DSM-III have improved stringency in diagnostic practice, they are somewhat arbitrary. Moreover, these criteria do not serve to identify mild dementia which presents a problem of central importance in this field (Henderson & Huppert, 1984).

There is more promise in the structured and semi-structured interview schedule from which diagnosis of organic mental disorder can be derived. The two best known schedules are the Present State Examination (PSE) of Wing *et al* (1974) and the Diagnostic Interview Schedule (DIS) of Robins *et al* (1981). However, neither of these instruments provide sufficient information regarding the history of onset and the character and progression of cognitive impairment.

The Geriatric Mental State Examination (GMS) of Copeland *et al* (1976) which is largely derived from the PSE and uses the same hierarchical approach to the problem of diagnosis, incorporates more tests of cognitive function. It has been used in the influential US–UK Diagnostic Project for comparing mental disorder in the elderly in New York and London and has now been incorporated, with some modification, into the Comprehensive Assessment and Referral Evaluation (CARE) of Gurland *et al* (1977). It differentiates between six principal diagnostic categories of old age mental disorder. They are: affective disorders, schizophrenia/paranoid states, organic psychoses, alcoholism, neuroses and personality disorders, and other diagnoses. And in two small studies of inter-rater reliability (Copeland *et al*, 1976), the diagnostic agreement was of the order of 85% on a sample of 20 and 73% on a sample of 22 patients.

These scales represent an advance in that they standardise the examination of the present mental state and render the findings relating to the present state more objective and replicable. However, the entire psychiatric examination required to make a diagnosis has not been standardised.

This is of particular importance in the characterisation and measurement of dementia. The relevant data cannot be extracted from standardised examinations formed on the present mental state alone. Such findings can lead to error if they are not combined with data relating to the development of the disorder. Information regarding adaptation during development and basic personality traits and observations on the behaviour of the patient over a period of time are also needed to determine the extent of his premorbid traits and competence in negotiating everyday tasks. For such information, the judgments of a relative or friend or observations conducted over a period in hospital, are indispensable. Such behaviour will sometimes be deranged and disorganised before evidence suggestive of dementia comes to light during a structured interview. To cite an example, in the course of a cross-sectional examination, a differential diagnosis between dementia and states of subacute clouding of consciousness can be difficult or impossible. Yet given a few items of information regarding the history and development of the condition and the background of the individual, the diagnosis rarely presents difficulties.

Differential diagnosis

Both in respect of therapy and scientific investigation, the failure to differentiate between forms of dementia attributable to different aetiological processes would serve to obscure important findings. Multi-infarct dementia requires to be differentiated from Alzheimer's Disease and the Ischaemia Score (Hachinski *et al*, 1975) has made a start in relation to this. Means of refining the Hachinski score have been suggested (Roth, 1981) and they have been incorporated in the interview described here. Again, clouded and delirious states need to be separated from the dementias. Doubts about diagnosis can be resolved by information relating to the development of the disorder, the previous medical history and evidence regarding drug and alcohol abuse. The record of previous psychiatric illness and family history can help in the differentiation of pseudo-dementia from true dementia. The family record can also assist in the differentiation of Alzheimer's disease of 'early' and 'late' onset; an excessive prevalence of dementia in first degree relatives has been found more commonly in 'early' cases (Heston, 1984).

Measurement of the range and severity of cognitive impairment

A scale for the objective assessment of cognitive function is an essential component of any systematic schedule for the diagnosis and precise delineation of dementia. Subjective complaints of poor memory and word finding difficulty have been shown to be

more influenced by depressed mood than by objective evidence of cognitive impairment (e.g. Kahn *et al*, 1960). The cognitive section of the GMS and the CARE have therefore to be interpreted with caution, since they contain a large number of self-report items. Nor are standard mental status questionnaires, of which there are a large number, adequate for this purpose. Although they employ objective tests, they are usually concerned only with memory and orientation and designed for use with a markedly impaired population. A cognitive function test must sample a broad enough range of functions to meet diagnostic criteria for dementia: DSM-III for example, requires the demonstration of a generalised loss of cognitive functions including language, praxis, perception, abstract thinking and constructional ability as well as memory. Both the older and some of the more recent schedules fail to meet these requirements.

The Mini Mental State Examination (MMSE) of Folstein *et al* (1975) appears to be the best brief objective cognitive test currently in use as part of a diagnostic schedule (it has been incorporated into the DIS), but even the MMSE fails to assess perceptual ability and abstract thinking, and permits only a rudimentary assessment of most other functions. For this reason, we have developed our own cognitive test as part of the diagnostic schedule. However, given the popularity of the MMSE and its use in the influential survey of elderly community residents currently being undertaken by the National Institute of Aging in the USA, we included the Mini Mental State Examination in our cognitive section to enable direct comparisons with the results of other investigators.

A further requirement for a research diagnostic tool, is the reliable grading of severity of dementia. A number of rating scales have been developed in recent years notably the Clinical Dementia Rating (CDR) of Hughes *et al* (1982) and the Global Deterioration Scale (GDS) of Reisberg *et al* (1982). The CDR rates dementia along a five-point scale (none, questionable, mild, moderate, severe) on the basis of the person's performance in six areas of daily living: memory, orientation, judgement and problem solving, community affairs, home and hobbies, and personal care. The criteria are not easy to apply in practice, but questions also arise regarding their validity. Patients may receive the same rating (e.g. CDR 1 or mild dementia) whether or not they have additional difficulty with language or praxis. Yet in a 12-month follow-up study, a poorer prognosis has been reported for patients who had such difficulty at the initial assessment. Patients who progressed to moderate (CDR 2) or severe dementia (CDR 3) performed significantly worse when originally assessed on all tests of language and praxis as well as on most memory tests (Berg *et al*, 1983). Findings such as these make it imperative that all areas of cognition should be taken into account when arriving at a severity rating. The Global Deterioration Scale (GDS) of Reisberg *et al* (1982) grades cognitive impairment along a seven-point scale, but the criteria rely very heavily on the severity of memory disorder. While we acknowledge that grading the severity of dementia is not an easy task, we propose to show that a clinical assessment of severity based on a range of cognitive tasks and activities of daily living can be made in a reliable way.

In its present form, the CAMDEX focuses on the diagnosis of dementia, with particular reference to its mild forms and to the identification of specific types of dementia. This task requires the differentiation of dementia from non-dementing conditions which may masquerade as dementia. Hence items relevant to other diagnoses must be included. Such items, particularly those relating to depression and paranoid states, are also needed to complete the clinical picture in dementia and are of therapeutic importance. At a later stage when an adequate body of CAMDEX data for patients with a wide range of psychiatric diagnoses has been collected it may be possible to broaden the CAMDEX into a comprehensive diagnostic instrument for psychiatric disorders of the elderly.

Objectives in the development of the present schedule

We have attempted in the development of the schedule which we have called the Cambridge Mental Disorders of the Elderly Examination (CAMDEX), to remedy the gaps in the existing standardised interviews and scales of measurement. We understand that since we began work on this project additional sections are now being added to the GMS to provide this information (Copeland, personal communication).

In developing the CAMDEX we have sought to create a diagnostic schedule with the following main ingredients.

(1) A structured psychiatric interview with the respondent incorporating questions regarding the present mental disorder and the past history and family history.
(2) The objective evaluation of a broad range of cognitive functions.
(3) A standardised schedule for recording observations of the present mental state together with appearance and demeanor.

(4) A structured interview with a relative or other informant able to provide independent information regarding the respondent's present state, any changes in personality and activities of daily living, past history, and family history.
(5) A brief physical examination including neurological examination.
(6) A record of a range of laboratory findings and present medication where applicable.

The CAMDEX schedule

In its present form this schedule comprises a number of sections which are outlined below. It starts with a sheet on which basic demographic data are recorded.

Section A

This section covers items of enquiry regarding the patient's present physical and mental state and in particular seeks symptoms relating to organic psychoses, depression and functional paranoid psychoses. Enquiries regarding past history and family history are also made. The questions posed in the final part of this section are prompted by the preliminary evidence suggesting a relationship in Alzheimer's disease on the one hand, and Down's syndrome and leukaemia on the other (Heston & Mastri, 1977). The section starts with three simple questions; the patient's name, age and date of birth. If the patient fails to provide satisfactory answers to two out of three questions the interviewer abandons Section A and moves on to Section B.

Section B

This consists of the cognitive examination. The 19 items which comprise the widely used Mini Mental State Examination (MMSE) of Folstein *et al* (1975) are incorporated into this section. However, a number of additional items have been included to compensate for weaknesses in the MMSE. First, the MMSE does not sample certain cognitive functions e.g. abstract thinking and perception, which are relevant to diagnosis and are included in DSM-III operational criteria for primary degenerative dementia. Second, many functions are assessed by the MMSE in insufficient detail. For example, memory is assessed only by the repetition and recall of three words; we have added items covering remote and recent memory and the recall and recognition of new information. (For full details of the cognitive examination see Huppert *et al*, 1985.) Thus the cognitive section of the CAMDEX provides a wider coverage of cognitive functions than the MMSE, as well as more information about most functions. The test assesses orientation, language, memory, praxis, attention, abstract thinking, perception and calculation. Parts of each interview have been recorded so that various aspects of spontaneous speech and the content of language can be systematically assessed later.

Section C

This consists of the interviewer's observations on the patient's appearance, behaviour, mood, speech, mental slowing, activity, insight, thought processes and level of consciousness, and any bizarre behaviour. The section is completed at the end of the interview.

Section D

This comprises a simple physical examination including blood pressure, superficial and tendon reflexes, gait, defects of hearing or sight, tremor and Parkinsonian features to provide some of the information needed for differentiating between 'primary' and 'secondary' dementias.

Section E

The results of laboratory and radiological investigations are recorded in this section. Blood count, B_{12} and folate, urea and electrolytes, liver function tests, VDRL, skull X-ray and CT scan, are recorded whenever available.

Section F

A record is set down of any medication currently being taken by the patient, and a note of the approximate period during which drugs have been taken.

Section G

This provides for any additional items of information obtained in the course of the interview. The purpose of this section is to amplify the picture of the patient already obtained by the structured questions. Much information in this section is spontaneously offered and of interest on this account alone in addition to the help it may afford to formulate a diagnosis at the end of the interview, particularly in atypical and difficult cases.

Section H

This comprises the structured interview with a relative, or a carer who knows the patient well. Any personality change, difficulty in functioning in everyday life or indications of cognitive difficulty noticed by the carer are noted. Items which permit the Newcastle Dementia Score (Blessed *et al*, 1968) to be scored are incorporated in this section. Questions referable to the presence or absence of depressive or paranoid phenomenology are included. Family history and past history are investigated with the aid of questions similar to those asked of the patient.

At the end of the interview, the interviewer makes a psychiatric diagnosis based on all relevant and available information according to operational diagnostic criteria. Diagnoses are assigned to one of 11 categories: normal, four categories of dementia (senile dementia of the Alzheimer type (SDAT), multi-infarct dementia (MID), mixed SDAT and MID; dementia secondary to other causes), two categories of clouding or delirium (clouded state, clouded state with dementia), depression, anxiety or phobic disorder, paranoid or paraphrenic illness and other psychiatric disorder. Patients are also graded for severity of dementia and severity of depression each on a five-point scale.

Duration of administration

The administration of the respondent's part of the interview can be completed in about 60 minutes. The informant's section takes about 20 minutes.

Test procedure

Subjects

Forty patients (33 female and 7 male) over the age of 65 were interviewed for the reliability study. The main diagnostic categories are given in Table I. A further 52 patients were interviewed (R.G.) so that clinical diagnostic scales could be developed and the cognitive tests used on a larger population. There were 61 females and 31 males in all. They were recruited mainly from inpatients and outpatients from the Department of Geriatric Medicine at Addenbrooke's Hospital, Cambridge, and the Department of Psychogeriatrics, Fulbourn Hospital, Cambridge. The normal group consisted of both geriatric patients and community residents, chiefly from warden-controlled sheltered accommodation.

TABLE I

Inter-rater reliability of CAMDEX for major diagnostic groups

Interviewer diagnosis	*Observer diagnosis*			
	Normals	*Dementia*	*Clouding*	*Depression*
Normal	9			
Dementia		22		
Clouding		1	4	
Depression	1		1	2

Method

The 40 patients participating in the study of inter-rater reliability were rated at the same time by two psychiatrists; one acting as interviewer for the whole interview and the other as observer. Both psychiatrists completed the CAMDEX independently. One psychiatrist (E.T.) was present at the interview of all patients and was the interviewer in half the interviews. Three other psychiatrists (H. H., S. V., R. G.) took part in the reliability study. Two of the four psychiatrists were trained in the UK and two in the USA. For each patient the ratings of the two psychiatrists were compared for all items and for each section of the CAMDEX. The purpose of the item analysis was to identify the questions with a high rate of disagreement between interviewers so that the source of the disagreement could be ascertained and the question modified or discarded from the next edition of the schedule.

The agreement between interviewers was measured by means of the phi (ϕ) coefficient (Guilford & Fructer, 1981). Although ϕ can vary from -1 to $+1$, only under certain conditions can the coefficient be as extreme as either of these limits. It is only when the two means are identical that the coefficient equals 1. The degree of difference between means is reflected in the degree of reduction in the value of the ϕ coefficient.

Results

Inter-rater reliability

Diagnostic agreement

There was good agreement between pairs of psychiatrists in the main diagnostic groupings (Table I). There was complete agreement on cases diagnosed by the interviewer as normal or demented. One of the five cases diagnosed by the interviewer as clouded was classed as demented by the observer, while of the four cases diagnosed by the interviewer as depressed, the observer agreed on two, but classed one as normal and one as demented.

The ϕ coefficient for diagnostic agreement was reduced to 0.63 when dementia was subdivided into four diagnostic categories: SDAT, MID, mixed SDAT and MID and dementia secondary to other causes. There was complete agreement between raters on the ten cases diagnosed by the interviewer as SDAT and one case of secondary dementia. Two of the eight cases diagnosed as MID were classed as

TABLE II
Inter-rater reliability of sections of CAMDEX

Section	ϕ Coefficients (2×2 agreement/ disagreement on individual items)		Pearson correlations of total scores for each section	
	Median	Range	r	P
A Interview with patient	0.94	1.0–0.28	0.99	0.000
B Cognitive examination	0.90	1.0–0.30	0.97	0.000
C Observations	0.83	1.0–0.30	0.81	0.000
H Interview with informant	0.91	1.0–0.56	0.90	0.000

mixed by the observer, and one of the three cases diagnosed as mixed was classed as SDAT by the observer.

Agreement on subsections of the scales

The ϕ coefficient was calculated for each item in Sections A, B, C and H of the CAMDEX. Table II presents the median and range of these values.

It will be seen that all the median coefficients for sections are high. The lowest value obtained was derived from the record of observed behaviour (Section C) independently set down by the two psychiatrists, but at 0.83 this section may be judged satisfactory and to show an acceptable degree of inter-observer agreement.

Some idea of the reliability of the items can be obtained from the range of ϕ coefficients estimated for the different items in each section. The item with the lowest reliability in Section A was the judgement by the psychiatrists as to whether physical disability accounted for the patients' inability to deal with household tasks (ϕ 0.28). The item with lowest reliability in the cognitive examination (Section B) concerned the naming of as many different animals as possible in a minute (ϕ 0.30). This wide disagreement was traced to the fact that one of the raters had excluded fish or birds. The poorest item in the observation section (Section C) was "Speech very slow. Pauses between the words" (ϕ 0.33). In such cases, scoring instructions have been made more explicit to increase reliability in the revised version.

The answers recorded from relations or carers (Section H) showed very good agreement between raters. The item with the lowest ϕ coefficient was "Does he/she have difficulty in knowing where he/she is or in recognizing you?" (ϕ 0.53). This is probably too terse and ambiguous for lay persons and has been made more specific in revision.

However, the proportion of items with low ϕ coefficients proved relatively small. The great majority of items reached an acceptably high inter-rater reliability.

Correlations between the total scores obtained by the two psychiatrists for each section are also shown in Table II. The correlations are all high and very significant statistically.

Cognitive performance

The results presented here were for the whole sample of 92 patients. The diagnoses in the total group were 17 normals, 26 with SDAT, 13 with MID, seven mixed SDAT and MID, three with dementia secondary to other conditions, five clouded-delirious (hereafter called clouded state), nine clouded states superimposed on dementia, and 12 depressed patients. For the three cases where interviewer and observer disagreed about the diagnosis, the interviewer's diagnosis was used. There was no significant difference between diagnostic groups in respect of sex or age of the patients, except that the depressed patients were significantly younger (71.9) than the normal (79.5), SDAT (79.3) and MID (80.1) groups.

Sensitivity and specificity

From the cognitive section (Section B) we obtain two overall measures of cognitive function: (a) total score on the Mini Mental State Examination (MMSE) of Folstein *et al* (1975) and (b) total score on The Cambridge Cognitive Examination (CAMCOG) which consists of 14 of the 19 MMSE items plus 43 items covering additional aspects of cognitive function. Maximum scores are 30 on the MMSE and 106 on the CAMCOG.

Table III shows the cognitive scores in the four major diagnostic groups. The normal and depressed groups did not differ significantly from each other on either test but performed markedly better than either the demented or clouded groups ($P<0.001$) which did not differ from each other.

The sensitivity and specificity of the two tests for detecting organic mental impairment have been calculated. For the MMSE a cut-off value of 21/22 was recommended for those aged 60 or over (Anthony *et al*, 1982). Using this cut-off we obtain values of 96% sensitivity and 80% specificity for our population. This means that 96% of cases with an MMSE score of 21 or less had a clinical diagnosis of organic mental disorder (dementia or clouded state) while 80% of cases with an MMSE score of 22+ had been diagnosed as normal or depressed. Conversely, 20% of those scoring 22+ had a clinical diagnosis of organic mental disorder and hence were misclassified using this cut-off. We found that the optimal cut-off for our sample, was 23/24 which yielded 94% sensitivity and 85% specificity.

Sensitivity and specificity of the CAMCOG were also calculated. Examination of the distribution of scores showed the optimal cut-off to be 79/80. This yields 92% sensitivity and 96% specificity. Only one organically

TABLE III
Total scores for the Cambridge Cognitive Examination (CAMCOG) and the Mini-Mental State Examination (MMSE) in the major diagnostic groups

	Mean and range of CAMCOG scores (maximum = 106)		Mean and range of MMSE scores (maximum = 30)	
Normal ($n=17$)	90.0	(72–101)	26.7	(22–29)
Demented ($n=49$)	44.2	(8–82)	13.4	(1–25)
Clouded ($n=14$)	52.3	(38–79)	15.3	(9–27)
Depressed ($n=12$)	83.9	(68–98)	24.8	(14–30)

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impaired patient was misclassified by this instrument compared with four who were misclassified by the MMSE.

Several patients obtained maximum or near maximum scores on the MMSE. Sixteen patients scored 27+, including five depressed and one clouded patient. Five patients scored 29+ (three normals, two depressed), the highest score (30) being obtained by a depressed patient. In contrast, only two patients, both normals obtained a CAMCOG score of 100+ while an additional two (one normal, one depressed) scored within 10 points of the maximum, and a further five (two normal, three depressed) scored within 20 points of the maximum. These findings demonstrate that CAMCOG can discriminate between individuals even at the high end of the ability range.

Severity of dementia and cognitive function

The relationship between cognitive performance and severity of dementia was examined by correlating both the dementia score (Blessed *et al*, 1968) and the clinical rating of severity of dementia with scores on the cognitive tests. For the group as a whole, all correlations were highly significant ($P<0.000$). The dementia score correlated -0.70 with the CAMCOG and -0.66 with the MMSE. The clinical rating of severity of dementia correlated -0.78 with the CAMCOG and -0.76 with the MMSE. There was a correlation of 0.94 between the two cognitive tests and 0.68 between the dementia score and the clinical rating of severity.

The dementia score correlated significantly with each of the eight subscales of the Cambridge Cognitive Examination (orientation, language, memory, praxis, attention, abstract thinking, perception and calculation). The clinical rating of severity of dementia also correlated highly with the cognitive subscales ($P<0.000$ for all comparisons).

Within the demented group as a whole ($n=49$) there was very good agreement between cognitive performance and the clinician's estimate of severity of dementia. The correlation was -0.83 for the total score on the CAMCOG and -0.69 for the score on the MMSE. The correlation was highly significant for each of the eight cognitive subscales, the highest correlation being obtained for language (-0.77) and the lowest for attention (-0.40, $P=0.004$).

Subjective assessment of cognitive function

Cognitive function was reported subjectively by the patient in Section A of the CAMDEX and reported by the informant in Section H. We examined the relationship between this type of information and objective measures of cognitive performance. Three questions in Section A were concerned with the patient's self-assessment of memory; a general question about memory difficulty, a question about misplacing objects and a question about losing one's way in familiar surroundings. None of these correlated significantly for the group as a whole, with performance on the memory items or any other measures of cognitive performance. Questions about difficulty with concentration, slowing of speech or slowing of thoughts also failed to correlate significantly with cognitive performance. On the other hand, the responses of informants to five questions about memory, concentration and muddled thinking, all correlated highly ($P<0.001$) with total score on the CAMCOG and ($P<0.01$) with seven of the eight cognitive subscales (orientation, language, memory, praxis, attention, abstract thinking, perception) while all failed to correlate with the calculation subscale and a measure of reading ability.

A question about word-finding difficulty was also asked of both the patient and the informant. Patient's self report did not correlate significantly with objective measures of naming or verbal fluency although it correlated significantly with measures of verbal memory ($P<0.01$). The informant's evaluation of the patient's word-finding difficulty correlated significantly ($P<0.01$) with both naming and fluency, and with each of the main cognitive subscales except memory.

In general it may be concluded that the patient's self report of cognitive function bears no relation to cognitive performance whereas the informant's judgment provides a reliable guide. Consistent with this is the absence of any significant correlations between patients' and informants' reports of the patient's of cognitive function.

Depressed mood and cognitive function

In addition to making a clinical diagnosis of depression and rating its severity, CAMDEX permits depressed mood to be assessed in all patients. This is done by; (a) self report on 20 items from Section A relating to the signs and symptoms of depression which were added together to provide a depression severity scale, and (b) the informant's response to the question, "Do you think he/she is depressed?". We examined the relationship between these measures and cognitive performance.

For the group as a whole, scores on the depression severity scale are significantly related to orientation and memory performance ($P<0.01$) but not to any other measure of cognitive performance. The informant's assessment of depressed mood correlated significantly ($r=0.30$, $P<0.01$) with scores on the depression severity scale but not with any measure of cognitive function.

Responses to a key item in the depression severity scale ("Do you feel sad, depressed or miserable?") were found not to be related to cognitive performance, but correlated 0.64 ($P<0.001$) with informant's assessment of depression. These findings indicate that the presence of the signs and symptoms of depression is related to impaired memory functioning but complaints about depressed mood are not.

Development of the clinical diagnostic scales

The number of patients in the SDAT, MID and depressed groups was sufficiently large to consider the development of a diagnostic scales from items in the CAMDEX. The first stage was to select items considered, on clinical grounds, to be of possible use in making differential diagnoses. The frequency distribution of these items was drawn up for all diagnostic groups recorded on the CAMDEX and those items which proved to differ in frequency between diagnostic groups were selected for the development of three diagnostic scales. The first intended

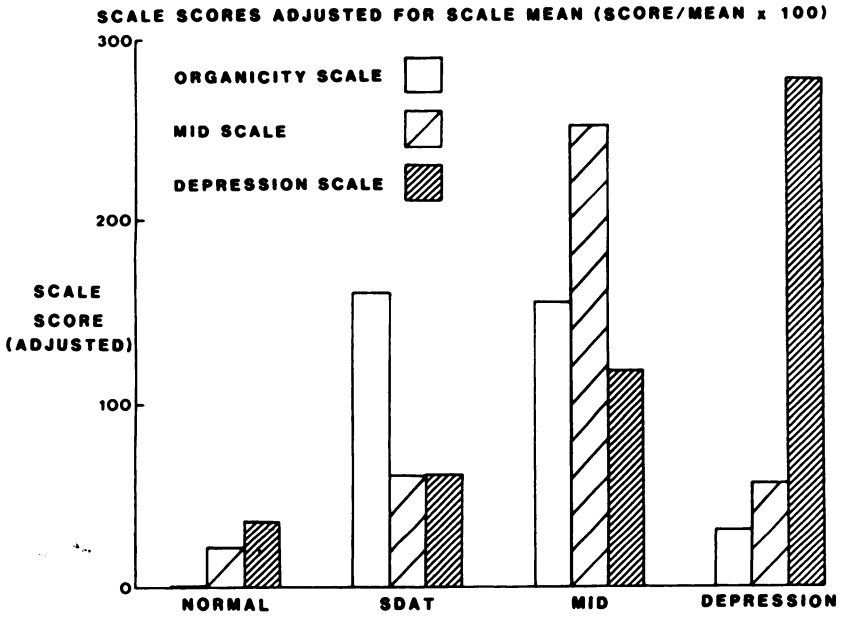

FIG. 1. Mean scores on diagnostic scales for four diagnostic groups. (Scores adjusted for scale score mean.)

as a scale for SDAT consisted of 18 items and proved to be a scale of organicity in general. The second was a scale for MID which consisted of 12 items, and the third for depression consisting of 14 items. The scores on these subscales plotted by the diagnosis made on the basis of operational diagnostic criteria is illustrated in Fig. 1.

The cumulative frequency curves of the scores in each scale were plotted for SDAT, MID, depressed and normal groups, (Figs 2, 3, 4). These graphs were used to determine optimal cut-off points for diagnosis. The proportion of correctly classified patients using these optimal cut-off points is shown in Table IV.

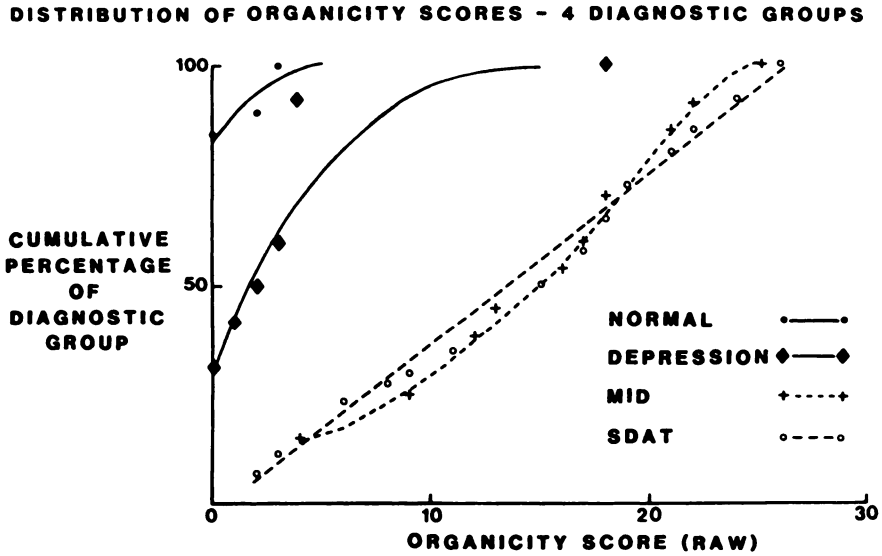

FIG. 2. Distribution of scores on organicity diagnostic scale for normal, depressed, SDAT and MID groups.

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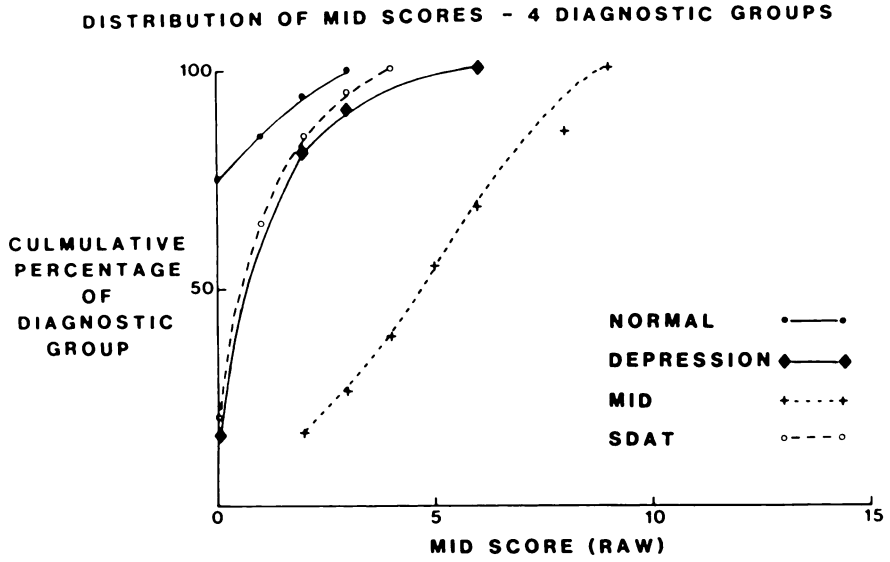

FIG. 3. Distribution of scores on MID diagnostic scale for normal, depressed, SDAT and MID groups.

The statistical significance of the diagnostic differentiation between the groups at these cut-off points was tested, using χ^2 tests and Fisher's exact test. Using a cut-off point of 4, the organicity scale differentiated between SDAT patients and normals ($P<0.0001$) and depressed patients ($P<0.0005$) but did not differentiate between SDAT and MID. A cut-off point of 2 on the MID scale produced significant differences between MID cases and normals ($P<0.01$), SDAT ($P<0.0001$) and depression ($P<0.001$). A cut-off point of 10 on the depression diagnostic scales produced significant differences between depressed patients and normals ($P<0.0001$), SDAT

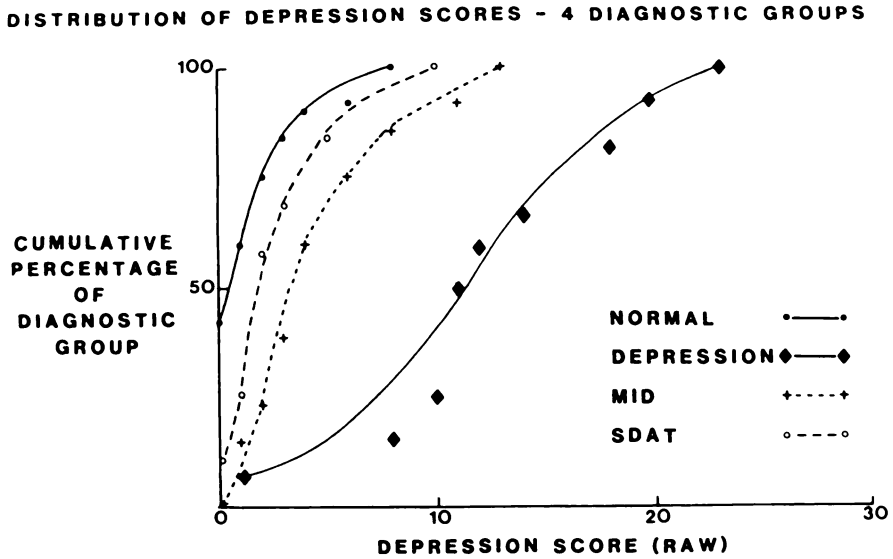

FIG. 4. Distribution of scores on depression diagnostic scale for normal, depressed, SDAT and MID groups.

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TABLE IV
Classification of diagnoses by clinical diagnostic scales using approximate cut-off points

	Cut-off score	% Correctly classified			
		Normal	SDAT	MID	Depression
Organicity scale	4	100	85	85	92
MID scale	2	95	85	85	83
Depression scale	10	100	100	85	75

($P<0.0001$) and MID ($P<0.01$). It has to be borne in mind of course that there can be no complete differentiation since the conditions are not mutually exclusive in reality as is probably reflected in cases of depression and MID.

The independence of the three scales was tested by calculating their inter-correlations. These showed that there was a high degree of independence between the depression scale and the other two scales ($r=-0.15$ and 0.18 for organicity and MID scales respectively) although a significant relationship between the organicity and MID scales was found.

A test of reliability of the scales was made by an odd-even-split-half method. The reliability coefficients were corrected to full length and are shown below. A particularly high level of reliability is shown for the organicity scale (0.95). The other two scales for depression (0.90) and MID (0.77) seem quite acceptably reliable.

The problem of validity is difficult. A clinical diagnosis made under these circumstances cannot be fully independent of responses to items in the scale since the items are based on similar considerations to those on which clinical judgement is based. This is, of course, substantially why the items are included in the scale at the outset. Equally the expectations resulting from a clinical diagnosis probably create some bias in the evaluation of responses to the scale items, where the scale is administered by the diagnostician. Difficulties of this kind are incapable of complete resolution and validation becomes a progressive process of iterations, in which many varied sources of information must be used. In the present research the scales described are derived only from clinical data and, therefore, it is possible to turn to the cognitive section to look for validation. A positive correlation would show a relationship between a scale and some aspect of cognitive performance such as to indicate the scale was a rational measure. It is, of course, to be noted that the absence of a correlation simply would leave the validity question open since the test does not propose a relationship of any hypothetical kind.

TABLE V
Correlations between clinical diagnostic scales and factors derived from cognitive items

	Factor 1 (66.5%)	Factor 2 (9.5%)	Factor 3 (6.7%)	Total score on CAMCOG
Organicity	−0.61***	0.19	0.13	−0.63***
MID	−0.27**	−0.10	−0.01	−0.25*
Depression	0.21*	−0.12	0.02	0.22*

(Figures in brackets are variance explained by each factor)
*$P<0.05$
**$P<0.01$
***$P<0.001$

Items from the cognitive section were subjected to a principal component analysis and the resulting factor scores of the first three factors were also correlated with the three scale scores. The pattern of results for Factor 1, a general factor, was strikingly similar to that obtained for the total score on CAMCOG as a whole (Table V). Both correlated highly with the organicity scale giving substantial support for its validity. There is also a smaller but statistically significant correlation with the MID and depression diagnostic scales.

The organicity and MID scales also correlated significantly with the psychiatric global rating of dementia though not with global ratings of depression. The reverse was true of the depression diagnostic scale which correlated highly with the clinical global rating of depression (Table VI).

TABLE VI
Correlation coefficients between clinical diagnostic scales and global ratings of severity

Clinical scale	Dementia	Depression
Organicity	0.73***	−0.11
MID	0.28**	0.15
Depression	−0.25	0.74***

**$P<0.01$
***$P<0.0001$

Eight of the 18 items in the organicity diagnostic scale are items which also appear in the Newcastle Dementia Scale for severity of dementia (Blessed *et al*, 1968) and there is therefore a high correlation between the two scales (0.95) although the Blessed scale did not differentiate satisfactorily between diagnostic groups.

Discussion

In this paper we have described a diagnostic and assessment schedule that seeks to evaluate all parameters of present state, history, observation and measurement that may be relevant for the purpose of diagnosis and quantitative gradation of dementia.

Each section of the CAMDEX has been found to have an acceptably high measure of inter-observer reliability and this holds also for the great majority of individual items. The measure of agreement between different psychiatrists in respect of broad categories of diagnosis has also proved satisfactory and compares favourably with figures for inter-observer agreement in published schedules directed at the problem of diagnosis alone (Henderson *et al*, 1983). Data relating to test and re-test reliability are for the present limited; there are special problems attaching to the administration within a short period

of a long assessment schedule to elderly individuals. However, agreement between test and re-test within 3 weeks in a small number of cases is good.

The CAMCOG score in the cognitive section proved to have a high sensitivity and specificity in differentiation between organic and non-organic cases and was highly correlated with the Blessed Dementia Scale and the psychiatrist's clinical rating of severity.

Two principal advantages which the CAMCOG has over the widely used Mini Mental State Examination (Folstein *et al*, 1975) are (i) it covers a broader range of cognitive functions (ii) it detects mild degrees of cognitive impairment and (iii) it avoids ceiling effects.

Comparisons between information obtained from patients and their relatives indicates that relatives may be unaware of depressed mood but are far better at assessing cognitive impairment than are patients themselves.

The diagnostic scales derived from the sample show a relatively good classification rate; are reliable as shown by the split half reliability and have some evidence of validity, inferred from their correlations with global clinical ratings and with cognitive performance. These scales must now be tested on a new population so that their utility can be assessed. In the longer term it is planned to use these as the basis for computerised diagnosis, along the lines of the CATEGO classification (Wing *et al*, 1974) and the AGECAT classification newly developed by Copeland and his colleagues for the GMS, in which organic psychosis is treated as a single category.

It is intended to investigate the validity of the CAMDEX schedule in a number of different ways, including long-term follow-up studies and correlation with pathological and biochemical measures. Examination of cognitive change in the follow-up studies will be of particular importance for the derivation of valid criteria in the diagnosis of early and mild dementia and depressive pseudo-dementia. Post mortem studies of the brain should also prove valuable to this end in addition to shedding light on the structural and neurochemical changes associated with the early stages in the development of dementia which are for the present largely unknown.

For the present the CAMDEX has proved itself of value as an instrumental aid in clinical diagnosis. When determined with the aid of CAMDEX, diagnoses have shown an acceptably high measure of inter-observer correlation. To develop the CAMDEX to the next stage will require additional data derived from the independent methods of validation which have been suggested in this section of the paper.

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