Dementia: Predictors of diagnostic accuracy and the contribution of diagnostic recommendations

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KEY POINTS FOR CLINICIANS

- Activities of daily living dependency and a longer time since the onset of symptoms are associated with a diagnosis of dementia, whereas somatic comorbidity is associated with the absence of dementia.
- Family physicians should be aware of diagnostic difficulties in patients with somatic comorbidity.
- We were unable to confirm the diagnostic value of the recommended dementia guidelines.

■ OBJECTIVES To explore and quantify the relative contribution of guideline recommendations and other determinants in the family physician's diagnostic work-up of patients suspected of dementia.

■ STUDY DESIGN We prospectively studied 64 family physicians in an Eastern district in the Netherlands who diagnosed dementia according to the national Dutch guidelines in primary care. Their diagnoses were compared with the reference standard embodied by the memory clinic team of the University Medical Center Nijmegen.

■ POPULATION The physicians evaluated 107 patients older than 55 years suspected of having dementia.

■ OUTCOMES MEASURED Predictive value of various clinical and demographic parameters were measured in both univariate and multivariate logistic regression analyses.

■ RESULTS Activities of daily living (ADL) dependency (odds ratio [OR] = 5.3, P = .03), years since symptoms first started (OR = 1.84, P = .03), and the presence of somatic comorbidity (OR = 0.48, P = .02) independently contributed to the prediction of the presence or absence of dementia. The area under the receiver-operating characteristic (ROC) curve for these 3 variables together was 0.79. The ROC area of the family physicians' diagnosis to determine the final diagnosis was 0.74. The number of recommendations applied did not additionally contribute to the assessment of the final diagnosis.

■ CONCLUSIONS The diagnostic accuracy of the family physician was reasonable. For family physicians, ADL dependency is a better predictor of dementia than cognitive impairment. Family physicians should be aware of diagnostic difficulties in patients with somatic comorbidity. We were unable to confirm the diagnostic value of many of the recommendations of dementia guidelines.

■ KEY WORDS Dementia; sensitivity; specificity; ROC curve; family physicians; memory clinic. (*J Fam Pract 2002; 51:00–00*)

Family physicians are commonly the first health care workers to have contact with elderly individuals suspected of having dementia, and are often the only physicians involved in diagnosing the condition. Earlier studies reported poor detection and moderate recognition of dementia by family physicians.[1–3] Some authors argued that family physicians should therefore refer all suspected patients for specialist assessment.[4] However, family physicians must first make an accurate patient selection. Now that dementia guidelines for primary care are widely available, determining whether their recommendations contribute to diagnostic accuracy would be valuable.[5–7]

Some authors have hypothesized that the continuity of care typical of family practice is an important tool for family physicians to recognize cognitive and behavioral changes in their patients.[8] The finding of a positive association between the number of previous contacts with the patient and the family physician's diagnostic accuracy supports this asser-

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tion.[1] The family physicians' accuracy is also positively associated with the severity of the dementia.[1,3,9] However, 2 intervention studies that tried to improve the family physicians' diagnostic accuracy were inconclusive.[10,11] Although family physicians may be hesitant to communicate a diagnosis of dementia to patients and their relatives,[12] an early and accurate diagnosis is important for a number of reasons. First, explaining the diagnosis enables the patient and relatives to better understand and deal with changed behavior.[13,14] Second, realizing the progressive nature of the condition permits patients and relatives to prepare for future care planning and allows support for the often severely burdened caregivers.[15,16] Third, dementia patients with Alzheimer's disease may benefit from anti-Alzheimer drugs.[17,18] Therefore, the aim of this study was to quantify the relative contribution of guideline recommendations and other diagnostic determinants in the family physicians' work-up of patients suspected of having dementia.

METHOD

Subjects and design

All 250 family physicians from an eastern district in the Netherlands (Nijmegen) were approached by mail to participate in a prospective dementia case-finding study. Of these, 64 family physicians participated. The main reasons for not participating were limited time, having a young practice population, or having no interest in the subject. During consultations or home visits the family physicians assessed patients newly suspected of having dementia using the dementia guideline of the Dutch College of General Practice (DCGP).[5,19] Suspicion of dementia was defined by 2 criteria: age 55 years or older and presence of signs of cognitive impairment that had not yet been evaluated. These signs included memory complaints, worsening orientation, or behavioral changes and could be reported by patients or family members or observed by the family physician. After the family physicians' assessment using the Dutch guideline, all patients with suspected dementia were referred to the outpatient memory clinic of the Academic Medical Center of Nijmegen. Their evaluation served as the diagnostic reference standard. The Medical Ethics Committee of the University Medical Center St Radboud in Nijmegen approved of the study and

TABLE 1

Comparison of recommendations in 3 dementia guidelines

	Dutch guideline	AHCPR	VA
History assessment			
Presenting problem	R	R	R
Past medical history	R	R	R
Medication use	R	R	R
Drug/alcohol use	R	R	R
Family medical history	R	R	R
Personality change	R	—	R
Report of daily activities	R	—	R
Suicidality	—	—	(R)
Clinical examination			
Physical	R	R	R
Neurologic	R	R	R
Sensory	R	R	R
Cognitive status	R	R	R
Speech/language	R	—	—
Depression	R	R	R
Delirium	R	R	R
Neuropsychological testing	T	T	T
Hachinski score	—	—	—
Psychiatric assessment	—	—	R
Psychotic symptoms	—	—	R
Standardized functional assessment	—	R	Opt
Additional tests			
Hematology (Hgb, HCT, MCV, ESR)	R	R	R
Biochemistry (glucose, creatine, thyroid function)	R	R	R
Kalium	T	R	R
Liver function (ALAT)	T	R	R
Liver function specific (GGT)	T	R	R
Vitamin B_{12}	T	—	—
Folate acid	T	R	—
Brain scanning	Opt	Opt	T
Human immunodeficiency virus	—	T	T
Toxicology screen	—	T	T
Urinalysis	—	R	—
Drug concentrations	—	—	—
Albumin	—	—	—
Cerebrospinal fluid analysis	—	T	T
Electrocardiogram	—	R	—
Electroencephalogram	—	T	T
Chest x-ray	—	R	—
Specialist consultation and/or referral	Doubt about dementia or its cause	With mixed results	—

AHCPR, Agency for Health Care Policy and Research; ALAT, alanine aminotransferase; ESR, erythrocyte sedimentation rate; GGT, gamma-glutamyltransferase; HCT, hematocrit; Hgb, hemoglobin; MCV, mean corpuscular volume; Opt, optional; R, recommendation; (R), implied recommendation; T, targeted; VA, US Department of Veterans Affairs.

TABLE 2

Dementia diagnoses of family physicians and DSM-III-R compared with the memory clinic team (reference test)

	Reference test: Dementia (n = 59)	Reference test: No dementia (n = 34)	Total	PPV	NPV	SE	SP	LR+	LR–
Family physician diagnosis									
Dementia	49	12	61	0.80*	0.69*	0.85*	0.65*	2.43*	0.23
Unsure	2	6	8						
No dementia	8	16	24	0.74†	0.66†	0.86†	0.47†	1.62†	0.30†
DSM-III-R criteria‡									
Dementia	13	8	21	0.62	0.36	0.22	0.76	0.92	1.03
No dementia	46	26	72						

*Dichotomizing the family physicians' diagnoses by grouping the unsure to the category "no dementia."
†Dichotomizing the family physicians' diagnoses by grouping the unsure to the category "dementia."
‡The registered symptoms were integrated by the researchers according to the DSM-III-R criteria.
LR+, positive likelihood ratio; LR–, negative likelihood ratio; NPV, negative predictive value; PPV, positive predictive value; SE, sensitivity; SP, specificity.

informed consent of patients was sought by the family physician. A few patients were not able to reproduce basic information about the study, in which case informed consent was sought from their principal caregiver.

Dementia guideline

The DCGP dementia guideline is a national, evidence-based guideline for the diagnosis of dementia (Table 1). It contains diagnostic criteria of the *Diagnostic Statistical Manual, 3rd edition, revised* (DSM-III-R)[20] and includes assessment of cognitive, physical, and activities of daily living (ADL) functioning. A cognitive screening test such as the Mini-Mental State Examination (MMSE) is optional. Instead, the dementia guideline includes a brief assessment of 11 cognitive functions that correspond to the DSM-III-R criteria (long- and short-term memory; orientation to time, place, and person; gnosis; praxis; language ability; judgment; personality changes; and abstraction), and indications on how to assess these functions. In Table 1 the recommendations of the DCGP guideline are compared with the dementia guideline of the Veterans Affairs (VA) and of the Agency for Health Care Policy and Research (AHCPR). These 2 guidelines are constructed for use in primary care as well. The DCGP guideline closely resembles the VA and AHCPR guidelines with some exceptions.[21] Results about the applicability of the Dutch dementia guideline to practice were recently published.[22]

Measurements

For every patient suspected of having dementia based on the DCGP guideline, the family physicians recorded their assessment findings, whether a close relative was available, the presence of dementia (yes, no, unsure), the final diagnosis, the number of contacts needed, and their actions taken to reach the diagnosis. Assessment of cognitive functions, behavioral changes, and somatic comorbidity were scored trichotomously: normal, unsure, or impaired. The level of ADL dependency of a patient was scored on a 4-point Likert scale ranging from independent to severely dependent. For cognitive disorders, behavioral changes, and comorbidity, sum scores were computed to reduce the number of variables. A sum score of 11 variables was made for cognitive disorders (Cronbach's a = 0.75): long- and short-term memory; orientation to time, person and place; praxis; gnosis; language ability; abstraction; judgment; and personality changes. A sum score of 6 variables was made for behavioral changes (Cronbach's a = 0.65): aggression, apathy, restlessness, denial, depression, and incontinence. Finally, a sum score of 5 variables was made for comorbidity (Cronbach's a = 0.78): internal (medical) dysfunction, neurologic dysfunction, sensory impairment, adverse effects, and drug intoxication.

A sum score was made of the number of recommendations made from a list of 31 possible recommendations (Cronbach's a = 0.76). Two indicators for continuity of care, namely, the length and familiarity of the family physician–patient relationship, were recorded by the family physician on a 4-point Likert scale.

DSM-III-R diagnoses

In addition to the diagnosis by the family physician, we also determined the diagnosis based on the DSM-III-R criteria. The findings recorded by the family physician were applied independently by 2 researchers blinded to the DSM-III-R criteria.

Differences were discussed and consensus was reached in all cases.

Reference standard: memory clinic

An experienced multidisciplinary team that included a geriatrician, a neurologist, and a psychologist assessed the presence of dementia in all suspected referred patients. The memory clinic's team was blinded to the family physicians' and DSM-III-R diagnoses. To this aim, the CAMDEX (Cambridge Mental Disorders of the Elderly Examination)[23] and the criteria of the DSM-IV were used.[24] Studies on diagnostic accuracy of memory clinic teams compared with postmortem diagnostics show high levels of accuracy (80%–90% of diagnostic agreement).[25,26] To our knowledge, the inter- or intraobserver reliability of memory clinic diagnoses has not been studied. The assessment, interpretation, and communication of the results took approximately 4.5 hours spread over 3 visits.

Statistical analyses

The accuracy of the family physicians' diagnoses and DSM-III-R diagnoses in comparison with the memory clinic diagnosis (reference standard) was estimated using the sensitivity, specificity, positive and negative predictive values, and likelihood ratios. Univariate logistic regression analyses were used to quantify the association of clinical and sociodemographic characteristics, continuity of care, and performance indicators with the presence and absence of dementia. All determinants with $P < .25$ were entered in an overall multivariate logistic regression model to evaluate which were independently associated with the presence or absence of dementia.[27–30] The overall model was then reduced by excluding variables with $P > .05$ to obtain a simpler diagnostic model. The reliability of the overall and reduced diagnostic model was assessed by using the Hosmer and Lemeshow test.[27]

The ability of the overall and reduced model to discriminate between patients with and without dementia was quantified using the area under the receiver-operating curve (ROC area).[31] The area under the ROC curve is a measure of the ability of a test to discriminate between patients with and without a disease, and can range from 0.5 (no discrimination, like flipping a coin) to 1.0 (perfect discrimination). A value between 0.7 and 0.8 is considered to represent reasonable discrimination, and a value of more than 0.8 is good discrimination.[32] Differences in diagnostic discriminative value between different models and variables were estimated by comparing ROC areas, taking into account the correlation between models as they were based on the same cases.[33] To perform these analyses, the family physicians' diagnoses had to be dichotomized into

TABLE 3

Univariate associations of each documented variable by the family physicians

	Dementia			
	Absent	Present	OR (95%CI)	*P*
Clinical findings by family physician				
Cognitive symptoms				
(0–12), mean (SD)	7.6 (5.2)	9.8 (4.6)	1.13 (1.03–1.24)	.01*
ADL dependency, %	25	75	3.53 (1.46–8.56)	.01*
Somatic comorbidity, %†	88	67	0.27 (0.08–0.89)	.03*
Blood abnormality, %‡	21	42	2.84 (1.07–7.55)	.04*
Behavioral changes, %	41	68	0.74 (0.54–1.02)	.07*
Duration of symptoms, years (SD)	1.5 (0.8)	1.9 (1.0)	1.77 (1.07–2.94)	.03*
Family physicians' performance				
Number of consultations, mean (SD)	3.9 (3.4)	3.5 (3.6)	0.97 (0.86–1.09)	.60
Home visit, %	35	43	1.39 (0.58–3.33)	.46
Recommendations applied, mean (SD)	24.5 (3.4)	25.0 (3.7)	1.04 (0.92–1.17)	.57
MMSE used, %	21	15	0.69 (0.23–2.07)	.51
Informant contacted, %	65	83	2.67 (1.01–7.11)	.05*
Familiar with patient, %	79	84	1.41 (0.47–4.21)	.54
Family physician–patient relation, >5 years, %	65	75	0.60 (0.24–1.50)	.27
Patient characteristics				
Mean age, years (SD)	73 (8.7)	74.3 (6.3)	1.03 (0.97–1.09)	.41
Male sex, %	44	44	1.00 (0.42–2.34)	.99

n = 93. Values are in means (SD) or percentages.
* $P < .25$ to be included in the multivariate analysis.
† Sensory impairment, internal dysfunction; neurologic dysfunction; intoxication; adverse drug effect, sum score of dichotomous items.
‡ Hematology (hemoglobin; hematocrit; mean cell count; erythrocyte sedimentation rate); biochemistry (glucose; creatine; thyroid function), sumscore of dichotomous items.
ADL, activities of daily living, 1 question scored on a 4-point scale; CI, confidence interval; MMSE, Mini-Mental State Examination; OR, odds ratio.

dementia present and absent. We chose to classify the 8 cases with family physicians' diagnoses "unsure" as dementia absent, as the DCGP guideline recommends a reluctant policy in such cases. We performed a sensitivity analysis to check whether the classification of these 8 cases as "dementia present" would have resulted in different findings.

RESULTS

Patients and family physicians

Over 16 months, 64 family physicians enrolled 107 patients suspected of having dementia, a mean of 1.7 patients per family physician. The participating family physicians were aged an average of 47 (SD = 7) years old and handling a practice population of 2113 (SD = 600) patients. Their characteristics were comparable to other Dutch family physicians except that they included fewer solo practitioners (32% versus 49% nationwide) and slightly more female family physicians (21% females versus 17% nationwide).[34] Both the family physicians and the memory clinic completed the diagnostic evaluation for 93 patients: 14 patients dropped out because of refusal (n = 9), medical complications (n = 3), or death (n = 2). The clinical and demographic characteristics of these 14 patients were comparable to those of the 93 completed patients. Of the 93 patients, 93% lived independently and 62% were married. Other demographic characteristics are shown in Table 4. For 22 patients no informant was available (23.6%). The available informants were partners (77%), children or stepchildren (19%), or friends, neighbors, and others (4%). Of the informants, 67% were female and 66% shared a household with the patient.

A mean of 26 of the 31 recommendations (84%) was applied for each patient (SD = 3.3; range, 15–30). The family physicians needed on average 3.6 (SD = 3.3) contacts to assess a patient, and 40% received a home visit. Most patients were well known to the family physician; only 18% were not at all or only somewhat familiar. The MMSE was used as a diagnostic tool for only 19%. The mean time between the last assessment contact of the patient with the family physician and the first visit at the memory clinic was 61 days (SD = 39). The mean duration of the symptoms before the assessment was 22 months (SD = 13).

Diagnostic accuracy

Table 3 shows the accuracy of the family physicians' and the DSM-III-R diagnoses compared with the memory clinic diagnoses. The prior probability of dementia was 63.4% (59/93). A positive diagnosis by the family physician increased the probability (positive predictive value) to 80.3%, and a negative diagnosis decreased this probability to 31.2% (10/32). The positive and negative predictive values of the DSM-III-R criteria were much lower (Table 2).

The 9 patients classified unsure by the family physicians were diagnosed by the memory clinic team as having amnestic syndrome (n = 3), dementia (n = 2), delirium (n = 1), age-dependent cognitive decline (n = 1), depression (n = 1), and unavailable (n = 1). Of the 12 patients with a false-positive diagnosis, 6 showed cognitive impairment, but did not fulfill all diagnostic criteria of dementia, and 1 patient received a diagnosis of depression. Of the 8 patients with false-negative findings, 6 had Alzheimer's disease, 1 had dementia with unknown cause, and 1 had a normal pressure hydrocephalus. The family physicians expressed diagnostic confidence in 59% of all cases and in 47% of the patients diagnosed with Alzheimer's disease.

Classification of the 8 patients labeled "unsure" as "dementia present" or "dementia not present" led to only small differences in the positive and negative predictive values (Table 2).

Predictors of presence/absence of dementia

The univariate analyses revealed that informant availability, years of education, sex of the family physician, number of cognitive symptoms, ADL dependency, somatic comorbidity, blood abnormality, behavioral changes, and duration and severity of the symptoms were associated with the presence or absence of dementia (Table 3). Neither the number of applied recommendations nor the use of the MMSE was related to the presence or absence of dementia.

The multivariate logistic regression model (Table 5) revealed that ADL dependency (OR = 5.28, P = .001) and time since the first symptoms started (OR per year =1.84, P = .026) independently predicted the presence of dementia, whereas somatic comorbidity predicted the absence of dementia (OR = 0.48, P = .021).

TABLE 4

Multivariate associations between predictors of accurate dementia diagnoses by family physicians and the reference standard memory clinic team diagnosis

	Adjusted odds ratio (95% CI)	*P*
ADL dependency, score 1–4	5.35 (2.00–13.9)	.0212
Years since symptoms started	1.84 (1.08–3.14)	.026
Somatic comorbidity present	0.48 (0.25–0.89)	.006

n = 93.
ADL, activities of daily living (1 = independent to 4 = fully dependent); CI = confidence interval.

The ROC area of the model with all 9 significant univariate variables from Table 4 was 0.86 (95% confidence interval [CI], 0.77–0.94). Reduction of the model to the 3 significant multivariate variables (ADL, time since the first symptoms were noticed, and somatic comorbidity) resulted in an ROC area of 0.79 (95% CI, 0.70–0.88). The family physicians' global diagnosis had an ROC area of 0.74 (95% CI, 0.63–0.85). Finally, the ROC area of the expected DSM-III-R diagnosis was only 0.50 (95% CI, 0.37–0.62).

DISCUSSION

The family physicians' diagnosis based on their assessment of all available information was reasonably accurate. Formal DSM-III-R diagnoses, derived by integrating the recorded symptoms, resulted in poor accuracy. Degree of ADL functioning, the duration of symptoms, and the presence of somatic comorbidity independently contributed to the prediction of presence or absence of dementia. Neither the number of diagnostic recommendations made nor the use of the MMSE added to the family physicians' accuracy. The latter is rather disappointing news for makers of all 3 dementia guidelines. Many of the current diagnostic recommendations in the dementia guidelines are based at best on lower quality evidence from observational studies. Trials are lacking in which diagnostic interventions by family physicians are tested against usual diagnostics.

It was remarkable that neither the core symptoms of dementia (cognitive impairment) nor the DSM criteria added to the diagnostic accuracy. Our findings raise the question of how family physicians made their diagnoses. In this respect, the concept of illness scripts (also called pattern recognition) may be helpful to understand how clinicians make diagnostic decisions.[35] According to this concept, clinicians base their decisions more on accumulated clinical patient pictures during their medical career or so-called illness scripts than on medical-deductive reasoning, which is taught in medical schools and offered in evidence-based guidelines.[36] The illness scripts family physicians have of suspected dementia patients may be triggered more by ADL malfunctioning than by cognitive dysfunction.

When the time effort per patient of the family physicians and the memory clinic is compared, the family physicians performed well. The family physicians invested on average 3.5 consultations per patient. Multiplied by the average consultation time of 10 minutes in Dutch family practices, this yields a total consultation time of 35 minutes per patient to arrive at a diagnosis. This time should be compared with the 4.5 hours needed per patient for high-tech diagnostic assessment at the memory clinic. Taking the limited time and low-tech approach into account, it must be concluded that the family physicians did a fair job in diagnosing suspected patients.

We did not confirm the hypothesis that continuity of care enhanced diagnostic accuracy. In contrast to the finding of Eefsting and colleagues,[1] the number of contacts with a patient showed a trend toward a negative association with diagnostic accuracy. A possible explanation is that only contacts related to the evaluation of dementia were recorded in our study; a larger number of contacts may therefore reflect a family physicians' diagnostic difficulty or uncertainty rather than better continuity of care.

Strengths of our study include the detailed information from the family physician assessments, the primary care setting, and the use of a memory clinic as the reference standard. A limitation was that the diagnostic criteria of the family physicians' guideline were based on the DSM-III-R, whereas the memory clinic used the DSM-IV criteria.[20,24] Nevertheless, this difference may have accounted for the diagnostic variation only to a small degree.[37] Second, the finding that additional value was not found for use of the MMSE or for a more frequent use of recommendations might be explained by the fact that the family physicians in this study already applied the recommendations on a large scale. Higher use, therefore, did not add much to the diagnostic accuracy of the family physicians. Third, concerning the importance of the availability of an informant, the kind of information the family physicians received from these informants remains unclear, as the content of the informant interview was neither standardized nor registered. Fourth, few patients per family physician were included. The numbers of included patients per family physician, however, are only a little below the incidence figures for dementia in the Netherlands.[38] Anecdotal reactions from the participating family physicians revealed that some patients were not included because they did not want medical interference and some were unable to travel to the memory clinic. Finally, we modeled various predictors to estimate the presence or absence of dementia and derived a reduced model. In this modeling we did not adjust for overfitting and did not prospectively validate the model. This tactic was necessary given the relatively small number of subjects in the study.[28] Therefore, before our reduced prediction model can be used in medical practice it should first be validated on new patients.

REFERENCES

1. Eefsting JA, Boersma F, Van den Brink W, Van Tilburg W. Differences in prevalence of dementia based on community survey

and general practitioner recognition. Psychol Med 1996; 26:1223–30.
2. O'Connor DW, Pollitt PA, Hyde JB, Brook CP, Reiss BB, Roth M. Do general practitioners miss dementia in elderly patients? BMJ 1988; 297:1107–10.
3. Valcour VG, Masaki KH, Curb JD, Blanchette PL. The detection of dementia in the primary care setting. Arch Intern Med 2000; 160:2964–8.
4. Verhey FR, Jolles J, Ponds RW, et al. Diagnosing dementia: a comparison between a monodisciplinary and a multidisciplinary approach. J Neuropsychiatry Clin Neurosci 1993; 5:78–85.
5. Wind A, Muskens J, De Bruyne G, et al. NHG-standaard M21 Dementie [Dutch dementia guideline]. Utrecht, The Netherlands: Nederlands Huisartsen Genootschap; 1999.
6. Eccles M, Clarke J, Livingstone M, Freemantle N, Mason J. North of England evidence based guidelines development project: guideline for primary care management of dementia. BMJ 1998; 317:802–8.
7. Rose VL. Consensus statement focuses on diagnosis and treatment of Alzheimer's disease and related disorders in primary care. Am Fam Physician 1998; 57:1431–2.
8. Wind AW, Van Staveren G, Schellevis FG, et al. The validity of the judgement of general practitioners on dementia. Int J Geriatr Psychiatry 1994; 9:543–9.
9. Cooper B, Bickel H, Schäufele M. The ability of general practitioners to detect dementia and cognitive impairment in their elderly patients: a study in Mannheim. Int J Geriatr Psychiatry 1992; 7:591–8.
10. Pond CD, Mant A, Kehoe L, Hewitt H, Brodaty H. General practitioner diagnosis of depression and dementia in the elderly: can academic detailing make a difference? Fam Pract 1994; 11:141–7.
11. O'Connor DW, Fertig A, Grande MJ, et al. Dementia in general practice: the practical consequences of a more positive approach to diagnosis. Br J Gen Pract 1993; 43:185–8.
12. van Hout H, Vernooij-Dassen M, Bakker K, Blom M, Grol R. General practitioners on dementia: tasks, practices and obstacles. Patient Educ Couns 2000; 39:219–25.
13. Colerick EJ, George LK. Predictors of institutionalization among caregivers of patients with Alzheimer's disease. J Am Geriatr Soc 1986; 34:493–8.
14. Vernooij-Dassen MJFJ, Persoon JMG, Felling AJA. Predictors of sense of competence in caregivers of demented persons. Soc Sci Med 1996; 43:41–9.
15. McCurry S, Teri L. Advance planning for dementia caregivers. J Am Geriatr Soc 1997; 45:1102–3.
16. Droës R. Psychosocial treatment for demented patients: overview of methods and effects. In: Miesen B, Jones G, Eds. Care-Giving in Dementia, Research and Applications. London: Routledge; 1997:127–48.
17. Rösler M, Anand R, Cicin-Sain A, et al. Efficacy and safety of rivastigmine in patients with Alzheimer's disease: international randomised controlled trial. BMJ 1999; 318:633–8.
18. Rogers SL, Farlow MR, Doody RS, Mohs R, Friedhoff LT. A 24-week, double-blind, placebo-controlled trial of donepezil in patients with Alzheimer's disease. Donepezil Study Group. Neurology 1998; 50:136–45.
19. De Bruyne GM, Meyboom-de Jong B, Muskens JB, et al. De NHG-standaard dementiesyndroom [Guideline on dementia of the Dutch College of General Practitioners]. Huisarts & Wetenschap 1991; 34:598–607.
20. Diagnostic and Statistical Manual of Mental Disorders. 3rd ed rev. Washington, DC: American Psychiatric Association; 1987.
21. Beck C, Cody M, Souder E, Zhang M, Small GW. Dementia diagnostic guidelines: methodologies, results, and implementation costs. J Am Geriatr Soc 2000; 48:1195–203.
22. Van Hout H, Vernooij-Dassen M, Poels P, Hoefnagels W, Grol R. Applicability of diagnostic recommendations on dementia in family practice. Int J Qual Health Care 2001; 13:127–33.
23. Roth M, Tym E, Mountjoy CQ, et al. CAMDEX, a standardised instrument for the diagnosis of mental disorder in the elderly with special reference to the early detection of dementia. Br J Psychiatry 1986; 149:698–709.
24. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, DC: American Psychiatric Association; 1994.
25. Mendez MF, Mastri AR, Sung JH, Frey WH 2nd. Clinically diagnosed Alzheimer disease: neuropathologic findings in 650 cases. Alzheimer Dis Assoc Disord 1992; 6:35–43.
26. Rasmusson DX, Brandt J, Steele C, Hedreen JC, Troncoso JC, Folstein MF. Accuracy of clinical diagnosis of Alzheimer disease and clinical features of patients with non-Alzheimer disease neuropathology. Alzheimer Dis Assoc Disord 1996; 10:180–8.
27. Hosmer D, Lemeshow S. Applied Logistic Regression. New York: Wiley; 1989.
28. Harrell FE Jr, Lee KL, Mark DB. Multivariable prognostic models: issues in developing models, evaluating assumptions and adequacy, and measuring and reducing errors. Stat Med 1996; 15:361–87.
29. Moons KG, Stijnen T, Michel BC, et al. Application of treatment thresholds to diagnostic-test evaluation: an alternative to the comparison of areas under receiver operating characteristic curves. Med Decis Making 1997; 17:447–54.
30. Moons KG, van Es GA, Michel BC, Buller HR, Habbema JD, Grobbee DE. Redundancy of single diagnostic test evaluation. Epidemiology 1999; 10:276–81.
31. Hanley J, McNeil B. The meaning and use of the area under the receiver operating characteristic (ROC) curve. Radiology 1982; 143:29–36.
32. Murphy JM, Berwick DM, Weinstein MC, Borus JF, Budman SH, Klerman GL. Performance of screening and diagnostic tests. Application of receiver operating characteristic analysis. Arch Gen Psychiatry 1987; 44:550–5.
33. Hanley JA, McNeil BJ. A method of comparing the areas under receiver operating characteristic curves derived from the same cases. Radiology 1983; 148:839–43.
34. Harmsen J, Hingstman L. Cijfers uit de registratie van huisartsen, peiling 1996 [Numbers of the registration of General Practitioners in the Netherlands]. Utrecht, The Netherlands: NIVEL; 1996 November.
35. Schmidt HG, Norman GR, Boshuizen HPA. A cognitive perspective on medical expertise: theory and implications. Acad Med 1990; 65:611–21.
36. Custers EJ, Boshuizen HP, Schmidt HG. The influence of medical expertise, case typicality, and illness script component on case processing and disease probability estimates. Mem Cognit 1996; 24:384–99.
37. Erkinjuntti T, Ostbye T, Steenhuis R, Hachinski V. The effect of different diagnostic criteria on the prevalence of dementia. N Engl J Med 1997; 337:1667–74.
38. Van den Hoogen H, Huygen F, Schellekens J, et al. Morbidity figures from general practice, data from four general practices 1978–1982. Nijmegen, The Netherlands: Nijmegen University Department of General Practice; 1985.

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