

Clinical Utility of Magnetic Resonance Imaging Radiographs for Suspected Organic Syndromes in Adult Psychiatry

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Objective: In psychiatric practice, adult patients are most commonly referred for magnetic resonance imaging (MRI) to screen for suspected organic medical diseases of the central nervous system that can mimic psychiatric syndromes. We identified the most common signs and symptoms prompting MRIs to establish the predictive value of these signs and symptoms for clinically pertinent organic syndromes.

Method: This study was a retrospective chart review of psychiatric patients at the Veterans Affairs Greater Los Angeles Health Care Center (Los Angeles, Calif.) who were referred for MRI of the brain between 1996 and 2002. Patients referred for evaluation of dementia were excluded. The specific indications leading clinicians to obtain MRI were identified and grouped. In order to offset the uncertain significance of many MRI findings, for this study, the predictive value of each indication was calculated based on the percentage of patients in whom clinical management changed in response to MRI findings rather than on the percentage with any abnormal MRI results.

Results: Of 253 patients who had MRIs, 38 (15%) incurred some degree of treatment modification as a result of MRI findings, including 6 patients in whom MRI identified a medical condition that became the focus of treatment. Six indications appeared most likely to prompt clinicians to obtain MRIs. Because pertinent results were associated with each of these indications, statistical evaluation did not reveal significant differences in their predictive values ($\chi^2 = 4.32$, $df = 5$, $p = .505$).

Conclusions: Unlike prior studies showing no value to screening radioimaging, this study shows MRI can be a useful screening test among patients suspected of having organic psychiatric disorders and that the common indications for MRI employed at one institution were predictive.

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In adult psychiatry, magnetic resonance imaging (MRI) is most commonly used to identify occult organic medical conditions of the central nervous system (CNS), which can mimic psychiatric symptoms. While the role of MRI in the evaluation of dementia is well established,¹ there is no consensus on the indications for its use in the evaluation of nondemented patients. Even the signs and symptoms considered suspicious in the diagnosis of organic conditions are uncertain, as the available literature is limited to occasional case reports and a few case series. To date, there has been no systematic attempt to identify the particular clinical features that should be considered suspicious for organic illness and thus lead clinicians to obtain MRI. To clarify the usefulness of MRI in the evaluation of patients with suspected organic syndromes, we performed a retrospective review of all MRIs obtained for adult, nondemented patients at a large health care center within the Department of Veterans Affairs. We identified the most common signs and symptoms considered indications of organic conditions and calculated the predictive value of these indications for pertinent MRI findings.

While estimates of the prevalence of medical syndromes causing psychiatric symptoms suggest that they are relatively uncommon compared with functional psychiatric disorders (Table 1),^{2–8} patients with these syndromes may be disproportionately represented in selected demographic groups, including the elderly. Given the potential benefits for treatment from early diagnosis of these conditions, the ability to identify them should be of interest. While computerized tomography (CT) scanning remains the most sensitive investigative procedure for patients with suspected cranial fractures or acute intracranial bleeding, MRI is the diagnostic procedure of choice for CNS neoplasms, vascular disorders (including arteriovenous malformations, vasculopathies, and aneurysms), and demyelinating diseases. MRI may also provide clinically useful information in patients with a prior history of head trauma or suspected infectious diseases of the CNS (including herpes and prion diseases), as well as in patients with systemic illnesses that involve the CNS (systemic lupus erythematosus, sarcoid, etc.), although its usefulness in the identification of these conditions is less distinct.

The available practice guidelines for the major psychiatric diagnoses either make no recommendations for MRI

Table 1. Published Estimates of the Incidence of Organic Conditions First Presenting as Psychiatric Symptoms in the General Population

Disorder	1-Year Incidence (per 100,000)	Percentage First Presenting With Psychiatric Symptoms	Odds Ratio ^a
Schizophrenia	16–42	100 ²	16.0–42.0
Multiple sclerosis	1	18 ³	0.2
Neoplasms of the central nervous system	12	20 ⁴	2.0
Head trauma	400	3–5 ⁵	12.0–20.0
Chronic subdural hematoma	3	< 50 ⁶	< 0.9
Aneurysms/arteriovenous malformations	18	Case reports ⁷	Rare
Vasculitides	10–20	Case reports ⁸	Rare

^aEstimated number of patients initially presenting to psychiatrists with organic conditions relative to patients initially presenting with schizophrenia, i.e., for every 16–42 patients with new-onset schizophrenia, psychiatrists see 2 patients with unrecognized central nervous system neoplasms.

or recommend against its use in the evaluation of patients with presentations clearly consistent with these diagnoses. In part, the low prevalence and protean nature of the symptoms that characterize the organic syndromes, combined with the expense and uncertain clinical relevance of many MRI findings, have contributed to the absence of accepted guidelines for MRI use in evaluation of suspected organic syndromes. Also relevant is the absence, to date, of any systematic attempt to identify the clinical features of organic illness.

The utility of CNS imaging as a screening measure in psychiatric patients without dementia has been studied twice.^{9,10} The most widely cited is a case series¹⁰ of 261 patients who underwent CT scans as a routine procedure upon admission to a psychiatric hospital. Because this practice did not yield any clinically pertinent results, routine use of imaging as a screening device in patients without suspicious features has subsequently been discouraged. In the case of MRI, one retrospective chart review of 731 patients screened by MRI yielded a number of instances of patients with occult medical conditions including tumors and hemorrhages.⁹ However, the authors did not indicate either the basis for referral for MRI or whether it had any treatment impact, and the study appears to have been largely ignored. The applicability of either of these studies to the current use of MRI by clinicians is limited, however. The design of the McClellan et al. study,¹⁰ in particular, includes a selection bias toward patients with long-standing and static symptoms who, as a group, do not resemble the patients who today receive MRI, namely those with atypical clinical features.

While the particular signs and symptoms considered atypical vary among clinicians, certain symptoms on face value have come to be considered suspicious for organic illness. A literature review of case reports of medical conditions mimicking psychiatric syndromes discovered by MRI suggests that the most common clinical features prompting MRI are subsyndromal cognitive deterioration^{11–14} and psychiatric symptoms whose emergence is accompanied by neurologic signs.¹⁵ Less commonly, important MRI results have also been reported for cases of

mutism¹⁶ and Capgras syndrome.¹⁷ Small numbers of case reports describe MRI studies prompted by mood and behavioral symptoms.^{18,19}

Here, we present the results of a review of the usefulness of MRI in the management of nondemented patients who were suspected of having organic illnesses. In addition to identifying the common indications for MRI and calculating their predictive value for pertinent results, we also provide preliminary data on the cost-effectiveness of MRI, as measured by changes in clinical management and quality of life that occurred among patients with positive findings.

METHOD

This study was a retrospective chart review of patients who received MRIs of the brain ordered by psychiatrists as part of the evaluation of suspected organic symptoms. The potential subjects included all psychiatric patients receiving care at the Veterans Affairs Greater Los Angeles (VAGLA) Health Care Center, Los Angeles, Calif., who had MRIs between 1996 and 2002. The project was approved by the VAGLA Institutional Review Board.

Patients were identified using the computerized medical records of the Department of Veterans Affairs. Patients who received MRIs for the evaluation of dementia or had an existing diagnosis of dementia at the time of MRI were excluded. Patients who received MRI ordered by a psychiatrist at the direct request of another specialty service (e.g., otolaryngology, neurology) were also excluded.

Patient information gathered included sex, age greater than 65 years, history of human immunodeficiency virus, and history of head trauma. Data reviewed included the MRI results, coincident chart notes, and discharge summaries and orders for a follow-up period of up to 1 year after MRI.

MRI results were recorded based on the reports by the radiologist at the time the MRI was obtained. MRI at this facility used a 1.5 Tesla magnet. All results were reported by board-certified neuroradiologists working on site.

Table 2. Categories of Clinical Impact Designated for Magnetic Resonance Imaging (MRI) Findings in Psychiatric Patients Suspected of Having an Organic Disorder

Category	Explanation
None	MRI could be normal or abnormal but resulted in no impact on treatment and/or diagnostic formulation.
Theoretical	MRI was abnormal but associated treatment modification and/or diagnostic reformulation was less immediate or distinct: (1) treatment modification (via dose change and/or medication modification) might have been undertaken in the course of good empirical management without MRI or (2) specialists are consulted but do not intervene.
Significant	MRI was abnormal and resulted in significant impact on treatment and/or diagnostic reformulation: some presenting psychiatric symptoms are attributable to organic condition, and identification of the organic condition prompts referral to another specialty along with discontinuation of some psychiatric treatment; treatment outcome by other service may vary, however.

Table 3. Clinical Rationale for Magnetic Resonance Imaging (MRI) Referral in Psychiatric Patients (N = 253^a) With Suspected Organic Syndromes

Rationale	N (%)
Subsyndromal cognitive deficits	64 (25)
Unusual age at symptom onset or unusual symptom evolution	57 (23)
Personality changes	39 (15)
Accompanying neurologic signs/symptoms	38 (15)
Unusual symptoms	19 (8)
Sustained confusion/delirium	18 (7)
Other	46 (18)

^aGroup Ns do not total 253 due to 28 patients for whom more than 1 rationale was listed for MRI.

MRI results were also assigned a clinical impact level, determined by the degree to which management after MRI was influenced by the MRI results. MRI impact was categorized post hoc. The use of post hoc analysis in MRI studies of usefulness allows for results to be weighed in light of clinical impact and has become an accepted practice in MRI research where it serves to offset the uncertain significance of many MRI findings.²⁰

In this study, the 3 designated categories of clinical impact were (1) None: results have no significance for treatment, (2) Significant: results have clear significance for treatment, and (3) Theoretical: results have theoretical significance for treatment (Table 2). The difference between clear and theoretical significance adopted here may be explained by example. In this study, there were 2 patients whose MRIs showed masses consistent with meningiomas. In one case, the patient's records showed that this finding was deemed responsible for the presenting psychiatric symptoms by the psychiatric team, and the patient was transferred to another service. This was listed as an instance where MRI findings had clear significance for treatment. By contrast, in another patient, the patient's meningioma on MRI was deemed less clearly linked with the presenting symptoms, and review of subsequent progress notes showed that treatment (addition of pharmacotherapy specifically for disinhibition) might well have evolved empirically as part of good clinical management. In this case, MRI findings were considered to have theoretical impact on patient management. Statistical significance of these impact categories was determined using a 95%, binomial confidence interval for each impact cat-

Table 4. Positive Predictive Value of Signs and Symptoms for Clinically Pertinent Organic Syndromes by Clinical Rationale Prompting Magnetic Resonance Imaging

Clinical Rationale	Any Impact ^a		Significant Impact ^b	
	N/N	%	N/N	%
Subsyndromal cognitive deficits	9/64	14	1/64	1.6
Unusual age at symptom onset or unusual symptom evolution	13/57	23	3/57	5.3
Personality changes	9/39	23	2/39	5.1
Accompanying neurologic signs/symptoms	10/38	26	3/38	7.9
Unusual symptoms	4/19	21	0/19	0
Sustained confusion/delirium	2/18	11	0/18	0
Other	1/46	2	0/46	0

^aTotal N > 253 because some patients had more than 1 clinical indication.

^bSubset Ns total > 6 because 3 patients had 2 clinical indications each.

egory. A review of impact category assignment by a second evaluator showed good agreement: There were no differences between raters related to cases where impact was "significant." Interrater agreement related to patients with no or theoretical impact was 96% (238/247).

Because a secondary purpose of this study was evaluation of the predictive value of the particular signs and symptoms considered suspicious by clinicians at one institution, we clustered these into groups (Table 3) and calculated the percentage of patients referred from each group who demonstrated pertinent MRI findings (Table 4). The clinical indication for the MRI was determined on the basis of psychiatrist chart notes and communications with the radiologist and then assigned post hoc to 1 of 7 rationale groups that emerged in a review by the principal investigator (S.M.E.; Table 5). Identification of rationales and assignment of patients into rationale groups was performed by the principal investigator. Statistical evaluation of the predictive values of the various indications for MRI used a generalized linear model (G.E.E. approach as implemented by SAS-Genmod [SAS, Cary, N.C., 2002]).

RESULTS

Between 1996 and 2002, 751 patients in the VAGLA Health Care System had MRI radiographs requested by psychiatrists. Four hundred ninety-eight referrals were for the evaluation of dementia or were initiated by other

Table 5. Clinical Rationale Groups: Specific Signs and Symptoms Prompting Magnetic Resonance Imaging (MRI)^a

Rationale Group	N
Subsyndromal cognitive deficits	
New memory disturbance	17
Poor concentration/slowness	8
Dysexecutive	6
Language abnormalities	6
Not specified	27
Unusual age at symptom onset or unusual symptom evolution	
Abrupt symptom onset	22
Unusual response to treatment	19
Unusual patient age for symptom	16
Personality changes	
Lability/explosiveness	18
Apathy	7
Not characterized	14
Accompanying neurologic signs/symptoms	
Movement abnormalities	13
Headache	13
Weakness	1
Other	11
Unusual symptoms	
Discrete delusions	10
Visual hallucinations	7
Other	2
Sustained confusion/delirium	18
Other	46

^aNs include 28 patients for whom more than 1 rationale was listed for MRI.

Table 6. Characteristics of Psychiatric Patients (N = 253) Referred for Magnetic Resonance Imaging to Screen for Suspected Organic Syndromes

Characteristic	N
Sex, female/male	18/235
Age > 65 y	50
Identified history of head trauma	29
Positive test result for human immunodeficiency virus	3

medical services and are not included. The balance comprised 253 patients who had MRIs to investigate clinical symptoms considered suspicious for organic illness and will be discussed here (Table 6).

Of these 253 MRIs, the findings of 115 were interpreted as normal and 138 included features considered abnormal according to the reports by the radiologist (Table 7). Common abnormalities included diffuse ischemic changes (N = 51) and atrophy (N = 30). Consistent with prior reports, localized ischemic changes (N = 21) and atrophy (N = 18) were less common. Other MRI findings included 2 patients with suspected meningiomas, 2 patients with aneurysms, and 3 patients with findings consistent with multiple sclerosis.

The reasons clinicians obtained MRIs appeared attributable to 1 of 6 indications that emerged in a review by the principal investigator (S.M.E.) in the majority of patients. The most common indication for referral was for subsyndromal cognitive deterioration not commensurate with dementia, which was cited in 25% of all referrals.

Table 7. Magnetic Resonance Imaging Results by Radiologist for Psychiatric Patients (N = 253) Referred for Suspected Organic Syndromes

Result	N ^a
Normal	115 (45%)
Ischemic changes	72 (28%)
Diffuse	51
Localized	21
Atrophy	48 (19%)
Diffuse	30
Localized	18
White matter changes	19 (8%)
Diffuse	13
Localized	6
Demyelination	3
Cysts	3
Sinus	1
Arachnoid	2
Meningioma	2
Aneurysm	2
Subacute hematoma	1
Gyriform enhancement	1
(consistent with vasculitis vs encephalitis)	
Other	5

^aPercentages shown only for the most prevalent cases. Total N > 253 because some patients had more than 1 result.

Table 8. Magnetic Resonance Imaging Results by Impact Category for Psychiatric Patients (N = 253) Referred for Suspected Organic Syndromes

Impact on Treatment	N	%	95% Confidence Interval
None	215	85	79.97% to 89.15%
Theoretical	32	13	8.8% to 17.4%
Significant	6	2	0.9% to 5.1%

The second most common indication for MRI was for symptoms that emerged at an unusual patient age (23%). Patients also were referred for abrupt personality changes (15%), for psychiatric symptoms that emerged concurrently with neurologic symptoms (15%), or for psychiatric symptoms that have historically been deemed unusual—visual hallucinations and discrete delusions, in particular (8%). In addition to these reasons, 46 patients (18% of all referrals) were referred for “other” reasons, which appeared poorly characterized or idiosyncratic. (For a more detailed description, see Table 5.)

Among the 138 MRIs with abnormal findings, 38 were associated with some degree of clinical impact: 6 were associated with significant impact in clinical management and 32 were associated with evident but nonessential impact on treatment modifications (Table 8). An analysis of the outcomes among the 6 patients who had significant changes in clinical management in response to MRI findings suggests that 2 of the 6 cases also experienced unequivocal changes in outcome as a direct result of the test (Table 9).

Of the rationales most commonly listed by clinicians obtaining an MRI, clinically pertinent results were most frequently found among patients who were referred in

Table 9. Long-Term Outcomes Among Psychiatric Patients With Significant Magnetic Resonance Imaging (MRI) Findings

Outcome	Details
Improved	
Patient 1	Aneurysm identified on MRI underwent surgical repair. The patient is alive, and presenting symptoms remitted.
Patient 2	Genetic degenerative condition (causing infarcts and atrophy) was identified on MRI. The patient continued to deteriorate, but the family was referred for testing.
Neutral	
Patient 3	MRI identified probable vasculitis believed responsible for symptoms. The patient died while awaiting additional evaluation.
Patient 4	MRI identified a meningioma. The patient was referred to neurosurgery but refused recommendation. The patient subsequently resumed supportive care by psychiatry and is without symptom progression.
Patient 5	MRI identified olivopontocerebellar atrophy believed to be responsible for psychiatric symptoms. The patient's psychiatric treatment was halted but condition continued to deteriorate. The patient died 2 years later having become institution dependent.
Unknown	
Patient 6	The patient had an aneurysm found on MRI. The patient was referred to neurosurgery, but long-term outcome is unknown.

cases when psychiatric symptoms emerged coincident with neurologic symptoms. MRI findings with significant impact were associated with 4 of the 7 indication categories, although some clinically meaningful results were associated with all indications (see Table 4). Statistical evaluation using a generalized linear model (G.E.E. approach as implemented by SAS-Genmod) did not reveal significant differences in the predictive values of any of the 6 indications ($\chi^2 = 4.32$, $df = 5$, $p = .505$), once patients referred for the rationale "other" were excluded. By contrast, this latter group of patients in whom MRI referral was for idiosyncratic or poorly characterized reasons were statistically less likely to have pertinent MRI findings than patients referred for 6 better characterized indications ($\chi^2 = 18.87$, $df = 6$, $p = .0044$).

DISCUSSION

This study demonstrates that there are circumstances under which brain MRI is a useful test and that almost all of the indications cited by clinicians at one institution for obtaining MRI were equally predictive of organic syndromes. Of 253 patients who had MRIs, 38 (15%) incurred some degree of treatment modification based on the MRI results, including 6 patients in whom the MRI identified an unexpected medical condition that became the main focus of treatment. Among 6 clearly identified clinical rationales for MRI, 3 appeared to have the greatest predictive value for clinically significant abnormalities: psychiatric symptoms that emerged coincidentally with neurologic symptoms, symptoms that emerged at an unusual age (or that responded unusually to treatment), and abrupt changes in personality. The greater predictive value for these rationales was not statistically significant in this sample, however, perhaps due to the limited sample size. All of the 6 clearly characterized indications were statistically more likely to be associated with pertinent MRI findings than were a group of idiosyncratic or poorly characterized referrals.

These results are at odds with a previous study¹⁰ evaluating the usefulness of neuroimaging employed as a screening method among patients without suspicious clin-

ical features, which yielded no pertinent CT results in any of its patients. The difference quite likely reflects the fact that the total number of MRIs obtained in our study amounts to only a small fraction of approximately 25,000 unique patients cared for by psychiatrists during the period of the study and implies that selective use of imaging studies increases the yield rate.

Even though this study was relatively large, the data cannot be used to precisely quantify either the cost-effectiveness or the impact on health-related quality of life attributable to MRI findings because statistical considerations necessitate sample sizes of several thousand patients to measure even large changes in these domains.²¹ However, a preliminary review suggests that in the hands of psychiatrists at this institution, the cost-effectiveness ratio for this procedure is promising: Since brain MRI scans cost roughly \$500 to \$1000 apiece, the scans obtained here most likely cost no more than \$253,000. If even 10 quality-adjusted life years were gained by patients, this test would fall within the range of commonly accepted procedures.²²

The design of this study has several methodological limitations. First, while the data provide an indication of the ability of clinicians throughout one health care center to identify signs and symptoms of organic illness, they do not establish the sensitivity of these clinicians to organic illnesses overall. Practical concerns did not allow for a control group composed of patients with similar demographics who were randomly sent for MRI. Although the literature on the prevalence of these conditions does not imply that large numbers of patients with organic syndromes went undetected, their actual number remains unknown. Because this is the first project to identify the clinical indications leading any psychiatrists to obtain MRI in the evaluation of organic illness, it is also uncertain whether these indications would be emphasized similarly among clinicians at other institutions. Differences in training emphases could cause variability between institutions concerning the features that are perceived as predictive of organic illness.

Secondly, because impact in this study was measured only as it related to post-MRI decisions made by the ordering clinician, a quite restrictive definition, several theoretic-

cal benefits of MRI were not considered. These theoretical benefits, including patient reassurance, education of family members, and the development of the scientific database, are not reflected in the data of this study but could also be considered relevant.

A final factor that may limit generalizability is that the population of this study (psychiatry patients enrolled in a Veterans Affairs health care system) may differ from the general population in several respects, as indicated by prior research. In addition to being disproportionately male, the VA population has a high prevalence of substance abuse disorders that may predispose patients to some of the organic conditions, although their prevalence in this particular study group is unknown. The VA population is also older than non-VA populations.

While this study should not be interpreted as indicating that MRI scans should be more widely performed, it does show that selective use of MRI can provide meaningful clinical information in the management of adult patients. It also establishes chart review as a reasonable research design for this topic. A larger sample size might more precisely establish the predictive values of the clinical indications identified in this study.

REFERENCES

- Knopman DS, DeKosky ST, Cummings JL, et al. Practice parameter: diagnosis of dementia (an evidence-based review): report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology* 2001;56:1143–1153
- McGrath J, Saha S, Welham J, et al. A systematic review of the incidence of schizophrenia: the distribution of rates and the influence of sex, urbanicity, migrant status and methodology. *BMC Medicine* 2004;2:12
- Skegg K. Multiple sclerosis presenting as a pure psychiatric disorder. *Psychol Med* 1993;23:909–914
- Tennstedt A. Atypical symptoms and brain tumour cases: a contribution to their topography [in German]. *Zentralbl Allg Pathol* 1982;126:19–22
- Lishman WA. Organic Psychiatry: The Psychological Consequences of Cerebral Disorder. 3rd ed. Oxford, UK: Blackwell Science; 1997:161
- Tagle P, Mery F, Torrealba G, et al. Chronic subdural hematoma: a disease of elderly people [in Spanish]. *Rev Med Chil* 2003;131:177–182
- Max JE, Fox PT, Lancaster JL, et al. Putamen lesions and the development of attention-deficit/hyperactivity symptomatology. *J Am Acad Child Adolesc Psychiatry* 2002;41:563–571
- Birrer RB, Vemuri SP. Depression in later life: a diagnostic and therapeutic challenge. *Am Fam Physician* 2004;69:2375–2382
- Wahlund LO, Agartz I, Saaf J, et al. MRI in psychiatry: 731 cases [letter]. *Psychiatry Res* 1992;45:139–140
- McClellan RL, Eisenberg RL, Giyanani VL. Routine CT screening of psychiatry inpatients. *Radiology* 1988;169:99–100
- Chukwudelunzu FE, Meschia JF, Graff-Radford NR, et al. Extensive metabolic and neuropsychological abnormalities associated with discrete infarction of the genu of the internal capsule. *J Neurol Neurosurg Psychiatry* 2001;71:658–662
- Hall DA, Anderson CA, Filley CM, et al. A French accent after corpus callosum infarct. *Neurology* 2003;60:1551–1552
- Mendez MF, Ghajarnia M. Agnosia for familiar faces and odors in a patient with right temporal lobe dysfunction. *Neurology* 2001;57:519–521
- Ramasubbu R. Conversion sensory symptoms associated with parietal lobe infarct: case report, diagnostic issues and brain mechanisms. *J Psychiatry Neurosci* 2002;27:118–122
- Schneider RK, Robinson MJ, Levenson JL. Psychiatric presentations of non-HIV infectious diseases: neurocysticercosis, Lyme disease, and pediatric autoimmune neuropsychiatric disorder associated with streptococcal infection. *Psychiatr Clin North Am* 2002;25:1–16
- Wang MC, Winston KR, Breeze RE. Cerebellar mutism associated with a midbrain cavernous malformation: case report and review of the literature. *J Neurosurg* 2002;96:607–610
- Lykouras L, Typaldou M, Goumellis R, et al. Coexistence of Capgras and Fregoli syndromes in a single patient: clinical, neuroimaging and neuropsychological findings. *Eur Psychiatry* 2002;17:234–235
- Scheid R, Voltz R, Guthke T, et al. Neuropsychiatric findings in anti-Ma2-positive paraneoplastic limbic encephalitis. *Neurology* 2003;61:1159–1161
- Sugimoto T, Murata T, Omori M, et al. Central pontine myelinolysis associated with hypokalaemia and anorexia nervosa. *J Neurol Neurosurg Psychiatry* 2003;74:353–355
- Warren RM, Crawley A. Is breast MRI ever useful in a mammographic screening programme? *Clin Radiol* 2002;57:1090–1097
- Sturm R, Unutzer J, Katon W. Effectiveness research and implications for study design: sample size and statistical power. *Gen Hosp Psychiatry* 1999;21:274–283
- Zhang M, Owen RR, Pope SK, et al. Cost-effectiveness of clozapine monitoring after the first 6 months. *Arch Gen Psychiatry* 1996;53:954–958