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Determinants of hospital length of stay for people with serious mental illness in England and implications for payment systems: A regression analysis

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Abstract

Background

Serious mental illness (SMI), which encompasses a set of chronic conditions such as schizophrenia, bipolar disorder and other psychoses, accounts for 3.4m (7%) total bed days in the English NHS. The introduction of prospective payment to reimburse hospitals makes an understanding of the key drivers of length of stay (LOS) imperative. Existing evidence, based on mainly small scale and cross-sectional studies, is mixed. Our study is the first to use large-scale national routine data to track English hospitals' LOS for patients with a main diagnosis of SMI over time to examine the patient and local area factors influencing LOS and quantify the provider level effects to draw out the implications for payment systems.

Methods

We analysed variation in LOS for all SMI admissions to English hospitals from 2006 to 2010 using Hospital Episodes Statistics (HES). We considered patients with a LOS of up to 180 days and estimated Poisson regression models with hospital fixed effects, separately for admissions with one of three main diagnoses: schizophrenia; psychotic and schizoaffective disorder; and bipolar affective disorder. We analysed the independent contribution of potential determinants of LOS including clinical and socioeconomic characteristics of the patient, access to and quality of primary care, and local area characteristics. We examined the degree of unexplained variation in provider LOS.

Results

Most risk factors did not have a differential effect on LOS for different diagnostic sub-groups, however we did find some heterogeneity in the effects. Shorter LOS in the pooled model was associated with co-morbid substance or alcohol misuse (4 days), and personality disorder (8 days). Longer LOS was associated with older age (up to 19 days), black ethnicity (4 days), and formal detention (16 days). Gender was not a significant predictor. Patients who self-discharged had shorter LOS (20 days). No association was found between higher primary care quality and LOS. We found large differences between providers in unexplained variation in LOS.

Conclusions

By identifying key determinants of LOS our results contribute to a better

understanding of the implications of case-mix to ensure prospective payment systems

reflect accurately the resource use within sub-groups of patients with SMI.

350 words

Key words:

Schizophrenia; Bipolar disorder; Psychosis; Serious mental illness; Length of stay;

Hospitalisation; Mental health funding; Prospective payment; Resource use

Background

Serious mental illness (SMI) encompasses a range of chronic and frequently disabling conditions including schizophrenia, bipolar disorder and psychoses. These conditions are associated with substantial morbidity and mortality. The life expectancy of SMI patients is 10 to 15 years shorter than the general population in England [1], and 15 to 20 years shorter in Denmark, Finland and Sweden [2]. A recent global morbidity study attributed 3.5% of total Years Lost to Disability to schizophrenia and bipolar disorder combined [3]. The two diseases alone are estimated to constitute 1.5% of the total Disability Adjusted Life Year burden of disease for the UK in 2010 [4] and 1.1% in 21 regions worldwide [5]. People with SMI are at higher risk of hospitalisations than the general population [6, 7] as physical comorbidity is more common [8, 9]. SMI is associated with increased treatment costs [10] and hospitalisation for this patient group represents a significant proportion of health care resource use. In England, these illnesses account for 3.4 million or 7.2% of total bed days [11]. This paper examines the key patient and local area determinants of inpatient length of stay (LOS) for patients with a main diagnosis of SMI and examines the variation in LOS between hospital providers in England.

The delivery of mental health services and the incentives that service providers face have changed radically in the last few decades. Most western health care systems have deinstitutionalised care for patients with mental health problems and shifted treatment from secondary care settings into the community [12]. This has led to significant reductions in average LOS and also in overall numbers of psychiatric beds. More recently, policy shifts have focused on changes in funding arrangements for mental health care as a response to pressure to contain costs. Whereas most health care systems reimburse the full costs for providers of inpatient care, several are considering the use of activity-based prospective payment systems, similar to those already in use in the acute physical care setting, in order to reduce costs [13]. Canada (Ontario), Australia and New Zealand have developed case-mix classification systems for mental health services which have included information on diagnosis. In Australia and New Zealand provider factors were shown to significantly drive cost variations making the classification systems unsuitable for provider payment [13].

97 In England, the National Health Service (NHS) is moving away from traditional block

98 contracts towards a more transparent prospective funding for providers called the

99 National Tariff Payment System (NTPS) (formerly known as Payment by Results

100 (PbR) [14]). Under the NTPS, patients are classified into one of 21 care clusters based

101 on need and severity, rather than diagnostic coding. These clusters are in turn grouped

102 into three super-classes corresponding to non-psychotic, psychosis and organic mental

103 illness. The intention is that each cluster will have a fixed national price based on the

104 national weighted average cost of admitted and non-admitted care. Each cluster has a

105 specific review period attached to it with payments made to cover all care during the

106 cluster review period. Whilst the current implementation of NTPS focuses on the

107 development of locally negotiated cluster prices, the move towards a national fixed

108 price payment system would provide a strong incentive to control costs and should

109 therefore encourage providers to reduce LOS. Evidence from the US has reported

110 reductions in LOS following the introduction of a prospective payment system in

111 psychiatric care, as well as reductions in LOS due to anticipatory effects prior to

112 payments starting [15, 16]. LOS for inpatient care is a major driver of resource use

113 and is highly correlated with hospital costs, especially when care is labour-intensive

114 as is the case in mental health [17]. Reductions in LOS may reduce the very high

115 psychiatric bed occupancy rates observed in the English NHS and the associated

116 difficulties in accessing acute psychiatric beds for severely ill patients in crisis [18],

117 although driving down reductions in LOS too far can impact on quality and outcomes

118 and may increase readmission rates [19-21].

119

120 Differences in LOS across providers can reflect differences in patient needs, but can

121 also be indicative of differences in treatment philosophies and practice patterns [22]

122 and in efficiency of care provision. A better understanding of the factors which

123 determine LOS is imperative for the design of payment systems, e.g. by identifying

124 high cost casemix profiles. Estimates of how LOS varies between providers after

125 allowing for differences in case-mix can also provide measures of the extent to which

126 LOS may be amenable to potential reductions by high cost providers in response to

127 the introduction of a prospective payment system. Given the high proportion of bed

128 days and the high cost associated with the care of people with psychotic disorders, as

129 well as the fact that psychosis is one of the three super-classes in the NTPS, this study

130 focuses on the determinants of LOS for people with SMI.

131

There is conflicting evidence about the key determinants of hospital LOS for people
with SMI. This may in part reflect the methodological weaknesses in many previous
studies. Many studies are cross-sectional with small samples split into case-control
groups by mean or median LOS in order to examine the difference between long and
short-stays, typically using logistic regression. Comparing sub-populations in this way
leads to inconsistent findings as LOS is typically skewed and sub-populations may be
small [12]. Single site studies are not generalisable to other settings with a different
patient case-mix [23]. Finally, SMI covers a range of clinical sub-groups with
different treatment requirements. Studies to date have typically pooled clinical sub-
groups to increase their sample size, making the untested assumption that risk factors
will have the same effect on all sub-groups.

This study has two aims. First, we aim to assess the independent effects of patient
characteristics (case-mix) and local area characteristics on LOS and study whether
there is heterogeneity in those effects across patient sub-groups with SMI. We
improve on previous work by using large scale administrative datasets to investigate
factors associated with LOS. Second, we aim to assess the degree of unexplained
variation in provider LOS i.e. the variation which remains after controlling for the
patient and local area characteristics in our model. The residual unexplained variation
in LOS may be interpreted as the element most amenable to influence by
policymakers and providers. Thus it may help to define the limits on the extent to
which a prospective payment system for providers may be successful in reducing LOS
and costs.

Determinants of length of stay for patients with serious mental illness

We searched the literature for key determinants of LOS for patients with SMI to
identify a relevant set of explanatory variables for subsequent analysis. We searched
several bibliographic databases (e.g. PubMed, EMBASE, PsycINFO) to identify
relevant literature published between 1946 and 2014. Our search strategy (see
Appendix 1) included terms for schizophrenia, psychotic disorders, bipolar disorder;
for trials, cohort studies or systematic reviews; and length of stay. Titles were
screened and abstracts were checked for relevance from 132 articles. We found 15

164   studies with LOS as the primary or secondary outcome for patients with SMI

165   specifically. We also identified 5 studies from alternative sources such as suggestions

166   from experts.

167

168   Most studies consider 3 groups of predictor variables: (a) socio-demographic

169   characteristics of patients (e.g. age, gender, living arrangements, degree of social

170   support, ethnicity, insurance status); (b) clinical characteristics (e.g. psychiatric

171   diagnosis, severity, legal status/compulsory admission, psychiatric or physical co-

172   morbidities, measure of functioning, previous admissions, medication); and (c)

173   characteristics of hospitals or the health care system (e.g. type of hospital, measures of

174   quality of care).

175

176   While some studies covered a wide array of determinants, many of these were found

177   not to be significant and the results for some factors differed across studies. Socio-

178   demographic characteristics which were associated with increased LOS for patients

179   with SMI include being single / not married [24-26], having accommodation or

180   housing problems [12, 26-28], having no educational qualification [12, 29], being on a

181   national health insurance plan [30, 31], and being in receipt of welfare [29], whilst

182   higher deprivation was associated with shorter LOS in another study [32]. There is

183   limited evidence of an effect for ethnicity [25]. Being a foreigner was associated with

184   increased LOS in one study [29] while being a migrant was associated with reduced

185   LOS in another [12]. Having family ties or social support was also associated with

186   reduced LOS [33, 34]. Older age was associated with increased LOS in some studies

187   [25, 30, 32, 33, 35], and reduced LOS in others [29, 31, 36]), while male gender was

188   associated with increased LOS in some studies [24, 30, 31], and reduced LOS in

189   others [25, 26, 32, 37]).

190

191   Clinical characteristics which were associated with increased LOS for patients with

192   SMI include: a primary diagnosis of schizophrenia or psychosis [25-27, 29, 31, 32,

193   35, 36, 38, 39] or a mood disorder [35] although some studies found diagnosis to be a

194   poor predictor of LOS [39, 40]. Other characteristics associated with increased LOS

195   were higher severity as measured by e.g. the Brief Psychiatric Rating Scale (BPRS)

196   [24, 41, 42] or the Global Assessment of Functioning (GAF) [37] or other severity

197   indicators [28, 39]. Co-morbidities were associated with increased LOS in some

198 studies [24, 29], while having no secondary diagnoses increased LOS in other studies

199 [30]. A diagnosis of co-morbid substance abuse was associated with a reduced LOS

200 [35, 37, 39] as was personality disorder [37]. Prior hospitalisation was associated with

201 increased LOS in some studies [32, 35, 38] but with lower LOS in other studies [29].

202 Previous violence / forensic history was positively associated with LOS [28, 33] as

203 was use of seclusion or restraint [12, 37]. Legal status/compulsory admission as a risk

204 factor was positively associated with LOS in some studies [23, 38], but negatively in

205 others [25, 26]. Being on an open rather than a locked ward was associated with

206 reduced LOS [29] as was having an emergency admission or weekend admission [32]

207 and being discharged against medical advice [26]. Receiving psychopharmacological

208 medication, such as neuroleptics, antidepressants and lithium was associated with

209 reduced LOS in one study [29] and increased LOS in another [27]. Being admitted

210 from another institution was positively associated with LOS in one study [34] and

211 negatively in another [12].

212

213 Finally, characteristics of hospitals and the healthcare system which were positively

214 associated with LOS include the patient being treated at a psychiatric hospital, rather

215 than another type of hospital [30, 31], a higher number of beds [25, 30, 31], a higher

216 proportion of male patients [31], and a higher proportion of elderly patients [31]. The

217 number of health care professionals employed was associated with reduced LOS [30,

218 31] as was a shorter distance from patient's place of residence to hospital [24]. There

219 was also evidence of marked regional variation in LOS [12, 38].

Methods

220

Study population

221

222 Our study population was all patients aged 18 or over and admitted with a primary

223 diagnosis of SMI to a mental health hospital in England during the study period April

224 2006 to October 2010. All patients were followed until March 2011. SMI patients

225 were identified using ICD-10 diagnostic codes in the primary diagnosis field of their

226 admission record. Many studies focus on a wide range of mental health conditions and

227 thus tend to group the primary diagnoses according to type of disorder by ICD-10

228 code (e.g. F2, F3) which also reflects severity to some degree [12, 43]. We focussed

229 on individual conditions within SMI to more accurately assess the impact on resource

230 use for each condition. In addition to considering the effects of patient and local area

231 characteristics on LOS for all SMI patients in a pooled model (1), we also examined

232 patients with three types of SMI: (2) schizophrenia (F20); (3) schizoaffective

233 disorders, and schizotypal and delusional disorders (F21- F29); and (4) bipolar and

234 mood affective disorders (F30-F31) (see Table 1).

235   Table 1 about here

236 **Data sources**

237 Our study combined several datasets. Record-level data on hospital admissions were

238 obtained from the Hospital Episodes Statistics (HES) which covers all NHS-funded

239 secondary care in England. These data are reported as Finished Consultant Episodes

240 (FCEs) and we converted these to continuous inpatient spells (CIPS) (admissions).

241 Using CIPS has the advantage that it reduces coding errors e.g. where patients leave

242 hospital for a weekend but are not discharged, they may otherwise be coded as a new

243 admission on their return. We used HES to derive our dependent variable (LOS) and a

244 range of demographic and clinical characteristics. Individual patient records were

245 linked over time through a unique patient identifier, based on the patient's NHS

246 number. Data on local area-level characteristics (i.e. the number of people resident in

247 an NHS community psychiatric establishment, and urban status) were sourced from

248 the Office of National Statistics (ONS). These data were derived from the 2001

249 Census and were available at small area level (Lower Super Output Area (LSOA)).

250 Data on the number of incapacity benefit claimants at small area level were obtained

251 from the Department of Work and Pensions. Data on access to and quality of care for

252 patients with SMI received in primary care were extracted from the Quality and

253 Outcomes Framework (QOF) dataset and the GP Patient Survey (GPPS) dataset and

254 linked to HES through the practice identifier and the year. Appendix 2 provides a full

255 list of datasets and sources. As confirmed by the University of York Research Ethics

256 Committee, no ethical approval was required for this study since it is classed as low

257 risk due to minimal burden or intrusion for participants as it is based on the analysis

258 of anonymised secondary data.

259 **Data**

260 LOS for each admission was calculated as the difference between the dates of

261 admission to and discharge from hospital. All patients were admitted and discharged

262 from the same hospital. Patients with unfinished episodes were dropped from the

263 sample.

264

265 For each admission, we also extracted information from HES on socio-demographic

266 variables such as age (we categorised patients' age into seven 10-year bands and used

267 the first band (18-24) as a reference category), gender, ethnicity, and carer support;

268 clinical variables including main and secondary diagnoses, previous history of

269 psychiatric care, legal status - whether the patient was detained under the Mental

270 Health Act; and the mode of discharge (discharged by clinician, self-discharged, or

271 died in hospital).

272

273 In relation to co-morbidity, previous studies adopt a range of different approaches,

274 with many studies including co-morbidity in terms of secondary diagnoses of a mental

275 health condition, rather than other clinical conditions. Some ignore this aspect

276 completely [31]; others record whether a secondary diagnosis was present or absent

277 [29]; and many tend to focus only on a secondary diagnosis related to substance or

278 alcohol misuse or personality disorder [23, 35, 37].

279

280 We counted the total number of co-morbidities for a patient up to a maximum of 13,

281 including secondary diagnoses for mental health and non-mental health conditions.

282 We imposed a limit of 13 to account for the change in the number of available fields

283 in HES for recording secondary diagnoses (ranging from 13 in 2006 to 19 in year

284 2010). We also derived a set of indicator variables for a secondary diagnosis of co-

285 morbid alcohol and substance misuse (F10-F19) [35, 37] and co-morbid personality

286 disorder (F60) [37].

287

288 We derived a number of neighbourhood level characteristics to account for the local

289 context, e.g. the deprivation profile. We extracted data on the proportion of the local

290 population who resided in NHS community psychiatric establishments. Ideally, we

291 would have used a measure based on the number of beds available each year (rather

292 than occupancy at one time point). However, as long as demand for community beds

293 is at least equal to supply, the measure was considered a reasonable approximation of

294 capacity and therefore a likely proxy for local area need. Socio-economic status was

295 approximated by the percentage of the local population claiming incapacity benefit for

296 a mental disorder. Since the LSOA population (i.e. denominator) changed over time,

297 we estimated moving averages for both these variables. We then categorised the

298 deprivation measure (i.e. incapacity claimants) into quintiles. Finally, we accounted

299 for whether the local area was 'urban' (defined as having a population above 10,000),

300 using a dummy variable based on the 'Rural and Urban Area Classification for Super

301 Output Areas, 2004' (from ONS). This variable was assumed to be time-invariant.

302

303 Effective primary care may shorten patients' LOS in two ways: firstly, if hospitals can

304 be confident that the patient will be followed up by the GP practice they may decide

305 to discharge the patient more quickly. Secondly, patients with better access to primary

306 care prior to admission may require a shorter stay once admitted.

307

308 The Quality and Outcomes Framework (QOF) is a pay-for-performance scheme in

309 primary care which includes a set of indicators for SMI against which practices score

310 points according to their level of achievement. We extracted data on the proportion of

311 SMI patients with a comprehensive care plan documented, which we interpreted as a

312 measure of quality and continuity of care. To approximate accessibility of primary

313 care services, we extracted the proportion of patients reported to have been seen by

314 their GP within 48 hours, derived from the annual GP survey. Both variables were

315 measured at GP practice level and linked to the HES record through unique practice

316 and year identifiers.

317 **Exclusions**

318 We excluded admissions with very long LOS, defined as stays over 180 days

319 (approximately 6 months), to reduce the effect of unusually long stay patients on the

320 stability of the estimates and focus on a more homogeneous patient population that

321 reflects the majority of cases seen in the inpatient setting. These long-stay patients

322 tend to be different with respect to observable characteristics. For example, those

323 patients staying longer than 180 days are twice as likely to be detained and 1.5 times

324 as likely to have a main diagnosis of schizophrenia (ICD-10: F20). To ensure our

325 analysis included all patients who could have stayed in hospital up to the upper

326 threshold, we excluded admissions that occurred after the 2nd October 2010

327 calculated as 31st March 2011 minus 180 days.

328

329 We also excluded admissions to mental health providers which treated fewer than 10

330 admissions for the particular clinical diagnosis sub-category over our study period

331 (see study population). Finally, patients were excluded if they were recorded as living

332 outside of England.

Analysis

334 Poisson regression models were estimated to relate observed LOS to patient

335 characteristics, neighbourhood characteristics and indicators of primary care. All

336 models included hospital fixed effects to account for unobserved differences in

337 hospital policies, efficiency, and case-mix. Hence, coefficients are estimated from

338 within-hospital variation only. We included time fixed effects to account for common

339 temporal trends. No exposure term was defined. Poisson regression was appropriate

340 for these data due to the skewed distribution of LOS. It was also preferable to

341 logarithmic transformations, which are commonly used to analyse LOS, because it

342 estimated the conditional mean on the scale of interest and did not suffer from re-

343 transformation bias [44, 45]. Poisson regression is increasingly used to analyse length

344 of stay and cost data, and has been found to fit those data at least as well as for

345 example, Weibull or Cox proportional hazard survival models [46, 47]. Since

346 censoring was not a major concern in this study - only 2.7% of patients self-

347 discharged or died in hospital - we decided to model these factors as covariates. The

348 Poisson estimator produces unbiased point estimates as long as the conditional mean

349 is correctly specified. We obtained robust Huber-White standard errors to account for

350 over-dispersion or other misspecification of the variance function [48].

351

352 Estimated effects are reported as average partial effects (APEs), which represent the

353 expected change in LOS for a unit change in the independent variable. APEs were

354 calculated conditional on hospital fixed effects, which we recovered after estimation

355 using the procedure outlined in [48] (p.281). We also calculated Incidence Rate Ratios

356 (IRRs) with two-sided 95% confidence intervals, where values greater than 1 indicate

357 an increase in relative risk of incurring an additional inpatient day.

358

359 All models were estimated on the pooled sample of all SMI admissions and separately

360 for the three groups of SMI admissions. We compared the estimated effects across

361 groups to explore heterogeneity in the effect of risk factors. We also correlated the

362 hospital fixed effects estimates across groups to examine whether unobserved hospital

363 characteristics had a similar effect on LOS for the different patient groups.

364

365   All analyses were conducted in Stata 13.

Results

Descriptive analysis

Our sample included 89,510 admissions for patients treated in 67 hospitals and who

were registered with 7,792 GP practices. Across all five years, the median annual

volume of admissions with a primary diagnosis of SMI was 270.

Approximately 42.7% of admissions had a recorded primary diagnosis of

schizophrenia, and another 33.4% were diagnosed with bipolar disorder or a manic

episode (Table 1). However, there was substantial variation in intake across providers.

Figure 1 shows the proportion of patients in each of the three sub-groups by provider.

For some providers, 55% of the SMI patients were diagnosed with schizophrenia,

whereas the proportion in other providers was less than 30%. Similarly, the proportion

of patients with bipolar or mood affective disorder was around 40% (and one as high

as nearly 60%) in some providers, but was just over 20% in other hospitals.
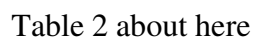
Figure 1 about here

Figure 2 shows a histogram of the distribution of LOS. LOS fell very slightly over

time by on average around 0.2 to 0.4 days per year across the three sub-groups (Table

2) and LOS was longest for individuals with a main diagnosis of schizophrenia (F20)

or schizoaffective disorder (F25) (Figure 3).

Figure 2 about here

Table 2 about here

Figure 3 about here

Estimation results - overview

Table 3 shows the average partial effects (APEs) estimates for the pooled model

(column (1)) and then separately for the three types of SMI patient (columns (2) to

(4)). Table 4 presents the results as Incidence Rate Ratios (IRR). In the pooled model,

the majority of diagnostic groups had a shorter LOS than schizophrenia, some as

396   much as 20 days shorter (F22). Diagnosis was a key predictor of LOS in the pooled

397   model. Results were broadly consistent across the three diagnostic groups of patients.

398   However, there were some differences in LOS across diagnoses: F23, F28 and F29

399   had significantly shorter LOS than schizotypal disorder (F21) of between 9 and 17

400   days. People with bipolar affective disorder had a significantly longer LOS of 7 days

401   compared to those suffering from a manic episode (F30).

402

403   Table 3 about here

404   Table 4 about here

405   **Estimation results – individual characteristics**

406   Our findings suggest that most independent risk factors do not have a differential

407   effect for different diagnostic sub-groups. However we do note some heterogeneity in

408   the effects. In terms of patient demographics and clinical characteristics, we found an

409   age gradient with patients from age 65 and above with schizophrenia, and from age 55

410   and above for the other diagnostic subgroups and in the pooled model, exhibiting

411   progressively longer LOS compared to 18-24 year-olds. This age gradient for the 65

412   to 74-year old age group, relative to the 18 to 24-year old age group, was 11 days in

413   the pooled model and ranged from 6 days for the schizophrenia subgroup, 14 days for

414   schizoaffective disorder and 19 days for bipolar disorder. Gender was not a significant

415   predictor of LOS. Longer LOS was associated with formal detention (16 days in the

416   pooled model and between 15 days for schizoaffective disorder and 19 days for

417   schizophrenia) and with black ethnicity (around 4 days), although detained patients

418   with black ethnicity had shorter LOS than detained white patients (see interactions in

419   Table 4). Having an informal carer was associated with longer LOS in the pooled

420   model (3 days) although this was not significant in all models (2) to (4). Patients with

421   schizophrenia who had a previous psychiatric history had a shorter LOS of around 2.5

422   days, but this was not the case in the pooled model or for any of the other sub-groups.

423   In the pooled model, patients from more deprived neighbourhoods had a longer LOS

424   (between 2 and 3 days) and the effect was larger in patients with bipolar disorder (6

425   days). Having a higher number of physical and psychiatric comorbidities was

426   associated with longer LOS (1 day) while shorter LOS was associated with co-morbid

427   substance or alcohol misuse (between 4 and 5 days), and co-morbid personality

428   disorder (between 7 and 9 days) for all types of patient. Patients who decided to self-

429   discharge had shorter LOS (between 19 and 29 days). Patients whose usual place of

430   residence was an urban area did not have significantly different LOS compared with

431   other patients. No association was found between LOS and primary care in terms of

432   either access or quality variables.

433   **Hospital variation**

434   Figure 4 shows histograms of the estimated hospital fixed effects by diagnostic group.

435   These fixed effects could be interpreted as the predicted length of stay for a given

436   patient (here given by the reference category in Table 3). The median hospital effects

437   were 42.8 days (Interquartile range (IQR) = 38.5 - 45.7) for schizophrenia (F20), 42.6

438   days (IQR = 38.0 - 46.0) for schizotypal disorders (F21-F29), and 42.3 days (IQR =

439   38.9 - 46.5) for bipolar and mood affective disorders (F30-F31). The differences

440   amongst hospital fixed effects reflect the average effect on hospital LOS of

441   differences across hospitals in factors that we do not observe.

442

443   Figure 4 about here

444

445   The correlations between the hospital effects for the three sub-groups of patients were

446   high (rho>0.75) for all pairs of diagnostic groups.

447   # Discussion

448   To our knowledge, this is the first study to use large-scale national routine data to

449   examine the key determinants of LOS for particular patient sub-groups with serious

450   mental illness in England. Previous literature has tended to produce inconsistent

451   results about factors associated with LOS partly because of small sample sizes and

452   also due to the limitations of the methods employed in some studies. Our main

453   contribution to the existing literature is in terms of our methodology which, compared

454   to other studies, provides results which are more robust. The methodological advances

455   include estimating a Poisson regression model with hospital fixed effects, rather than

456   using a logit model to examine long-stay patients using an arbitrary cut-off point to

457   model case-controls, and taking account of LOS as a continuous variable. Where

458   many previous studies ignore hospital effects, we examined differences in LOS

459   between mental health providers. Our larger sample size enabled us to improve on

460   previous studies by estimating separate models for three key diagnostic sub-groups to

461   analyse the independent contribution of a range of potential determinants of LOS on

462 each of the broad classes of diagnoses. Our study population was everyone admitted

463 to an NHS mental health hospital in England with SMI over the period 2006 to 2010

464 and was considerably larger and more representative than previous studies. There are

465 no reliable estimates of the number of patients seeking care in the private sector, but

466 this is likely to be small as the vast majority of mental health hospital care in England

467 is publicly funded. Specifically, the £143 m market for privately funded mental health

468 hospital care [49] compares with £2 billion of NHS spending on psychotic disorders

469 [50].

470

471 Contrary to some previous studies, we found that diagnosis was a strong predictor of

472 LOS [40, 51]. We found that shorter LOS was associated with co-morbid substance or

473 alcohol misuse, and with co-morbid personality disorder, although recorded

474 prevalence of these co-morbidities may be low due to poor coding. This finding is

475 however consistent with previous literature and may be because when these patients'

476 symptoms resolve following inpatient detoxification, they are more likely to leave

477 against medical advice (self-discharge), and may be motivated to show improvement

478 so they can leave to regain access to drugs or alcohol [35, 37]. Indeed patients who

479 self-discharged had shorter LOS. It may also reflect the transient nature of psychotic

480 symptoms in the context of substance misuse, where there is more rapid resolution

481 upon admission to hospital and removal from the usual environment. While previous

482 literature has been inconsistent with respect to the association with age, reporting

483 positive [30, 33, 35], and negative findings [29, 31, 36]), in our study we found a

484 strong age gradient only for people aged 55 and above (and the effect was not

485 apparent until 65 for those with schizophrenia). We also found, as in previous

486 literature [37, 38], that compulsory admission was positively associated with LOS,

487 increasing it by 16 days overall (19 days for schizophrenia, 15 days for

488 schizoaffective disorder and 17 days for bipolar disorder). While studies have found

489 mixed results on the association between male gender and LOS (positive [24, 30, 31],

490 negative [37]), gender was not a significant predictor of LOS in our analyses.

491 Previous evidence on the association between co-morbidities and LOS has been

492 inconsistent: while some studies found that patients with more co-morbidities had

493 longer LOS [24, 29], others found that individuals with no comorbidity had longer

494 LOS [30]. Our study found that having a higher number of psychiatric and physical

495 comorbidities was associated with longer LOS of around 1 day. Some previous

496   studies have reported positive associations between prior hospitalisation and LOS [35,

497   38] and others found a negative relationship [29]; in our analyses, only schizophrenia

498   patients with a psychiatric history had a shorter LOS of around 2.5 days. This may be

499   because these patients are well known to services and crisis stabilisation can be

500   achieved more swiftly since relapse signatures will be familiar, medication regimes

501   will be tried and tested, and care plans are more likely to be in place.

502

503   Having a carer was associated with longer LOS overall in the pooled model and for

504   schizophrenia and bipolar disorder patients, but there was no effect for schizoaffective

505   disorder patients. It is possible that if carers experience a significant carer burden

506   from patients with high levels of need, LOS may be prolonged, in the interests of

507   protecting carers' health and wellbeing. Just less than 7% of patients have an unpaid

508   carer registered in their hospital record. The record may underestimate the actual level

509   of both formal and informal care that this patient population receive. If a record of

510   having a carer is associated with increased patient need, then this may explain the

511   positive association that we observe.

512

513   Patients with manic or bipolar disorders who were from more deprived

514   neighbourhoods had longer LOS whilst this was not the case for schizophrenia

515   patients.

516

517   Although there were similarities in the association between LOS and patient

518   characteristics across the three diagnostic patient groups, there were some noticeable

519   differences. Whilst these should be interpreted with caution, our results suggest that

520   there may be advantages to modelling LOS stratified by diagnostic groupings to more

521   accurately determine associations between case-mix which can be used to ensure

522   prospective payment systems reflect accurately the resource use within sub-groups.

523

524   We found a large degree of variation in case-mix between providers. This will likely

525   have implications for the costs imposed on them by the risk profile of their patient

526   population, particularly if hospitals predominantly treat older patients with complex

527   care needs and detained patients. We also found significant variation in the hospital

528   fixed effects within diagnostic groupings. The interquartile range of the hospital fixed

529   effects for each diagnostic group is around 9 days suggesting a significant spread in

530   the distribution and large differences between providers in the unexplained variation

531   in LOS. We also found a high correlation between the provider effects across the

532   different diagnostic groups. This suggests that hospitals with unexplained high LOS

533   for one diagnostic group will also have high LOS for another sub-group. These

534   hospitals may be systematically different in the way they manage and treat patients.

535   Unobserved hospital characteristics (such as the quality of care, quality of

536   management, unmeasured differences in average case-mix, or differences in

537   efficiency) therefore appear to have similar effects on LOS for different types of

538   patients.

539

540   The proposed NTPS for mental health providers is based on need and, other than

541   assigning patients to the super-classes of non-psychotic, psychosis and organic mental

542   illness, the system does not directly use diagnoses (ICD-10 codes) to cluster service

543   users. The Mental Health Clustering Tool, used to allocate service users to the 21

544   clusters, explicitly states that people with the same diagnosis can be assigned to

545   different clusters, and that individuals can move between clusters as their needs

546   change over time [52]. Our results suggest that the payment system may need to be

547   tailored according to diagnostic group. A prospective payment system should be fair

548   (e.g. paying the same for treating patients with similar needs), but also needs to take

549   account of factors beyond the control of a hospital (e.g. the characteristics of patients

550   such as diagnosis if this affects LOS, age, detention status, local input prices).

551   However, a balance needs to be struck. If some factors make little economic

552   difference, though statistically significant, they should not be used in the payment

553   system as they would add unnecessary complexity. There are also risks of unintended

554   consequences if some diagnoses or detention status attract a higher payment,

555   generating inappropriate incentives. Finally, the argument for paying by diagnosis

556   hinges on the assumption that these are well coded. There are therefore concerns

557   about the feasibility of implementing such a system (coding quality, gaming, etc.).

558   Conclusions

559   This study used national administrative data linked to publicly available datasets to

560   produce a large sample with a rich set of potential determinants of LOS for patients

561   with SMI. Our data on individual patients was more limited than in studies adopting

562   retrospective case note review but were comprehensive in that they covered all

563   publicly funded hospital admissions in England. Many of the commonly identified

564   risk factors were captured, although some were an imperfect match for those

565   identified in the literature review. Other factors were omitted entirely due to limited

566   data availability, including psychiatric functioning or severity, the use of seclusion or

567   restraint and psychopharmacological medication. We also did not account for

568   readmissions which may be important in relation to LOS and payment mechanisms,

569   since providers with shorter LOS may benefit from early discharge, and a subsequent

570   new admission for which they could be paid, unless incentives were put in place to

571   discourage a quicker and sicker 'revolving door' phenomenon [53].

572

573   We found substantial variation between providers in unobserved hospital

574   characteristics (such as differences in management culture or efficiency). Providers

575   appear to be systematically different in terms of their resource use and this will likely

576   result in some hospitals being 'winners' and others 'losers' under a prospective

577   payment system. International experience suggests large variations in provider effects

578   with respect to costs or LOS may make a classification system unsuitable for provider

579   payment [13] as it may destabilize local health economies. There is therefore a need

580   for a careful transition to any new payment system.

581

582   The variation in case-mix which we observed may be the result of genuine differences

583   in risk profiles between providers, but may also be due to inconsistent use of

584   diagnostic codes between providers. There are some limitations to the use of

585   diagnostic classifications in HES for psychiatric admissions. Diagnostic coding is

586   often done by administrative staff removed from the nuances of psychiatric diagnosis,

587   rather than by the rigorous application of ICD-10 criteria by clinicians. Whilst we

588   have argued that payment systems may need to be tailored to diagnostic groupings,

589   this would require the consistent and accurate use of diagnostic codes across mental

590   health providers. Whilst some mental health professionals are reluctant to label

591   patients, in part due to stigma, and argue for treating the person rather than the illness

592   [54], diagnostic coding can be helpful to patients, by providing appropriate treatments

593   and access to support and services including benefits [55]. A quality indicator has

594   been recommended for use by commissioners and providers in drawing up contracts

595   as part of the NTPS which incentivises the collection of a valid ICD-10 code [56].

596   Improved data quality on diagnostic coding is imperative for future research purposes

597   to better understand the role of diagnosis as a driver of LOS and resource use as part

598   of a funding system.

599

600   Challenges in future may be not just to reward hospitals properly but also to

601   incorporate incentives for appropriate primary, community and social care to form

602   part of the care package for individuals with SMI, moving towards personalised

603   funding. Future research should therefore focus on examining cost drivers across the

604   full range of services that SMI patients utilise and across the full patient care pathway.

605   This will support the design and reimbursement of more effective and efficient care

606   pathways. Inpatient LOS for SMI patients will remain an expensive but important

607   component of that pathway and therefore understanding the key determinants of LOS

608   is vital as mental health service commissioners and providers grapple with the

609   challenges of continued cost pressures.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

NG led the data assembly, analysed the data and contributed to manuscript drafting. AM derived some of the key explanatory variables, and contributed to the analysis and manuscript drafting. TK contributed to study design, interpretation of results, providing clinical input and writing of the manuscript. MG and HG contributed to study design and interpretation of results and to the writing of the manuscript. SG contributed to study design, provided clinical input and helped to interpret findings. RJ was the principal investigator, overseeing all aspects of the study. RJ is the guarantor for the study. All authors read and approved the final manuscript.

Acknowledgements

List of abbreviations

APE Average Partial Effect

BPRS Brief Psychiatric Rating Scale

CIPS continuous inpatient spell

GAF Global Assessment of Functioning

GPPS GP Patient Survey

642   HES Hospital Episode Statistics

643   ICD-10 International Classification of Diseases, 10th revision

644   IQR interquartile range

645   IRR incidence rate ratio

646   LOS length of stay

647   LSOA lower super output area

648   NHS National Health Service

649   NTPS National Tariff Payment System

650   ONS Office for National Statistics

651   PbR Payment by Results

652   QOF Quality and Outcomes Framework

653   SMI serious mental illness

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830

Tables

Table 1 - Descriptive statistics for admissions contributing to the regression analyses

Variable	Pooled (N=89,510) (1)		Schizophrenia (N=38,216) (2)		Psychotic and schizoaffective disorder (N=21,415) (3)		Manic and bipolar disorder (N=29,879) (4)	
Main diagnosis (n, %)								
Schizophrenia (F20)	38,216	(42.7)	38,216	(100.0)				
Schizotypal disorder (F21)	229	(0.3)			229	(1.1)		
Persistent delusional disorder (F22)	3,605	(4.0)			3,605	(16.8)		
Acute and transient psychotic disorder (F23)	6,446	(7.2)			6,446	(30.1)		
Induced delusional disorder (F24)	66	(0.1)			66	(0.3)		
Schizoaffective disorders (F25)	8,200	(9.2)			8,200	(38.3)		
Other nonorganic psychotic disorders (F28)	268	(0.3)			268	(1.3)		
Unspecified nonorganic psychosis (F29)	2,601	(2.9)			2,601	(12.1)		
Manic episode (F30)	2,777	(3.1)					2,777	(9.3)
Bipolar affective disorder (F31)	27,102	(30.3)					27,102	(90.7)
Age (n, %)								
Age up to 25	8,224	(9.2)	3,893	(10.2)	2,795	(13.1)	1,536	(5.1)
Age 25-34	17,951	(20.1)	9,213	(24.1)	4,623	(21.6)	4,115	(13.8)
Age 35-44	22,116	(24.7)	10,308	(27.0)	5,094	(23.8)	6,714	(22.5)
Age 45-54	17,997	(20.1)	7,298	(19.1)	3,824	(17.9)	6,875	(23.0)
Age 55-64	11,652	(13.0)	4,194	(11.0)	2,281	(10.7)	5,177	(17.3)
Age 65-74	7,110	(7.9)	2,203	(5.8)	1,402	(6.5)	3,505	(11.7)
Age 75 and over	4,460	(5.0)	1,107	(2.9)	1,396	(6.5)	1,957	(6.5)
Gender (n, %)								

	n	(%)	n	(%)	n	(%)	n	(%)
Female	42,589	(47.6)	13,217	(34.6)	11,292	(52.7)	18,080	(60.5)
Male	46,921	(52.4)	24,999	(65.4)	10,123	(47.3)	11,799	(39.5)
Detention status (n, %)								
Not detained	72,273	(80.7)	30,554	(80.0)	17,039	(79.6)	24,680	(82.6)
Detained	17,237	(19.3)	7,662	(20.0)	4,376	(20.4)	5,199	(17.4)
Ethnicity (n, %)								
White	67,980	(75.9)	27,330	(71.5)	15,841	(74.0)	24,809	(83.0)
Mixed	1,822	(2.0)	948	(2.5)	443	(2.1)	431	(1.4)
Asian	6,728	(7.5)	3,290	(8.6)	1,684	(7.9)	1,754	(5.9)
Black	8,898	(9.9)	5,051	(13.2)	2,172	(10.1)	1,675	(5.6)
Unknown or missing	4,082	(4.6)	1,597	(4.2)	1,275	(6.0)	1,210	(4.0)
Patient has a carer (n, %)								
No	83,426	(93.2)	35,647	(93.3)	19,958	(93.2)	27,821	(93.1)
Yes	6,084	(6.8)	2,569	(6.7)	1,457	(6.8)	2,058	(6.9)
Patient was previously treated for mental health issues (n, %)								
No	48,126	(53.8)	19,377	(50.7)	12,803	(59.8)	15,946	(53.4)
Yes	41,384	(46.2)	18,839	(49.3)	8,612	(40.2)	13,933	(46.6)
Alcohol and substance misuse (n, %)								
No	84,786	(94.7)	35,797	(93.7)	20,304	(94.8)	28,685	(96.0)
Yes	4,724	(5.3)	2,419	(6.3)	1,111	(5.2)	1,194	(4.0)
Co-morbid personality disorder (n, %)								
No	88,329	(98.7)	37,800	(98.9)	21,077	(98.4)	29,452	(98.6)
Yes	1,181	(1.3)	416	(1.1)	338	(1.6)	427	(1.4)
Number of comorbidities (mean, sd)	0.43	(1.0)	0.39	(1.0)	0.47	(1.1)	0.45	(1.1)
Discharge type (n, %)								
Discharged by consultant	87,063	(97.3)	37,148	(97.2)	20,790	(97.1)	29,125	(97.5)
Self-discharged	2,017	(2.3)	902	(2.4)	525	(2.5)	590	(2.0)
Died in hospital	430	(0.5)	166	(0.4)	100	(0.5)	164	(0.5)

Resident in urban area (n, %)								
No	8,959	(10.0)	2,782	(7.3)	2,251	(10.5)	3,926	(13.1)
Yes	80,551	(90.0)	35,434	(92.7)	19,164	(89.5)	25,953	(86.9)
Percentage mental health benefit claimants in local community (mean, sd)	2	(1.6)	2.51	(1.7)	2.23	(1.6)	2.03	(1.5)
Percentage population of local community resident in NHS psychiatric establishment (mean, sd)	0	(0.3)	0.03	(0.4)	0.02	(0.3)	0.02	(0.3)
GP quality - % practice population with SMI with care plan (mean, sd)	1	(0.1)	0.84	(0.1)	0.85	(0.1)	0.84	(0.1)
GP access - % practice population able to see GP within 48h (mean, sd)	1	(0.1)	0.82	(0.1)	0.82	(0.1)	0.83	(0.1)

Table 2 – LOS by diagnostic group and pooled over time

Financial year	All (F20-F31) (1)		Schizophrenia (F20) (2)		Psychotic and schizoaffective disorder (F21-F29) (3)		Manic and bipolar disorder (F30-F31) (4)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2006/07	44.4	40.0	48.0	43.3	41.6	38.5	41.6	35.7
2007/08	43.3	39.7	47.0	42.7	40.8	38.5	40.2	35.9
2008/09	45.0	40.1	49.0	42.9	42.1	39.1	42.2	36.7
2009/10	43.7	39.6	47.7	42.7	40.6	37.8	41.1	36.3
2010/11	42.7	38.4	46.1	40.9	40.2	37.5	40.5	35.7
Pooled	43.9	39.7	47.7	42.7	41.1	38.3	41.2	36.1

Table 3 - Factors determining hospital length of stay – regression results, Average Partial Effects (APEs)

Variable	Pooled (F20-F31) (1) APE	SE		Schizophrenia (F20) (2) APE	SE		Psychotic and schizoaffective disorder (F21-F29) (3) APE	SE		Manic and bipolar disorder (F30-F31) (4) APE	SE	
Main diagnosis												
Schizophrenia (F20)	*(base category)*			*(base category)*								
Schizotypal disorder (F21)	-4.16	0.71	***				*(base category)*					
Persistent delusional disorder (F22)	-19.56	1.04	***				-2.12	2.86				
Acute and transient psychotic disorder (F23)	-11.57	4.69	*				-17.20	2.15	***			
Induced delusional disorder (F24)	0.75	0.52					-9.34	5.65				
Schizoaffective disorders (F25)	-11.67	2.32	***				3.78	3.18				
Other nonorganic psychotic disorders (F28)	-11.42	1.10	***				-9.29	3.79	*			
Unspecified nonorganic psychosis (F29)	-6.36	0.48	***				-9.03	2.69	***			
Manic episode (F30)	-3.02	2.80								*(base category)*		
Bipolar affective disorder (F31)	-12.57	1.01	***							7.42	1.27	***
Patient demographics and clinical characteristics												
Age 25-34	-1.63	0.61	**	-1.72	0.81	*	-0.93	1.13		-2.64	1.44	
Age 35-44	-3.54	0.53	***	-3.84	0.76	***	-3.68	1.10	***	-3.65	1.37	**
Age 45-54	-2.25	0.59	***	-3.22	0.98	***	-2.25	1.00	*	-0.66	1.42	
Age 55-64	1.64	0.63	**	-0.49	0.98		4.56	1.35	***	4.31	1.80	*
Age 65-74	10.88	1.23	***	6.21	1.60	***	14.39	2.33	***	18.55	3.01	***
Age 75 and over	18.64	1.57	***	11.60	2.45	***	25.57	3.84	***	27.45	3.73	***
Male	-0.41	0.38		-1.35	0.53	*	-0.62	0.62		0.72	0.77	
Detained	15.98	1.17	***	19.48	1.81	***	14.72	2.26	***	16.51	1.76	***
Ethnicity: mixed	2.31	0.99	*	0.57	1.49		3.65	1.80	*	7.74	3.45	*
Ethnicity: Asian	0.69	0.64		0.68	0.82		1.92	1.42		-0.45	0.89	

Ethnicity: black	4.46	0.63	***	5.28	0.93	***	3.99	1.25	**	4.88	1.70	**
Ethnicity: unknown or missing	-0.77	0.72		0.10	1.21		-0.81	1.17		-2.31	1.87	
Patient has a carer	3.16	1.14	**	3.19	1.35	*	1.44	1.64		5.50	2.22	*
Patient was previously treated for mental health issues	-1.00	0.76		-2.51	0.94	**	0.15	0.94		0.41	1.22	
MH benefit claimants - 2nd quintile	0.63	0.41		-0.07	0.62		1.12	0.94		1.32	0.75	
MH benefit claimants - 3rd quintile	1.41	0.47	**	0.59	0.67		1.24	1.00		3.14	0.97	**
MH benefit claimants - 4th quintile	2.43	0.78	**	1.41	0.99		1.75	1.28		5.76	1.09	***
MH benefit claimants - 5th quintile	2.65	0.68	***	1.11	0.88		3.03	1.34	*	6.08	1.13	***
Number of comorbidities	1.17	0.33	***	1.04	0.35	**	1.29	0.36	***	1.53	0.53	**
Alcohol and substance misuse	-4.21	0.67	***	-4.96	1.05	***	-2.40	1.38		-5.10	1.50	***
Co-morbid personality disorder	-7.81	1.30	***	-9.14	2.19	***	-7.18	2.91	*	-9.46	2.19	***
Discharge											
Self-discharged	-19.99	1.85	***	-19.24	2.48	***	-20.37	3.11	***	-29.17	2.76	***
Died in hospital	-3.30	1.64	*	-3.56	2.73		-0.96	4.12		-6.03	3.09	
Access to care											
Urban	0.41	0.61		-0.10	0.91		0.67	1.02		1.20	1.06	
% residents of local community in psychiatric establishment	-0.04	0.41		0.11	0.52		0.01	1.30		-0.41	0.87	
Ability to access GP within 48h	-0.54	1.12		0.10	1.73		-2.74	2.68		0.10	2.79	
Care plan developed in primary care	-1.01	0.95		-2.18	1.57		2.92	2.16		-1.70	2.23	
Time effects											
Year 2007	-1.18	0.97		-1.25	1.17		-1.27	1.45		-1.77	1.34	
Year 2008	0.22	0.86		0.49	1.06		-0.44	1.19		0.43	1.37	
Year 2009	-1.47	0.99		-1.34	1.33		-2.30	1.20		-1.79	1.33	
Year 2010	-3.08	1.15	**	-3.50	1.45	*	-3.67	1.44	*	-3.22	1.78	
Pseudo-R^2	0.061			0.046			0.091			0.050		
N	89,510			38,216			21,415			29,879		

Table 4 - Factors determining hospital length of stay – regression results, Incidence Rate Ratios (IRRs)

Variable	Pooled (F20-F31) (1)		Schizophrenia (F20) (2)		Psychotic and schizoaffective disorder (F21-F29) (3)		Manic and bipolar disorder (F30-F31) (4)	
	IRR	95% CI	IRR	95% CI	IRR	95% CI	IRR	95% CI
Main diagnosis								
Schizophrenia (F20)	*(base category)*		*(base category)*					
Schizotypal disorder (F21)	0.91	(0.88 ; 0.94)			*(base category)*			
Persistent delusional disorder (F22)	0.64	(0.62 ; 0.66)			0.96	(0.84 ; 1.08)		
Acute and transient psychotic disorder (F23)	0.77	(0.62 ; 0.95)			0.69	(0.61 ; 0.78)		
Induced delusional disorder (F24)	1.02	(0.99 ; 1.04)			0.82	(0.63 ; 1.05)		
Schizoaffective disorders (F25)	0.77	(0.69 ; 0.85)			1.09	(0.96 ; 1.23)		
Other nonorganic psychotic disorders (F28)	0.77	(0.74 ; 0.81)			0.82	(0.68 ; 0.98)		
Unspecified nonorganic psychosis (F29)	0.87	(0.85 ; 0.88)			0.82	(0.72 ; 0.94)		
Manic episode (F30)	0.93	(0.82 ; 1.06)					*(base category)*	
Bipolar affective disorder (F31)	0.75	(0.72 ; 0.78)					1.14	(1.10 ; 1.18)
Patient demographics and clinical characteristics								
Age 25-34	0.99	(0.93 ; 1.04)	1.00	(0.91 ; 1.10)	1.01	(0.93 ; 1.10)	0.96	(0.89 ; 1.03)
Age 35-44	0.94	(0.90 ; 0.99)	0.95	(0.88 ; 1.03)	0.94	(0.86 ; 1.02)	0.95	(0.88 ; 1.02)
Age 45-54	0.99	(0.94 ; 1.03)	0.98	(0.91 ; 1.07)	0.98	(0.91 ; 1.05)	1.00	(0.93 ; 1.08)
Age 55-64	1.10	(1.05 ; 1.16)	1.06	(0.97 ; 1.15)	1.17	(1.07 ; 1.27)	1.12	(1.04 ; 1.21)
Age 65-74	1.32	(1.25 ; 1.39)	1.23	(1.12 ; 1.34)	1.40	(1.30 ; 1.52)	1.37	(1.26 ; 1.48)

Age 75 and over	1.50	(1.41 ; 1.60)	1.34	(1.22 ; 1.48)	1.63	(1.47 ; 1.81)	1.56	(1.41 ; 1.72)
Male	1.06	(1.00 ; 1.12)	1.04	(0.95 ; 1.13)	1.05	(0.96 ; 1.16)	1.06	(0.99 ; 1.14)
Detained	1.41	(1.35 ; 1.47)	1.52	(1.45 ; 1.60)	1.35	(1.28 ; 1.42)	1.31	(1.25 ; 1.37)
Ethnicity: mixed	1.07	(1.01 ; 1.13)	1.05	(0.97 ; 1.14)	1.09	(0.99 ; 1.19)	1.10	(0.99 ; 1.23)
Ethnicity: Asian	1.03	(0.99 ; 1.06)	1.04	(0.99 ; 1.09)	1.04	(0.97 ; 1.12)	1.01	(0.97 ; 1.05)
Ethnicity: black	1.12	(1.09 ; 1.15)	1.15	(1.10 ; 1.20)	1.11	(1.05 ; 1.17)	1.11	(1.04 ; 1.17)
Ethnicity: unknown or missing	0.99	(0.95 ; 1.03)	1.03	(0.96 ; 1.09)	0.97	(0.91 ; 1.04)	0.95	(0.88 ; 1.02)
Interaction: Detained + Ethnicity: mixed	0.94	(0.84 ; 1.06)	0.85	(0.74 ; 0.98)	0.98	(0.80 ; 1.20)	1.14	(0.92 ; 1.41)
Interaction: Detained + Ethnicity: Asian	0.95	(0.89 ; 1.02)	0.91	(0.83 ; 1.00)	1.00	(0.91 ; 1.11)	0.93	(0.83 ; 1.05)
Interaction: Detained + Ethnicity: black	0.93	(0.88 ; 0.98)	0.90	(0.85 ; 0.96)	0.91	(0.84 ; 0.99)	0.91	(0.84 ; 0.98)
Interaction: Detained + Ethnicity: unknown or missing	0.99	(0.92 ; 1.06)	0.91	(0.82 ; 1.01)	1.03	(0.92 ; 1.16)	1.05	(0.90 ; 1.22)
Patient has a carer	1.07	(1.02 ; 1.12)	1.07	(1.01 ; 1.13)	1.03	(0.96 ; 1.10)	1.10	(1.03 ; 1.17)
Patient was previously treated for mental health issues	0.98	(0.94 ; 1.01)	0.95	(0.91 ; 0.99)	1.00	(0.96 ; 1.04)	1.01	(0.97 ; 1.05)
MH benefit claimants - 2nd quintile	1.01	(1.00 ; 1.03)	1.00	(0.97 ; 1.03)	1.03	(0.99 ; 1.07)	1.02	(1.00 ; 1.05)
MH benefit claimants - 3rd quintile	1.03	(1.01 ; 1.06)	1.01	(0.98 ; 1.04)	1.03	(0.99 ; 1.07)	1.06	(1.02 ; 1.09)
MH benefit claimants - 4th quintile	1.06	(1.02 ; 1.09)	1.03	(0.99 ; 1.08)	1.04	(0.99 ; 1.09)	1.11	(1.07 ; 1.14)
MH benefit claimants - 5th quintile	1.06	(1.03 ; 1.09)	1.03	(0.99 ; 1.07)	1.07	(1.01 ; 1.13)	1.11	(1.07 ; 1.15)
Number of comorbidities	1.03	(1.01 ; 1.04)	1.02	(1.01 ; 1.04)	1.03	(1.01 ; 1.04)	1.03	(1.01 ; 1.05)
Alcohol and substance misuse	0.90	(0.88 ; 0.93)	0.89	(0.85 ; 0.93)	0.95	(0.89 ; 1.01)	0.91	(0.86 ; 0.96)
Co-morbid personality disorder	0.82	(0.77 ; 0.88)	0.80	(0.71 ; 0.90)	0.84	(0.73 ; 0.97)	0.84	(0.77 ; 0.91)
Discharge								
Self-discharged	0.55	(0.49 ; 0.62)	0.57	(0.50 ; 0.66)	0.56	(0.48 ; 0.66)	0.50	(0.44 ; 0.57)
Died in hospital	0.93	(0.86 ; 1.00)	0.92	(0.81 ; 1.05)	0.98	(0.82 ; 1.17)	0.90	(0.80 ; 1.01)
Access to care								
Urban	1.01	(0.98 ; 1.04)	1.00	(0.96 ; 1.04)	1.01	(0.97 ; 1.06)	1.02	(0.99 ; 1.06)
% residents of local community in psychiatric establishment	1.00	(0.98 ; 1.02)	1.00	(0.98 ; 1.03)	1.00	(0.95 ; 1.06)	0.99	(0.96 ; 1.02)

	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Ability to access GP within 48h	0.99	(0.94 ; 1.04)	1.00	(0.93 ; 1.08)	0.94	(0.83 ; 1.06)	1.00	(0.91 ; 1.10)
Care plan developed in primary care	0.98	(0.94 ; 1.02)	0.95	(0.89 ; 1.02)	1.07	(0.98 ; 1.16)	0.97	(0.90 ; 1.05)
Time effects								
Year 2007	0.97	(0.93 ; 1.02)	0.97	(0.92 ; 1.02)	0.97	(0.92 ; 1.03)	0.97	(0.93 ; 1.02)
Year 2008	1.00	(0.97 ; 1.04)	1.01	(0.97 ; 1.06)	0.99	(0.94 ; 1.04)	1.01	(0.96 ; 1.05)
Year 2009	0.97	(0.92 ; 1.01)	0.97	(0.92 ; 1.03)	0.95	(0.91 ; 1.00)	0.97	(0.93 ; 1.01)
Year 2010	0.93	(0.88 ; 0.98)	0.92	(0.86 ; 0.99)	0.92	(0.87 ; 0.98)	0.95	(0.89 ; 1.01)
Pseudo-R^2	0.061		0.046		0.091		0.050	
N	89,510		38,216		21,415		29,879	

Note: Model includes hospital fixed effects (not shown). Age x gender interactions suppressed. Pseudo-R2 are based on model with standard errors clustered at hospital level but no hospital fixed effects.

Additional files provided with this submission:
Additional file 1: BMC HSR additional file - Sept15.docx
Appendix 1 – Literature review search strategy
Appendix 2 – Data sources