

Impact of an integrated rapid response psychiatric liaison team on quality improvement and cost savings: the Birmingham RAID model

George Tadros,¹ Rafik A. Salama,² Paul Kingston,² Nageen Mustafa,² Eliza Johnson,³ Rachel Pannell,⁴ Mahnaz Hashmi⁵

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¹Warwick Medical School, University of Warwick; ²Centre for Ageing and Mental Health, Staffordshire University; ³Birmingham and Solihull Mental Health Trust, Birmingham City Hospital; ⁴Sandwell and West Birmingham Hospitals NHS Trust; ⁵City Hospital, Birmingham

Correspondence to George Tadros (george.tadros@nhs.net)

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Aims and method To evaluate whether the implementation of the Rapid Assessment, Interface and Discharge (RAID) integrated model improves access to psychiatric assessment and reduces cost of health service provision in an acute hospital. Length of hospital stay was calculated using a case-by-case matched control design. Readmission rates were calculated and survival analysis was used to measure endurance in the community following discharge.

Results In an acute hospital with 600 beds, the total savings in bed days through reducing length of stay and readmissions was 43–64 beds per day. The elderly care wards provided the majority of bed savings.

Clinical implications The development of a rapid response, age-inclusive, comprehensive psychiatric team integrated in an acute hospital can lead to significant savings in health service provision.

Declaration of interest None.

There are different models of liaison psychiatry to deal with the high level of mental illness in general hospital populations.¹ It has been reported that about 27% of patients admitted to medical wards have mental illness fulfilling DSM-IV criteria.² It has been recognised that the timing of psychiatric consultations could have an impact on patients' length of stay in hospitals,^{3–6} especially if psychosocial assessment is completed in the first 5 days of admission.^{7,8} Patients with severe psychiatric symptoms such as suicidal ideation tend to receive more timely consultations, as a result of less obvious psychiatric symptoms being undetected for greater lengths of time⁹ which leads to poorer outcomes.⁷ Moreover, the presence of physical illness has been found to delay the identification of mental health needs of patients to the extent that they may not even be recognised.¹⁰

Psychological and psychiatric comorbidity has been correlated with longer length of hospital stay, particularly in patients with impaired cognition, delirium, dementia, anxiety and depression.^{11,12} However, the detection of these illnesses has been limited in both out-patient and in-patient care.¹³ In addition, it was found that physicians who recognised mental health difficulties in patients with physical illness hesitated to discharge them, resulting in a prolonged admission.¹²

Patients that frequently attend hospital have been estimated to cost health services approximately £2.3 billion every year.^{14,15} Research suggests that there are almost half

a million frequent attendees in the UK and over a million emergency admissions to hospitals annually. This group of patients often have conditions that could be better managed with more appropriate treatment within the community.^{14,16} Reports suggest that staff attitudes towards patients who attend hospital for reasons other than physical health may be negative.¹⁷ This could be as a result of the difficulties that arise when attempting to address complex needs in an environment better suited for dealing with acute medical illnesses.^{17–19}

Although it is estimated that between 2001 and 2013 there will be a 53% increase in the number of people aged over 65 in the UK,¹⁴ two-thirds of hospital beds are occupied by elderly patients. Moreover, patients over 65 years of age admitted to hospital with or acquiring superimposed mental health conditions have poorer outcomes and increased length of hospital stay.¹ The literature suggests that for older adults, delayed discharges and lengthy stays in hospital can result in anxiety related to: their future, low mood, frustration, anger, feeling unsupported, disempowered and feeling passive in the process.^{20,21} Currently, 750 000 people live with dementia, a disease that carries a massive personal, family, social and economic cost.^{22,23} It is estimated that at any time, up to a quarter of older patients in general acute hospitals will have dementia.¹ The Royal College of Psychiatrists¹ reported that being admitted to a general hospital can often have a detrimental effect on the well-being of a person with

dementia. The National Dementia Strategy has outlined several key objectives for patients with dementia, including good quality of care within general hospitals.²³

The RAID model

City Hospital, Birmingham, has 600 beds and an accident and emergency (A&E) department that receives over 200 patients per day. The hospital's statistics show that on average there are 4000 admissions every month: 3000 of them are classified as emergency admissions and the rest are elective or day cases.

The Rapid Assessment, Interface and Discharge (RAID) service provides a new model of liaison psychiatry (awarded the Health Service Journal 2010 award for innovation in mental health) in City Hospital that delivers a rapid response, 24-hour, 7 days a week, age-inclusive service and comprehensive range of mental health specialties, including old age, working age, postnatal mental health and substance misuse. The service aims at a 1-hour target for assessing patients who present to A&E and a 24-hour target for assessing patients on all wards, and is available to any patient aged 16 years or over. Additionally, RAID offers brief follow-up clinics within City Hospital. This multi-professional team provides close clinical involvement alongside clinical support and supervision in mental health interventions for general hospital professionals, patients and carers. The RAID team provided formal and informal training to the acute hospital staff. The formal training included 2 days' training on dementia, depression, delirium and dignity every 3 months as well as a 1-hour weekly session on different mental health issues.

The RAID model was officially launched in December 2009 as a pilot project with extra investment of £0.8 million per year, although it currently receives recurring funding.

Aim

The aim of this study was to evaluate whether the implementation of an integrated rapid response mental health service improves access to psychiatric assessments and services, as well as reducing cost of health service provision in acute hospitals. The study focused on two areas of possible savings: length of hospital stay and readmission rates, including length of survival in the community after discharge. However, we also aimed to calculate savings from older adult services as a separate group.

Method

Data collection

This study used data already held by City Hospital. Participants were identified via a numerical coding system. The study examined two groups of patients. The RAID group consisted of all emergency admissions with a mental health diagnosis (category F, ICD-10²⁴) that were referred to and managed by the RAID team between 1 December 2009 and 31 July 2010, measuring the RAID direct effect. The RAID-influence group consisted of all emergency

admissions with a mental health diagnosis (category F, ICD-10) that were not referred to RAID but had a discharge date between 1 December 2009 and 31 July 2010, measuring RAID indirect effect. The RAID-influence group was identified because the RAID team provided training and support to the City Hospital staff that helped to manage these patients during the period of the study. Also, the study included a retrospective control group (pre-RAID), which consisted of all emergency admissions with a mental health diagnosis (category F, ICD-10) that were admitted between 1 December 2008 and 31 July 2009. The study included all patients over the age of 16 who were admitted to City Hospital during the study period and who had a length of hospital stay of more than 1 day.

Statistical assessment

The statistical assessment of the RAID team intervention assumed a latent effect that could not be measured directly but could be inferred from other observed variables as patient length of stay, readmission rates and patient survival post discharge. The model compared the patients with a retrospective control (pre-RAID) from the same hospital, controlling for any other possible latent effects within the hospital, assuming no other major interventions for mental health patients from the previous year except for the introduction of RAID team. This evaluation was focused mainly on measuring the effect of the service on length of stay and readmissions. Patients' data were added to an analysis database, which was used to match patients across groups. The statistical analysis was conducted mainly using R statistical package version 2.12.2 on Mac (www.r-project.org).

Length of hospital stay

Patient's length of stay indicates the number of days the patient stayed in the hospital. Since the length of stay variable is affected by fixed and random effects, a case-by-case matched control design was necessary to control the underlying confounding sources of variations except for length of stay.²⁵ Therefore pairs were matched on 'exact' and 'fuzzy' criteria. Exact rules match gender, Health Resource Group, main diagnosis, age band (16–55, 56–69, 70+ years) and seasonal variability. Fuzzy rules use probabilistic matching to match secondary diagnosis in the RAID/RAID-influence group with the control group (pre-RAID).²⁶ The cut-off limit for the lowest possible probability is identified within the RAID and RAID-influence group as the lowest possible secondary diagnosis matching probability with a minimum difference in the length of stay. However, with this sort of matching the marginal probability of finding matching patients between the two groups decreases with every criteria being considered

The result of this matching is a smaller subset of RAID *v.* pre-RAID and another subset of RAID-influence *v.* pre-RAID. Every pair of sets represents only the RAID latent effect and hence can be used as a direct empirical measure of the savings in the length of stay. As length of stay was found to generally follow a negative binomial distribution²⁷ (as shown in Fig. 1), significance of the

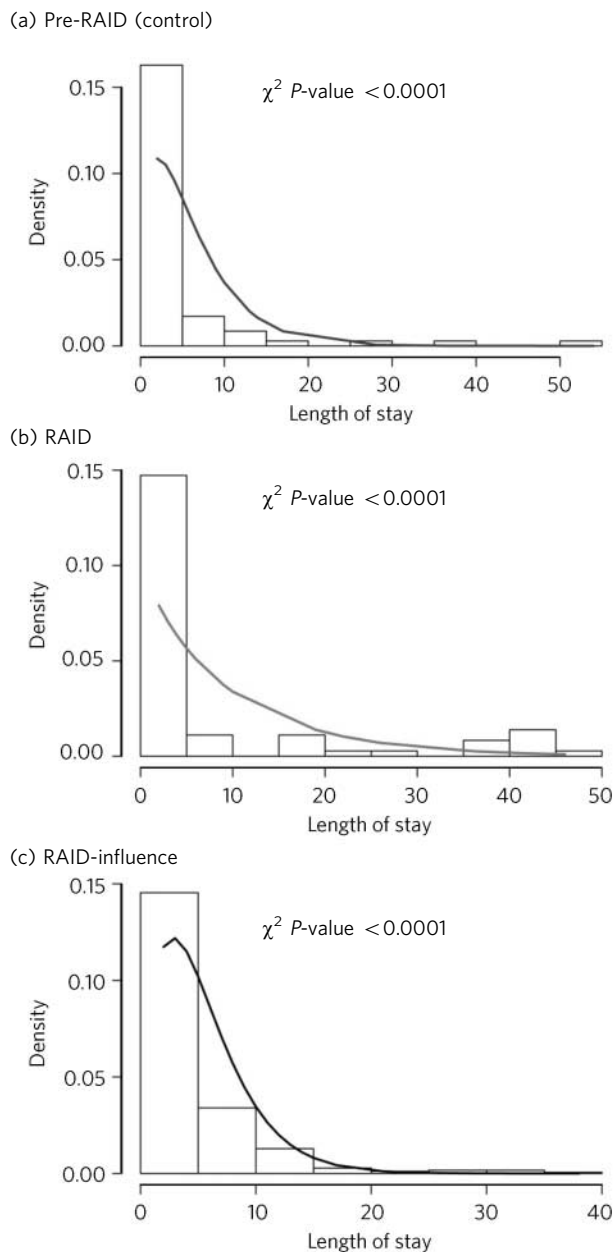


Fig 1 Negative binomial fit of patients' length of stay across matched samples. RAID, Rapid Assessment, Interface and Discharge.

savings was assessed using parametric Monte Carlo negative binomial likelihood ratios and non-parametric permutation tests using Wilcoxon paired test. The small matched sample was tested for selection bias using a Monte Carlo randomisation approach to calculate the confidence interval of the main population mean.

Discharge effect

The effect of the team to discharge patients was examined based on data measuring the time between the RAID intervention and the patients' discharge. A major covariate with the patient discharge is the patient's length of stay. To prove the independence between the length of stay and the discharge effect of RAID, the two events were hypothesised

to be independent and the Chi-squared test was used to test the null hypothesis of dependence.

Patient survival and readmission

The endurance of all patients in the community after discharge and before another admission was calculated using survival analysis methods²⁸ across the RAID, RAID-influence and pre-RAID groups. In the survival analysis, all patients across the three groups were included. The survival of the patient was measured as time to patient readmission. A categorical variable was introduced to identify patient group. A Kaplan–Meier estimate was used to estimate patient survival post discharge. To analyse the effect of any other measured covariate in a multivariate model, we used Cox proportional hazards model to fit the right-censored survival data. The proportionality of the covariates was tested using scaled Schoenfeld residues correlation with the time to readmission. The initial proportional hazards model of patients was fit to age, gender, all admissions during a 3-month period within 1 year, Health Resource Group, main diagnosis and group categorical variable. The final fit model is selected using stepwise selection, where Bayesian Information Criterion (BIC) is used to evaluate step models. We assessed the significance of the categorical variable in the best model using Chi-squared test. The analysis was done using R Stats and Survival library on Mac.

Results

The RAID team received, on average, 300 referrals a month, with 41.2% coming from the A&E department. The mean age of patients referred from A&E was 36.4 years, (95.6% aged 16–64, 4.4% aged 65+). The mean age of patients who were admitted because of self-harm was 34.5 years (95.9% aged 16–64, 4.1% aged 65+). The mean age of referrals from all wards was 65.7 years (40.4% aged 16–64, 59.6% aged 65+). During the period of the evaluation, in total there were 2258 referrals to RAID, including 886 patients who were referred from all the wards.

The RAID group consisted of 886 in-patients (407 male, 479 female), RAID-influence 2654 in-patients (1592 male, 1062 female) and pre-RAID 2873 patients (1686 male, 1187 female) (Table 1). Using paired Wilcoxon test, the *P*-value between all groups showed non-significant differences based on gender and age. It was noticed that patients in the RAID group had nine ICD-10 diagnostic codes on average (the most complex patients), whereas the RAID-influence group had three ICD-10 diagnostic codes on average.

RAID response times

Results indicate that 91% of A&E referrals were assessed by RAID within an hour; the average time was 24 min. In total, 89% of ward referrals were assessed within 24 h, with an average of 16 h.

Detection of mental health

Involvement of RAID also led to an increase in the detection and diagnosis of mental illness. The reasons for

Table 1 Demographics of the Rapid Assessment, Interface and Discharge (RAID), RAID-influence and pre-RAID groups

	RAID, %	RAID-influence, %	Pre-RAID (control), %
Male	46	60	58
Female	54	40	41
Age Band 1 (16–64 years)	67	69	67
Age Band 2 (65–74 years)	10	11	11
Age Band 3 (75+ years)	23	20	22

referral to the RAID team were: self-harm (32%), depression (18%), dementia (18%), alcohol-related problems (13%), psychosis (9%), anxiety (4%), drug misuse (4%) and others (2%). There was a noticeable increase in mental health diagnosis in City Hospital; the biggest increase was seen in the coding of eating disorders (46%), other anxiety disorders (44%), dementia (22%), mental and behavioural disorders due to the use of alcohol (21%), depression and related disorders (17%) and schizophrenia (8%).

Effect of RAID on length of hospital stay

The mean length of stay after matching for RAID group (79 cases) was 9.4 days compared with 10.3 days for the pre-RAID group, and the mean for the RAID-influence group (359 cases) was 5.2 days compared with 8.4 days for the pre-RAID matched group. The RAID-influence group reduction of 3.2 days from the matched pre-RAID group was highly significant ($P < 0.001$), and the RAID group reduction of 0.9 day was of low statistical significance ($P = 0.31$) (Table 2).

Selection bias of the matched groups was examined, as mentioned in the Method. It was found that the mean of 10.3 of the matched sample is within the 95% confidence interval of the population mean (7.5–27.7).

Total savings over 8 months were 9290 bed days in City Hospital. Consequently, estimated savings over 12 months will be 13 935 bed days, which will equate to 38 beds per day. It was also noticed that within the saved 38 beds, 35 beds came out of the geriatric wards. Using the Monte Carlo randomisation approach, we estimated the 95% confidence interval of the mean savings and calculated the minimum savings as 21 beds per day, and the maximum saving was 42 beds per day.

Discharge effect

In total, 75% of patients were discharged within 1 week and 65% were discharged within 3 days of seeing RAID independent of their length of stay. Figure 2 shows the cumulative distribution of the days from RAID referral to the discharge of the patient.

Table 2 Length of stay savings in the RAID, RAID-influence and pre-RAID groups

	Average length of stay, days	Saved days per patient	Saved days over 8 months
RAID matched cohort			
Pre-RAID matched cohort ^a	9.4	0.9	797
RAID-influence matched cohort			
Pre-RAID matched cohort ^b	5.2	3.2	8493

RAID, Rapid Assessment, Interface and Discharge.

a. Average length of stay, 10.3 days.

b. Average length of stay, 8.4 days.

Patient survival

The readmission of RAID patients v. RAID-influence and pre-RAID patients in the same hospital was estimated using Kaplan–Meier (Fig. 3). Using log rank test, the RAID group had a highly significant patient survival than the control group and the RAID-influence group ($P < 0.0001$), whereas the survival of the RAID-influence group was non-significant v. the pre-RAID group ($P = 0.21$). The final proportional hazards model post step selection included only the RAID group categorical variable and the main diagnosis, as shown in Table 3.

The hazard ratio calculated for the categorical variable for the RAID-influence v. the RAID group was 2.8 and for the pre-RAID v. RAID group was 2.45. This indicates that the RAID model decreases the hazard of readmission by 60% from the RAID-influence group and by 65% from the pre-RAID group. The RAID group reduced the readmission of patients with all mental illness codes to only 4 readmissions for every 100 patients as opposed to 15 readmissions for every 100 patients for the pre-RAID group, and 12 readmissions for every 100 patients for the RAID-influence group. Calculations for admissions per day that would have potentially occurred prior to the RAID intervention accumulated to 1200 saved admissions over an 8-month period (estimated 1800 saved admissions over 12 months) for both the RAID and RAID-influence group. The average length of hospital stay for this group of readmitted patients was 4.5 days, i.e. the total annual saved bed-days was 8100 and the daily saved bed days was 22 beds. It was observed that 20 out of those 22 beds came out of the geriatric wards.

Discussion

The RAID model evaluation focused on three areas: response time, quality improvement and cost savings. This evaluation showed that the team achieved the rapid response targets for A&E and all wards in the vast majority of cases. The team also improved the detection of mental illness in City Hospital and access to mental health services.

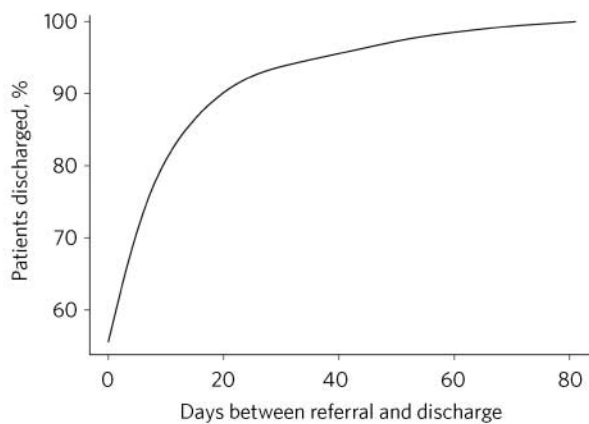


Fig 2 Cumulative distribution of days between RAID referral and discharge.

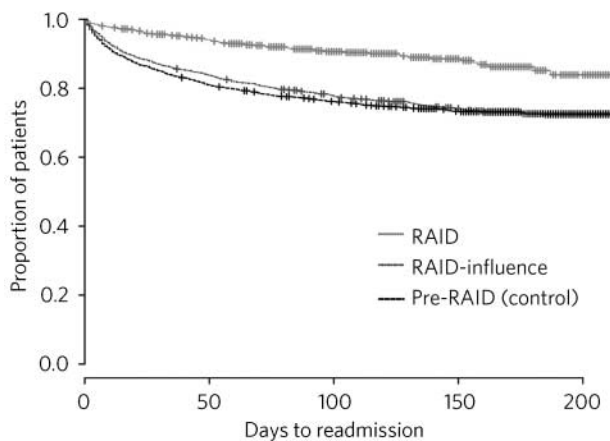


Fig 3 Kaplan-Meier estimate of patients' readmission for each patient group.

Table 3 Fitted Cox proportional hazards model ^a		
RAID categorical variable	Relative risk (95% CI)	P
RAID v. pre-RAID/control		
RAID	1.00	<0.0001
Pre-RAID	2.45 (2.33–2.57)	
RAID-influence	2.80 (2.68–2.92)	
Main diagnosis	0.99 (0.98–1.00)	<0.0001

a. Likelihood ratio test <0.0001.

Quality improvement is reflected in increasing detection of mental illness as well as reducing length of stay and readmission; patients and providers welcome both. However, measuring cost savings is more challenging because of the complexity and variations of patients' individual features and the known paucity of clinical information and diagnostic coding concerning retrospective patient groups with mental health issues in general hospitals; hence, the choice of the used methodology rather than simple group comparison.

The RAID model emphasises training for acute hospital staff in assessment, detection and intervention for mental health challenges. Research suggests that education can

help to both eliminate discrimination of those with mental health difficulties²⁹ and up-skill acute hospital staff. In particular, research suggests that health professionals feel unskilled in dealing with patients with mental health challenges due to a lack of training, and hold stigmatised and negative attitudes towards this patient group.^{30–32} This is particularly applicable to older persons with mental illnesses, including dementia.³³ This study included a RAID-influence group in order to capture the effects of providing training and support to hospital staff, whereas the RAID group was designed to measure the direct effect of RAID. Despite using a retrospective case-by-case matched control group (pre-RAID) to compare the effect of RAID and RAID-influence groups on length of stay, the small number in the pre-RAID group might have affected the outcome due to missing diagnostic codes in the control group and strict matching criteria. It must be emphasised that there were no major changes in the clinical services, managerial structural or discharge support in City Hospital during the study period. However, we acknowledge that it was not possible to control for all external changes in the community during the time period in which RAID cost savings were examined.

The RAID-influence group had a greater impact than RAID in reducing length of stay but both RAID and RAID-influence groups were more effective than the pre-RAID control group. However, the RAID group included the most complex cases in comparison to the RAID-influence group and suggests that nurses and junior doctors on the wards were able, after receiving training on mental health, to develop clinical skills to decide which patients could be managed by the general hospital staff and who should be referred to specialised psychiatric services. The RAID group was more effective than the RAID-influence group and the pre-RAID group in reducing readmissions through linking patients to the right care pathways into the community. Reducing readmission to general hospital is a new target by the Department of Health,³⁴ as readmissions often do not lead to any improvement in health outcomes and are sometimes associated with negative attitudes.^{17–19}

This evaluation showed that most of the savings through reduced length of stay (35 out of 38 beds), and reducing readmissions (20 out of total of 22 beds) came out of geriatric wards. The hospital was able to close down 60 beds by incorporating the reduction in bed use resulting from RAID. The RAID model savings were reviewed by the London School of Economics (LSE), who chose to adopt a very conservative estimate rather than the central estimate used in this paper, and concluded that the RAID model saved at least 44 beds per day, which correlates with the estimate of £1:£4 as reported by LSE.³⁵

Conclusions

Patients who are occupying hospital beds waiting to be assessed by psychiatric services is not only an example of financial waste in our health system, but it also increases dissatisfaction by both patients and staff, which in turn leads to poorer outcomes. Mental health issues in acute hospitals have a negative effect on outcome measures for health and economy. The total savings in bed-days reported in this study through reducing length of stay (21–42 beds

per day) and readmissions (22 beds per day) is estimated at 43–64 beds per day, which is equivalent to approximately 2–3 wards. The London School of Economics estimated that the team was able to save at least 44 beds per day. Most of the bed savings came from geriatric wards. We estimate the financial savings to be £4–6 million (based only on saved beds), but LSE estimated the saving to be around £3.5 million using a conservative calculation. During the period of the RAID intervention City Hospital managed to close 60 beds without cutting down on services.

We emphasise that rapid response to psychiatric patients in acute hospitals in a comprehensive and integrated model can lead to a reduction in readmissions and length of stay.⁶ Savings offer shared benefits between acute hospitals and primary care trusts (savings to the total economy, including social care cost, are not calculated in our study but can be viewed in the LSE report³⁵). We argue that improving mental health services in an acute hospital by enhancing the quality of care and increasing efficiency of psychiatric assessments in an integrated approach, can lead to achieving the required savings and improving quality. However, measuring the outcomes of liaison psychiatry remains a great challenge to research projects and service developments.

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About the authors

Professor George Tadros, MB BCh, PGDip, MRCPsych, MD, Warwick Medical School, Warwick University. **Dr Rafik A. Salama**, PhD, Centre for Ageing and Mental Health, Staffordshire University, and Cancer Research UK, Cambridge Research Institute, Li Ka Shing Centre, Cambridge. **Professor Paul Kingston**, PhD, **Dr Nageen Mustafa**, PhD, Centre for Ageing and Mental Health, Staffordshire University. **Dr Eliza Johnson**, DClinPsy, MA (Hons), Pg Cert, Birmingham and Solihull Mental Health Trust, Birmingham City Hospital. **Ms Rachel Pannell**, Information Department, Sandwell and West Birmingham Hospitals NHS Trust, Lyndon, West Bromwich. **Dr Mahnaz Hashmi**, Consultant Liaison Psychiatrist, City Hospital, Birmingham.

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