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**Hospitalisation and length of hospital stay following first-episode psychosis:  
systematic review and meta-analysis of longitudinal studies**

**Subtitle:** Meta-analysis of service-use outcomes in psychosis

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## **Abstract**

**Background:** Reducing hospitalisation and length of stay (LOS) in hospital following first episode psychosis (FEP) is important, yet reliable measures of these outcomes and their moderators are lacking. We conducted a systematic review and meta-analysis to investigate the proportion of FEP cases who were hospitalised after their first contact with services and the LOS in hospital during follow-up.

**Methods:** Studies were identified from a systematic search across major electronic databases from inception to October 2017. Random effects meta-analyses and meta-regression analyses were conducted.

**Results:** 81 longitudinal studies encompassing data for 23280 FEP patients with an average follow-up length of 7 years were included. 55% (95%CI=50.3-60.5%) of FEP cases were hospitalised at least once during follow-up with the pooled average LOS of 116.7 days (95%CI=95.1-138.3). Older age of illness onset and being in a stable relationship were associated with a lower proportion of people who were hospitalised. While the proportion of hospitalised patients has not decreased over time, LOS has, with the sharpest reduction in the latest time period. The proportion of patients hospitalised during follow-up was highest in Australia and New Zealand (78.4%) compared to Europe (58.1%) and North America (48.0%); and lowest in Asia (32.5%). Black ethnicity and longer duration of untreated psychosis were associated with longer LOS; while less severe psychotic symptoms at baseline were associated with shorter LOS.

**Conclusion:** One in two FEP cases required hospitalisation at least once during a 7-year follow-up with an average length of hospitalisation of 4 months during this period. LOS has declined over time, particularly in those countries in which it was previously longest.

**Key words:** First episode psychosis / schizophrenia / hospitalisation / length of stay / inpatient / follow-up / outcome

## Introduction

Psychotic disorders are a major cause of morbidity and premature mortality affecting approximately 3% of the general population (van Os *et al.*, 2009). They are associated with a significant public health burden worldwide (Knapp *et al.*, 2004) with approximately half of the costs attributable to hospitalisation (Kennedy *et al.*, 2014; Sledge *et al.*, 1996).

Even though hospitalisation for psychosis has been a common outcome measure in longitudinal studies for the past 40 years, it remains unclear how many patients require hospital admission in the years after FEP. Some studies have reported that 30% or fewer patients with FEP are hospitalised at least once during their illness course (Salem *et al.*, 2009; Stirling *et al.*, 2003; Uçok *et al.*, 2006) while others found that as many as 90% required hospital care after their first contact with mental health services (Berge *et al.*, 1983; Lehtinen *et al.*, 2000). Similarly, wide variations in the length of stay (LOS) in psychiatric inpatient units have been reported with average durations ranging from 20 days to 740 days (Fraguas *et al.*, 2014; Turner *et al.*, 2009). Methodological variations accounting for some of this heterogeneity preclude the development of a reliable picture of hospital use in patients after FEP (Eaton *et al.*, 1992). There is also the question of the generalisability of studies as a large proportion were conducted in high-income countries (Patel *et al.*, 2007; Saxena *et al.*, 2006). Thus, the current depiction of illness course is driven by findings obtained in the countries that are known for superior health-care rather than being globally representative.

It is important to provide unbiased and generalisable estimates of how many FEP cases will require hospitalisation after their first contact with services and of the time they will spend in inpatient care during their illness course. This will contribute to a better understanding of treatment needs for these individuals and aid service development and planning (Friis *et al.*, 2016). It is equally important to identify moderating factors for these outcomes which may help to identify those FEP cases who may be at greater risk of poor long-term outcomes (Friis *et al.*, 2016; Lally & Gaughran, 2018). However, no previous study has conducted a meta-

analysis incorporating global data and considered the moderators of hospital admission and LOS with meta-regression, which may identify important variables that influence these outcomes.

Therefore, the aims of the study were to conduct a systematic review and meta-analysis of all longitudinal studies that investigated the proportion of people with FEP who were hospitalised at least once during follow-up and/or reported average LOS during this period; and further to identify the moderators for these outcomes. Given the drive to reduce LOS and hospital admission, we hypothesised that the number of patients who required inpatient care, and the average LOS during follow-up would be significantly lower in the studies conducted in the last 20 years compared to earlier studies.

## **Methods**

This systematic review was conducted and reported according to the Meta-analysis of Observational Studies in Epidemiology guidelines (Stroup *et al.*, 2000) and the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) (Moher *et al.*, 2009).

### *Search Strategy*

Two independent authors (JL, OA) searched PubMed, Medline, and Scopus without language restrictions from database inception to 1<sup>st</sup> October 2017. Key words used were (“first episode psychosis” OR “early episode psychosis” OR “FEP” OR “schizophrenia” OR “schiz\*”) AND (“admission” OR “hospitalisation” OR “hospitalization” OR “hospital\*” AND “outcome” OR “follow-up”). A manual search of the reference lists of the retrieved articles was conducted.

Articles were initially screened based on title and abstract. The full texts of potentially eligible articles were independently inspected by two of the authors (O.A., J.L.). When data

were incomplete, the corresponding author was contacted and invited to send additional information. When studies reported on overlapping samples, details of the study with the longest follow-up were included. If this was unclear, studies with the largest study sample for each respective outcome were included. We included multi-site studies and retained data for the entire cohort and not for individual sites.

#### *Inclusion and exclusion criteria*

We included longitudinal studies, incorporating both retrospective and prospective study designs, which were conducted in patients with FEP (including first episode schizophrenia and first episode affective psychosis) irrespective of clinical setting (i.e., inpatient, outpatient or mixed) that fulfilled the following criteria: 1) studies reporting the a) proportion of patients who were hospitalised at least once during the follow-up period; and b) average LOS in psychiatric hospitals during the entire follow-up period; 2) studies including individuals with FEP who were making their first contact with mental health services for psychosis; 3) studies using a specified standardised diagnostic system (e.g., International Classification of Diseases (ICD versions 8, 9 and 10), Diagnostic and Statistical Manual of Mental Disorders (DSM versions III and IV), and the Research Diagnostic Criteria (RDC); 4) studies with a follow-up period  $\geq 12$  months; and 5) English language articles published in peer-reviewed journals.

We excluded studies if they: 1) were Randomised Control Trials, due to the potential that any structured intervention beyond routine care could influence the primary outcomes outlined in this meta-analysis; 2) assessed the feasibility and effectiveness of different treatment strategies for psychotic disorders; 3) were of organic psychosis due to medical conditions (i.e psychosis secondary to medical condition, such as encephalitis or epilepsy) or non-FEP cohorts; and 4) did not report quantitative data;

### *Data Extraction*

Three authors (J.L., O.A., E.F.) extracted all data using a predetermined data extraction form and any inconsistencies were resolved by consensus. The data extracted included first author, study participant details, including mean age (years) at illness onset and first contact with mental health services, gender, country, setting (i.e., inpatient, outpatients (community), mixed, in- and out-patient settings), population, study design (i.e., prospective, retrospective), diagnostic classification method, assessment type, economic income status of the countries, duration of untreated psychosis (DUP), socio-demographic characteristics of the sample at the time of recruitment (i.e., proportion of patients who were employed, single or in a stable relationship at the study entry), baseline psychotic symptoms (mean scores), length of study follow-up, attrition, proportion hospitalised and average LOS, the proportion of patients who were taking antipsychotic medications at the study entry and at the end of follow-up, compliance with antipsychotic medications during the follow-up period, and socio-demographic characteristics at the end of follow-up (i.e., proportion of patients who were employed, single or in a stable relationship at the end of the follow-up period). A more detailed definition of these variables is provided in Supplementary Materials.

### *Definitions of outcomes*

The co-primary outcomes were:

1. the proportion of people with FEP who were hospitalised at least once during the follow-up period (excluding any hospitalisation which occurred during the first contact for FEP)
2. the average LOS in psychiatric hospitals defined as the average (mean and the standard deviation measured in days) time spent in hospital during the follow-up period excluding any hospitalisation which occurred during the first contact for FEP.



### *Statistical analysis*

All analysis was conducted with Comprehensive Meta-Analysis software (CMA, Version 3) and RStudio version 3.4.4 (Integrated Development for R. RStudio, Inc., Boston). The pooled prevalence of hospitalisation and average LOS was calculated using a random-effects model (Borenstein *et al.*, 2010). The random-effects model was chosen to account for the influence of the context of care on these outcomes. To examine potential effects of specific factors on the primary outcomes, we further stratified these analyses according to: 1) baseline diagnosis, 2) assessment types; 3) length of follow-up; 4) study region; 5) study settings, and 6) economic income status of the country in which the study was conducted. The summary statistics were illustrated with a forest plot and funnel plot (Duval *et al.*, 2000; Phan *et al.*, 2014).

To investigate the variables that may influence the outcomes we conducted an unrestricted maximum likelihood meta-regression. The included moderating factors were age at illness onset, age at first contact with mental health services, male gender, ethnicity, baseline psychotic symptoms (mean scores), relationship and employment status at baseline, DUP, duration of follow-up, attrition rate, study year, treatment with antipsychotic medications at baseline and during follow-up, and compliance with antipsychotic medications during the entire follow-up period.

Publication bias was assessed with the funnel plot, Egger regression test (Opjordsmoen *et al.*, 2010). We also adjusted for the presence of any publication bias calculating the Duval and Tweedie “trim-and-fill” method (Tohen *et al.*, 1992). Heterogeneity was measured with the Q statistic yielding a chi-square and *p*-value, and the  $I^2$  statistic with scores above 50% and 75% indicating moderate and high heterogeneity, respectively (Higgins *et al.*, 2003). Statistical significance was considered to be at or below the 0.05 level.

## Results

### *Search results and included participants*

The flowchart of the article selection process is depicted in **Figure 1** and descriptive characteristics of each study are outlined in Supplementary Table 1. The search yielded 1434 non-duplicated publications, which were considered at the title and abstract level; 382 of these were extracted for full text review, of which 81 met the inclusion criteria with a total sample of 23280 FEP patients (range=20-12071). The mean age at illness onset in these studies was 23.5 years (SD=5.7), while mean age at first contact with mental health services was 27.3 year (SD=64); 42.3% were female and 59.3% had a baseline diagnosis of first episode schizophrenia.

### *Meta-analysis of hospitalisation*

The proportion of people with FEP who were hospitalised at least once during the follow-up, together with heterogeneity and trim-and-fill analyses, is presented in **Table 1**. In total, 60 studies reported on the number of people with FEP who were hospitalised at least once during the follow-up period. Average length of follow-up across these studies was 7.6 years (SD=6.1, interquartile range (IQR)=2-11.8). The total sample at the end of the follow-up period was 19675 FEP cases (range=20-12071, IQR=47-149). The pooled proportion of hospitalised FEP patients during follow-up was 55.4% (95%CI=50.3-60.5,  $Q=3575.1$ ,  $I^2=98.5$ ). The Begg-Mazumdar (Kendall's tau  $b=-0.005$ ,  $P=0.957$ ) and Egger test ( $t=-2.53$ ,  $df=56$ ,  $p=0.014$ ) indicated no publication bias.

### *Subgroup analyses of hospitalisation*

Stratified proportions of FEP patients who were hospitalised at least once during the follow-up period, together with heterogeneity and trim-and-fill analyses are presented in **Table 1**. The proportion of patients hospitalized during follow-up was significantly higher in studies from Australia and New Zealand (78.4%, 95%CI=59.2-97.5,  $I^2=98.4$ ,  $Q=203.7$ ) compared to studies from Europe (58.1%, 95%CI=50.7-65.5,  $I^2=97.1$ ,  $Q=1212.1$ ) and North America (48.0%, 95%CI=34.5-61.6,  $I^2=95.4$ ,  $Q=213.6$ ); the lowest proportion of hospitalised patients was reported in studies from Asia (32.5%, 95%CI=25.3-41.4,  $I^2=81.4$ ,  $Q=39.7$ ). The pooled proportion of hospitalised patients during follow-up was highest in studies which were conducted in high-income countries (57.9%, 95%CI=51.7-64.1,  $I^2=98.4$ ,  $Q=2833.6$ ) compared with studies conducted in middle-income countries (34.8%, 95%CI=20.0-49.6,  $I^2=96.0$ ,  $Q=355.8$ ). The trim-and-fill method demonstrated that the proportion of patients who required hospitalisation at least once during the follow-up period in the middle-income countries was 42.9% (95%CI=27.4-56.5) when adjusted for potentially missing studies. There were no studies from low-income countries.

#### *Effect of moderator variables influencing hospitalisation*

Full details of the moderators of hospitalisation during the follow-up period are presented in **Table 2**. A lower proportion of hospitalised patients during follow-up was associated with an older age of illness onset ( $\beta=-0.049$ , 95%CI=-0.092 - -0.005,  $p=0.028$ ,  $R^2=0.07$ ) and having a stable relationship at baseline ( $\beta=-0.011$ , 95%CI= -0.018 - -0.004,  $p=0.004$ ,  $R^2=0.33$ ). There was a trend association between Black ethnicity and increased hospitalisation ( $\beta=0.004$ , 95%CI=0.000-0.009,  $p=0.075$ ,  $R^2=0.13$ ), and between higher loss to attrition and reduced hospitalisation during follow-up ( $\beta=-0.003$ , 95%CI=-0.007-0.000,  $p=0.080$ ,  $R^2=0.04$ ).

#### *Meta-analysis of LOS*

Average LOS across the follow-up period with heterogeneity and trim-and-fill analyses is provided in **Table 3**. In total, 37 studies reported on LOS over the follow-up period. The average LOS was 176.8 days (SD=186.7, median=106 days, IQR=76-204 days). Average length of follow-up across these studies was 7 years (mean=6.6 years, SD=6.4, IQR 2-8) with a cumulative sample of 4877 FEP cases (range=20-720, IQR=43.5-191.5). The pooled average LOS across the entire follow-up period was 116.7 days (95%CI=95.1-138.3,  $I^2=99.5$ ,  $Q=4435.1$ ). The Begg-Mazumdar (Kendall's tau  $b=0.18$ ,  $p=0.215$ ) and Egger test ( $t=4.31$ ,  $df=24$ ,  $p<0.001$ ) indicated no publication bias.

#### *Subgroup analyses of LOS*

Stratified LOS during the follow-up period with heterogeneity and trim-and-fill analyses is provided in **Table 3**. The LOS was the longest in studies published from 1966-1995 (192.3 days, 95%CI=129.7-254.8,  $I^2=89.2$ ,  $Q=37.1$ ). The trim-and-fill method demonstrated that the average LOS in these studies was 216.8 days (95%CI=126.3-307.3) when adjusted for missing studies. The mean LOS appeared to decrease in more recent studies from 1996-2002 (129.9 days, 95%CI=78.8-180.9,  $I^2=98.9$ ,  $Q=368.1$ ) and 2003-2009 (97.7 days, 95%CI=55.3-139.9,  $I^2=99.8$ ,  $Q=3041.4$ ). The shortest average LOS was recorded in studies from 2010-2017 (96.6 days, 95%CI=54.0-139.2,  $I^2=99.3$ ,  $Q=852.8$ ).

#### *Effect of moderator variables influencing LOS*

Information on the moderators of LOS is presented in **Table 4**. The meta-regression analyses showed that a longer LOS was associated with Black ethnicity ( $\beta=2.905$ , 95%CI=1.273-4.537,  $p<0.001$ ,  $R^2=0.14\%$ ) and longer DUP (median<sub>days</sub>) ( $\beta=0.303$ , 95%CI=0.266-0.340,  $p<0.001$ ,  $R^2=0.11$ ). Another significant moderator of a longer mean LOS was a longer length of follow-up ( $\beta=11.707$ , 95%CI=6.577-16.838,  $p<0.001$ ,  $R^2=0.21$ ). Several

baseline factors associated with shorter average LOS were identified. A shorter average LOS was associated with White ethnicity ( $\beta=-0.181$ , 95%CI=-0.219- -0.143,  $p<0.001$ ,  $R^2=0.12$ ), reduced severity of psychotic symptoms at baseline ( $\beta=-0.019$ , 95%CI=-0.036- -0.003,  $p=0.018$ ,  $R^2=0.08$ ) and studies conducted in more recent years ( $\beta=-4.413$ , 95%CI=-7.456- -1.370,  $p=0.004$ ,  $R^2=0.15$ ).

## Discussion

To our knowledge this is the first systematic review and meta-analysis to investigate the proportion of FEP cases who required hospitalisation at least once after their first contact with mental health services and the average LOS in hospital during follow-up. We found that more than half (55%) of all FEP patients required a hospitalisation over an average follow-up of 7 years after FEP. This proportion may seem high, but is not surprising considering that only 38% of FEP patients recover during follow-up (Lally *et al.*, 2017), with 34% of FES patients meeting criteria for treatment resistance over a five year period (Lally *et al.*, 2016).

### *Hospitalisation and average LOS in FEP patients*

While bed capacity in psychiatric services has decreased in many developed countries since the 1950s (Raftery, 1992) supported by intensive attempts to integrate and care for people in the community (Munk-jorgensen, 1999), our findings demonstrate that the proportion of people with FEP who were admitted to hospital after their first contact with mental health services has remained stable over time. Nonetheless, in accordance with previous research (Agius *et al.*, 2010; Hobbs *et al.*, 2000; Leff and Trieman, 2000) we found that the average LOS in hospital for people FEP has decreased considerably over the past 20 years with the sharpest reduction observed in the last 7 years. This pattern was particularly pronounced in Australia and New Zealand. Our findings may indicate that while early intervention services

for psychosis are successful in facilitating earlier discharge from hospital (Agius *et al.*, 2010); the sustained high proportion who require inpatient care over the illness course questions whether they are able to reduce the need for hospital admissions. Recent observational data indicate the benefits of antipsychotic long-acting injections and clozapine in reducing the need for hospitalisation in psychotic disorders (Tiihonen *et al.*, 2017). Although we did not investigate the impact of antipsychotic long-acting injections and clozapine in reducing the need for hospitalisation in psychotic disorders in the present study, their wider use may be one route to reducing the sustained rates of hospitalisation identified in our study.

We found that the number of cases who were hospitalised at least once during follow-up did not differ significantly depending on the length of follow-up. Hospitalisation is considered an indicator of poor outcome in FEP (Lieberman *et al.*, 1998; Schoeler *et al.*, 2017) because it is costly and occurs when the illness becomes severe enough to warrant such an intervention (Pottick *et al.*, 2000). Accordingly, it may be argued that the longitudinal illness trajectory of psychosis is not characterised by a deteriorating course for most patients (Zipursky and Agid, 2015) as previously thought (Ropcke and Eggers, 2005; Schmidt *et al.*, 1995). This is consistent with what was observed in relation to longitudinal recovery rates in patients with FEP where no evidence for worsening recovery rates with longer duration of follow up were found (Lally *et al.*, 2017).

We found that the proportion of patients hospitalised during follow-up was considerably higher in high-income compared to the middle-income countries. Although this might imply a more debilitating illness course in well-developed countries (Lin and Kleinman, 1988), it could also be explained by differences in social support and family support structures and quality of mental health-care in middle-income countries where the burden of care and treatment costs tend to fall on families rather than hospitals (Patel *et al.*, 2007; Saxena *et al.*, 2005).

*Impact of moderator variables on hospitalisation and LOS in FEP patients*

The reasons for hospitalisation are complex (Schoeler *et al.*, 2017) and likely to be explained by a range of clinical and social factors. Medication adherence was shown to be an important determinant for hospitalisation in patients with FEP during an 18 month follow-up study (Sfercu *et al.*, 2017). However, this finding is not supported by studies with a longer follow-up period (Friis *et al.*, 2016) including the present work. Comparable to previous reports (Immonen *et al.*, 2017; Ingrid *et al.*, 2000; Uggerby *et al.*, 2011), which identified an association between a younger age of illness onset and increased hospitalisation, we found that an older age of illness onset was associated with reduced hospitalisation, though it was not a significant moderator for LOS. Consistent with previous literature highlighting associations between DUP and poorer outcomes in patients with psychosis (Harrigan *et al.*, 2003; Schimmelmann *et al.*, 2008), we found that longer DUP was significantly associated with longer LOS. It has been shown that the mode of onset of first psychotic symptoms is one of the strongest predictors of the duration of DUP (Compton *et al.*, 2008), with an insidious onset of psychotic symptoms associated with a longer DUP (Ajnakina *et al.*, 2017). The type of clinical or non-clinical service with whom the first contact is made following onset of psychosis has been shown to be another important factor in determining the length of DUP (Bechard-Evans *et al.*, 2007; Ghali *et al.*, 2013; Tanskanen *et al.*, 2011). Thus, multiple clinical and service level factors, as well as social factors, are related to DUP, these need to be examined in more detail to ascertain the best ways to reduce the length of DUP, and potentially LOS.

In the present study Black ethnicity appeared to be an important factor influencing hospitalisation and was associated with longer inpatient care during follow-up. Black ethnicity has consistently been highlighted as a risk factor for psychosis onset (Lally *et al.*, 2016; Radua *et al.*, 2018), and has been associated with the development of a treatment resistant course of illness (Lally *et al.*, 2016). Evidence is emerging from the UK that the longitudinal trajectory of psychosis in patients of Black ethnicity is characterised by more extensive utilisation of psychiatric services compared with patients of White British ethnicity (Ajnakina *et al.*, 2017; Morgan *et al.*, 2014), results supported by the present study. Considering that patients of Black

ethnicity are also at risk of becoming increasingly socially disadvantaged as their illness progresses (Ajnakina *et al.*, 2017; Morgan *et al.*, 2014), the need for hospitalisation and prolonged inpatient stays in those of Black ethnicity observed in the present study may be related to social adversity.

We found that being in a stable relationship at the time of first contact with FEP was associated with a reduced proportion of hospitalisation during follow-up. Being in a stable relationship may constitute improved social integration and strong social networks that have been shown to be associated with improved outcomes in FEP (Erickson *et al.*, 1989). However, as it is common for individuals with psychosis to struggle to develop or maintain stable relationships (Sundermann *et al.*, 2014), the protective effect of this factor may only be available to a minority of patients. Alternatively, being in a stable relationship may be indicative of a preserved premorbid level of functioning, improved outcomes and reduced hospitalisations during follow-up.

#### *Methodological considerations*

This is the first meta-analysis to investigate the proportion of FEP patients who required hospitalisation at least once after their first contact with mental health services and the average LOS in hospital during the entire follow-up period. We examined the proportion of hospitalised patients and average LOS during follow-up separately for baseline diagnosis of FEP, first episode schizophrenia and first episode affective disorders. Stratification by diagnosis allowed us to capture the most representative trajectory of illness for these diagnostic categories. Focusing on the incident sample of patients with a first presentation to services for psychosis ensured that the findings are not biased by chronicity of illness.

Notwithstanding the strengths, there are several limitations to the data and meta-analysis that warrant discussion. While we identified studies from five regions of the world, there was marked variability in the number of studies from each region, with the majority



conducted in Europe. We were unable to eliminate confounding variables relating to group differences in FEP cases that were enrolled in the different regions, and other service level confounds which may have existed between regions. This may include the variability in criteria employed that would warrant hospitalisation or prolonged hospital stays, bed availability, accessibility of community mental health services, treatment received in the community and in hospital, availability of community social supports, local mental health laws relating to involuntary hospital admission or other legal frameworks. Evidence suggests that all of these factors tend to vary between countries and regions (Burti, 2001; Saxena *et al.*, 2006; Tulloch *et al.*, 2012) and as such may have influenced hospitalisation and LOS across populations and studies included in the present meta-analysis. This should be taken into consideration when interpreting the study findings. Although it may be argued that studies utilising data from case notes may not have provided a reliable depiction of the clinical course of psychosis (Eaton *et al.*, 1992), in the present study we found that hospitalisation and average LOS did not significantly differ depending on sources of data ascertainment. In relation to the meta-regression analyses, some of the variables might have failed to achieve statistical significance because of a lack of power due to small sample sizes. Further, we did not obtain data on important confounders such as types of treatments received or services available, lifestyle factors such as substance use, and symptom profile over the course of follow-up precluding the meta-analytic assessment of these factors as moderating and/or mediating variables. By excluding hospitalisations that occurred at the first contact with mental health services for FEP we may have omitted a small proportion of severely ill patients who might have remained hospitalised for most of the follow-up period. Finally, we were unable to establish the reasons for hospitalisation, whether it was the result of psychotic relapse, antipsychotic intolerance or a comorbid mental disorder.

### *Conclusion*

This meta-analysis indicates that one in two patients with FEP will require hospitalisation at least once during a 7-year follow-up with an average inpatient stay of 4 months during this period. While the proportion of those with FEP who were admitted to hospital in the years following FEP has remained stable over the years, the average time FEP cases spent in hospital during follow-up has decreased in the last 20 years. This suggests that patients are now discharged earlier compared to previous time periods. While most patients and clinicians may favour shorter LOS in hospital, the question as to whether patients are discharged prematurely needs further investigation.

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## Declaration of Interest

R.M.M. has received honoraria from Janssen, Astra-Zeneca, Lilly, and BMS. A.S.D. has received honoraria from Janssen and Roche Pharmaceuticals. F.G. has received honoraria for advisory work and lectures from Roche, BMS, Lundbeck, Otsuka and Sunovion and has a family member with professional links to Lilly and GSK. The other authors (O.A., B.S., J.L., E.F.) have no conflict of interest to declare.

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## Figure Legends

**Figure 1.** The flowchart of the article selection process in the meta-analysis of hospitalisation and length of hospital stay during follow-up in patients with first episode psychosis (FEP).

**Table 1.** Meta-analysis of proportion of patients with first episode psychosis who were hospitalised at least once during a follow-up period

Analysis	Meta-analysis					Heterogeneity			Publication bias
	n studies	Pooled prevalence (%)	95% CI		Between group p-value	I <sup>2</sup>	Q-value	p-value	Trim and fill 95% CI
									[N studies trimmed]
Proportion of patients who were hospitalised at least once	58	55.4	50.3	60.5		98.5	3575.1	<0.001	Unchanged
<i>Study year group</i>					0.191				
1966-1996	17	63.2	53.6	72.9		92.9	231.1	<0.001	Unchanged
1997-2005	16	47.6	36.5	58.8		96.1	490.6	<0.001	Unchanged
2006-2011	17	56.1	45.0	67.2		99.3	1743.7	<0.001	Unchanged
2012-2017	8	46.6	30.7	62.5		98.2	564.4	<0.001	Unchanged
<i>Study region</i>					0.013				
Asia	6	32.5	23.5	41.4		81.4	39.7	<0.001	Unchanged
Australia and New Zealand	3	78.4	59.2	97.5		98.4	203.7	<0.001	Unchanged
Europe	38	58.1	50.7	65.5		97.1	1212.1	<0.001	Unchanged
North America	9	48.0	34.5	61.6		95.4	213.6	<0.001	Unchanged
Middle East	1	64.0	63.1	64.9		0.0	0.0	1.000	N/A
Multicentre	1	21.0	15.69	26.23		0.0	0.0	1.000	N/A
<i>Assessment type</i>					0.106				
Case notes	18	62.5	52.1	72.9		99.2	1541.3	<0.001	Unchanged
Interview	32	52.7	44.6	60.7		96.3	1047.5	<0.001	Unchanged
Combination of both approaches	7	43.3	26.7	60.0		97.6	413.8	<0.001	Unchanged
<i>Study settings</i>					0.659				
In-/out-patient psychiatric services	20	57.1	46.4	67.7		98.6	1557.4	<0.001	Unchanged
Adult psychiatric hospitals	34	54.0	43.4	59.2		97.4	908.1	<0.001	Unchanged
Community & early intervention services	4	45.0	22.1	67.8		98.9	420.3	<0.001	Unchanged
<i>Length of follow-up categories</i>					0.388				
1-2 years	17	47.9	36.0	59.7		98.3	2155.2	<0.001	52.7 (40.3-65.0) [2]
3-5 years	14	56.9	46.2	67.6		96.2	450.9	<0.001	Unchanged
≥6 years	27	57.4	48.3	66.48		98.5	859.1	<0.001	Unchanged

<i>Country socioeconomic status</i>						<b>0.010</b>					
	High income	50	57.9	51.7	64.1		98.4	2833.6	<0.001		Unchanged
	Middle income	7	34.8	20.0	49.6		96.0	355.8	<0.001		42.9 (27.4-56.5) [2]
<i>Baseline diagnoses</i>						<b>0.930</b>					
	FEP	22	55.9	45.7	66.1		98.0	2351.3	<0.001		Unchanged
	FES	35	53.5	45.7	61.3		98.0	948.4	<0.001		Unchanged
	FEAP	1	54.2	34.2	74.1		0.0	0.0	1.000		NA

n, number; FEP, first episode psychosis; FU, follow up period; FEAP, first episode affective psychosis; N/A, not appropriate; CI, confidence intervals.

**Table 2.** Meta regression of moderators of proportion of patients with first episode psychosis who were hospitalised at least once during a follow-up

	Number of comparison	$\beta$	95% CI		p-value	R <sup>2</sup>
<b>Moderators</b>						
<i>Demographic factors</i>						
Age (mean) at onset	15	0.060	-0.002	0.122	0.058	0.04
Age (mean) at first contact	41	-0.049	-0.092	-0.005	<b>0.028</b>	0.07
Males (%)	56	0.001	-0.004	0.006	0.762	0.00
White (%)	16	0.002	-0.002	0.005	0.344	0.00
Black (%)	16	0.004	0.000	0.009	0.075	0.13
Asian (%)	13	-0.002	-0.005	0.001	0.164	0.07
<i>Clinical presentation and treatment</i>						
Baseline psychotic symptoms(mean)	14	0.000	-0.005	0.005	0.935	0.00
Duration of untreated psychosis (days-mean)	12	0.000	-0.001	0.000	0.732	0.00
Duration of untreated psychosis (days-median)	8	-0.001	-0.003	0.001	0.202	0.09
Taking antipsychotic medications at baseline (%)	15	0.000	-0.003	0.004	0.934	0.00
Taking antipsychotic medications at follow up (%)	27	-0.002	-0.007	0.003	0.383	0.00
Compliance with antipsychotic medications during FU (%)	10	0.004	-0.002	0.010	0.185	0.08
<i>Social factors</i>						
Employed at baseline (%)	16	-0.002	-0.008	0.004	0.555	0.00
Single at baseline (%)	23	0.003	-0.002	0.008	0.203	0.03
Stable relationship at baseline	19	-0.011	-0.018	-0.004	<b>0.004</b>	0.33
<i>Other factors</i>						
Drop-out	54	-0.003	-0.007	0.000	0.080	0.04
Length of follow up	58	0.004	-0.006	0.013	0.488	0.00
Study year publication	58	-0.004	-0.010	0.002	0.161	0.02

DUP, duration of untreated psychosis;  $\beta$ , beta coefficient; CI, confidence intervals

**Table 3.** Meta-analysis of length of inpatient stays during a follow-up in patients with first episode psychosis

Analysis	Meta-analysis				Heterogeneity			Publication bias	
	n studies	Pooled mean	95% CI		Between group p-value	I <sup>2</sup>	Q-value	p-value	Trim and fill 95% CI [N studies trimmed]
Average length of inpatient stay during a follow-up	26	116.7	95.1	138.3		99.5	4435.1	<0.001	Unchanged
<i>Study year group</i>					<b>0.058</b>				
1966-1995	5	192.3	129.7	254.8		89.2	37.1	<0.001	216.8 (126.3-307.3) [1]
1996-2002	5	129.9	78.8	180.9		98.9	368.1	<0.001	Unchanged
2003-2009	7	97.7	55.3	139.9		99.8	3041.4	<0.001	126.0 (54.0-197.0) [1]
2010-2017	7	96.6	54.0	139.2		99.3	852.8	<0.001	94.6 (67.2-121.9) [1]
<i>Study region</i>					0.326				
Asia	4	71.1	-25.6	167.7		99.0	349.4	<0.001	60.2 (28.8-91.7) [1]
Australia and New Zealand	1	25.9	-167.2	219.0		0.0	0.0	1.000	N/A
Europe	18	145.7	99.2	192.2		99.6	2416.1	<0.001	Unchanged
North America	3	175.0	47.5	302.5		99.8	51.6	<0.001	Unchanged
<i>Assessment type</i>					0.798				
Case notes	3	114.2	54.9	173.5		98.0	101.3	<0.001	Unchanged
Interview	20	119.3	95.0	143.5		99.5	3967.9	<0.001	Unchanged
Combination of both approaches	1	83.1	-20.7	186.9		0.0	0.0	1.000	N/A
<i>Study settings</i>					0.794				
In-/out-patient psychiatric services	11	114.9	81.1	148.6		99.7	3573.1	<0.001	Unchanged
Adult psychiatric hospitals	11	128.6	92.1	165.2		98.3	596.3	<0.001	Unchanged
Community & early intervention services	1	92.8	-18.2	203.8		0.0	0.0	1.000	N/A
<i>Country socioeconomic status</i>					0.178				
High income	23	120.5	97.7	143.3		99.5	4433.8	<0.001	Unchanged
Middle income	1	47.8	-55.6	151.2		0.0	0.0	1.000	N/A
<i>Baseline diagnoses</i>					0.345				
FEP	8	103.8	33.8	173.8		99.8	658.4	<0.001	Unchanged
FES	15	159.5	106.2	212.7		99.8	2164.0	<0.001	Unchanged
FEAP	2	81.8	-58.4	222.0		96.3	27.3	<0.001	N/A



n, number; FEP, first episode psychosis; FU, follow up period; FEAP, first episode affective psychosis; N/A, not appropriate; CI, confidence intervals

**Table 4.** Meta-regression of moderators of an average length of inpatient stay during a follow-up during a follow up in patients with first episode psychosis

	Number of comparison	$\beta$	95% CI		p-value	R <sup>2</sup>
<b>Moderators</b>						
<i>Demographic factors</i>						
Age (mean) at onset	11	3.604	-1.039	8.246	0.128	0.00
Age (mean) at first contact	15	5.150	-1.212	11.512	0.113	0.00
Males (%)	20	-0.566	-3.049	1.916	0.655	0.00
White (%)	8	-0.181	-0.219	-0.143	<b>0.000</b>	0.12
Black (%)	5	2.905	1.273	4.537	<b>0.000</b>	0.14
Asian (%)	4	0.072	-0.507	0.651	0.808	0.00
<i>Clinical presentation and treatment</i>						
Baseline psychotic symptoms(mean)	10	-0.019	-0.036	-0.003	<b>0.018</b>	0.08
Duration of untreated psychosis (days-mean)	9	-0.005	-0.158	0.149	0.953	0.00
Duration of untreated psychosis (days-median)	4	0.303	0.266	0.340	<b>0.000</b>	0.11
Taking antipsychotic medications at baseline (%)	4	1.289	-0.804	3.383	0.227	0.00
Taking antipsychotic medications at follow up (%)	8	1.249	-1.756	4.254	0.415	0.00
Compliance with antipsychotic medications during FU (%)	3	1.910	-1.281	5.177	0.237	0.17
<i>Social factors</i>						
Employed at baseline (%)	5	2.137	-1.010	5.284	0.183	0.00
Single at baseline (%)	7	-1.747	-4.776	1.282	0.258	0.01
Stable relationship at baseline	5	5.930	-4.082	15.942	0.246	0.00
<i>Other factors</i>						
Drop-out	22	1.091	0.033	2.149	0.043	0.10
Length of follow up	22	11.707	6.577	16.838	<b>0.000</b>	0.21
Study year publication	22	-4.413	-7.456	-1.370	<b>0.004</b>	0.15

DUP, duration of untreated psychosis;  $\beta$ , beta coefficient; CI, confidence intervals