



THE UNIVERSITY
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Mental Health Service Cost Drivers – an International Literature Review

**Final report for Stage B of the Definition and
Cost Drivers for Mental Health Services project
Volume 2**

Prepared by The University of Queensland for the Independent
Hospital Pricing Authority to assist the development and
specification of a mental health classification system

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Executive Summary

Purpose

This document presents the results of a national and international review of the cost drivers of mental health care, commissioned by the Independent Hospital Pricing Authority as an initial step in developing a new national classification for mental health services in Australia.

Method

The review was based on documents obtained via a systematic search of the academic literature and a focussed web search, evaluated for relevance against a set of inclusion and exclusion criteria. For each document meeting criteria for inclusion, the following categories of data were extracted: study identifiers (authors, year, country); study design (sample, setting); analyses and results (type of analysis; outcome(s) assessed; predictor(s) assessed; results; variance explained); other information (strengths and limitations). For casemix studies, information was also collected about the class-finding results. This information was aggregated into summary tables to assist interpretation.

Results

This review considered a range of studies that had a common goal of seeking to identify factors that affected treatment cost, intensity or duration, whether for defined episodes, or specified periods, for people accessing mental health services.

We profiled 33 studies reporting the results of explanatory analyses that aimed to identify significant predictors of mental health service costs or service utilisation. We counted the number of analyses in which various patient-related variables were investigated and then shown to be significant cost drivers. This exercise showed that:

- The most commonly identified patient-level cost drivers were:
 - *patient illness factors*: principal diagnosis/diagnostic cluster; functioning/disability; overall symptom severity; comorbidities; indicators of risk of harm to self or others, overall; and treatment history;
 - *patient characteristics*: socio-demographic factors overall; age; ethnicity/aboriginality; socio-economic factors overall; and employment status.

These factors, or groups of factors, were investigated in at least one-quarter of analyses, and found to be statistically significant predictors of outcome in at least one half of those.

- These patterns were broadly similar across the other outcome categories, although there were some variations, for example:
 - Amongst analyses examining inpatient outcomes only, legal status, aggressivity, ethnicity/aboriginality, and ECT administration were also commonly identified cost drivers in their own right, whereas treatment history, sex, and socio-economic factors overall were not.
 - Amongst analyses examining outcomes across multiple service settings, overall symptom severity and risk of harm to self or others were not commonly identified predictors.
- Principal diagnosis and patient age and sex were the most commonly *examined* factors, with diagnosis and age among the most commonly recognised patient-level cost-drivers. In most

cases these factors also happen to be the most readily available and it is perhaps not surprising that they predominate in the literature.

- Treatment history was one of the more commonly investigated patient illness factors, however a range of variables was used for this purpose:
 - In some analyses, these measures could be interpreted as an indicator of whether the episode is the first time treatment (overall, or of a particular type, e.g., psychiatric inpatient admission) has been received. For example, proxy measures included prior lifetime psychiatric inpatient admissions as a dichotomous variable (Yes/No). Analyses using these variables did not tend to find a significant association between first time treatment and outcome.
 - The remainder of treatment history measures tended to be based on prior length or intensity of contact with services, or the number of psychiatric admissions and/or service contacts within a defined time period. Where analyses using these measures reported a significant association between treatment history and outcome, it was consistently in a positive direction:
- Support for other patient characteristic variables was less consistent. There was good support for age, employment status, and ethnicity/aboriginality. In contrast, marital/partner status, accommodation/living status, and educational status were relatively frequently investigated but were less often found to be significant predictors of outcome. Level of family/carer support was investigated in relatively few analyses, but well supported among those. Having dependent children was investigated in only one study included in this review.
- Treatment factors were less commonly investigated, although this may to some extent reflect the criteria we used to include studies in this analysis. Of the studies that did investigate these factors, strongest support tended to be for treatment setting, ECT administration and treatment focus/stage of care, however the small number of included analyses makes it difficult to draw conclusions.

We then examined the statistical performance of the models described. We found that the most common way of analysing cost drivers was a regression analysis, and 23 of these studies reported an R^2 value for at least one analysis, estimating the percentage of variance in costs (or proxy variables) explained by the model. Across the various analyses reported in these 23 papers, there was wide variability in the ability of the models examined to account for mental health service costs. Six papers reported maximum R^2 values of less than 25%, nine papers reported maximum R^2 values between 25- $<$ 50%, and eight papers reported maximum R^2 values of at least 50%.

The eight papers that reported at least one analysis where the model accounted for at least 50% of the variance in the outcome measure were examined in more detail. Overall, these analyses tended to include patient demographic and clinical factors, as well as treatment history, provider factors, and sometimes treatment factors. Despite a wide range of cost drivers being investigated, it was generally difficult to identify the variance explained by individual factors. Where the studies reported comparative analyses with different groups of cost drivers, the general pattern was that treatment history and provider factors tended to account for much more of the variance in costs than patient demographic or clinical characteristics.

We also profiled 13 casemix classifications with respect to the way the most commonly identified cost drivers have been aggregated for use in each classification. We found that:

- Most systems were designed around inpatient care. Only five (Payment by Results¹ [PbR, England], MH-CASC² [Australia], NZ-CAOS³ [New Zealand], PsyCMS⁴ [USA], and ZZPs⁵ [The Netherlands]) included non-inpatient care.

- The utility of Australian Refined Diagnosis Related Groups (AR-DRGs) is limited, since they are based only or mainly on principal diagnosis.
- A new set of mental health DRGs that includes age, ECT, legal status and improved comorbidity assignment may have utility, but would only be applicable to acute inpatients.
- The English PbR is an attractive model since it spans settings and providers, includes social care, and uses a single simple symptom/disability/comorbidity rating instrument. However:
 - The PbR clustering tool includes the original 12 Health of the National Outcome Sales (HoNOS) items plus several additional patient level measures (referred to as the “extended HoNOS”). Unfortunately, in Australia, we are limited in our capacity to model those clusters since the National Outcomes and Casemix Collection (NOCC) and other National Minimum Data Set (NMDS) materials do not provide direct mappings to the additional PbR purpose specific “extended HoNOS”.
 - Another significant issue is how the assignment to clusters aligns with “episodes of mental health care”.
- Although it may be worth exploring how the severity of illness classes used in the US All Patient Refined DRG⁶ (APR-DRG; 3M™) system are assigned, intellectual property rights may prevent this.
- A per diem or day-of-stay funding approach was used in all systems where the mental health classification was used for funding purposes (Medicare⁷ [USA], Medicaid⁶ [USA, New York State], PbR¹, DBCs⁵ [The Netherlands]).

Chapter 1: Background

1.1 Setting the context

The 2011 National Health Reform Agreement (NHRA) requires that a nationally consistent system of Activity Based Funding (ABF) be implemented for all public hospital care, including mental health services. The Independent Hospital Pricing Authority (IHPA) has been given responsibility for the casemix classification systems that will be used in the national ABF model. These include separate classifications for acute inpatient care, subacute care, outpatients, emergency departments (EDs) and mental health. While existing casemix classifications have been adopted for the other clinical streams, the IHPA has determined that a new mental health casemix classification system is required.

An important step was taken 17 years ago by the Commonwealth Government to develop a classification model for specialised mental health services, the Mental Health Classification and Service Costs (MH-CASC) project. However, the patient symptom and functioning scales upon which MH-CASC relied were not in use in Australia at the time. This has subsequently been overcome by the introduction in 2000 of the National Outcomes and Casemix Collection (NOCC) which required all states and territories to implement agreed collection instruments and upgrade their data systems to collect the required data. The NOCC Collection thus forms an important starting point for a new mental health classification. Several developments are likely to influence the shape of the new classification. A major national review of the NOCC suite of measures and their collection protocols is currently underway under the auspice of the National Mental Health Information Strategy Subcommittee. Another development is the expected introduction in 2015 of a nationally-agreed set of clinical intervention codes. These should materially improve the collective understanding about what treatments are actually delivered, and what works best and for whom and in what circumstances.^a

1.2 Cost drivers of mental health services

1.2.1 Types of cost drivers

Unlike much acute health care, diagnosis alone is not a good predictor of resource use among people with a diagnosed mental disorder. Because the care that a patient needs is not primarily determined by their principal medical diagnosis, classifications such as the existing mental health Australian Refined Diagnosis Related Groups (AR-DRGs) that are based mainly on principal diagnosis are not predictive of the care that the patient receives or the cost associated with providing that care. This was highlighted in a recent review by the National Casemix Classification Centre of admitted patient data from the National Hospital Morbidity Database which confirmed that this continues to be the case for current AR-DRGs, v6.0⁸. An attempt to improve the mental health DRGs through the re-introduction of the Version 5.2 complexity splits has not resulted in any material improvement in statistical performance. These DRGs are still only able to explain approximately 16 per cent of the variation in length of stay for acute mental health overnight episodes. This is by far the worst statistical performance of DRGs across all major diagnostic categories.

^a The Mental Health Information Strategy Standing Committee (MHISSC) has recently agreed that the Australian Institute of Health and Welfare (AIHW) will progress the publication of its Mental Health Intervention Classification (MHIC) report as an AIHW online working paper. The working paper will summarise the activity over the past 5 years to develop a prototype Australian mental health intervention classification for potential inclusion in the Australian Classification of Health Interventions (ACHI) to enable future reporting in a range of national minimum data sets.

Cost drivers can be considered to fall into five broad groups. Three groups are the same as in general health care: consumer-related factors such as diagnosis, age, availability of carers, and functional impairment; setting-specific service factors that may be different for hospital care versus ambulatory care or psychiatric disability support rehabilitation and recovery services; and treatment factors such as administration of ECT, pharmacotherapies, occupational therapies, psychological therapies and family therapies. The other groups of cost drivers are either unique to mental health care or are much more important in mental health care, considered here in terms of legal status, safety, and emergency care factors and more generally as Chronic Disease Management. These groups are considered below:

- **Consumer-related factors:** Though diagnosis alone is not a strong predictor of costs, it is an essential component of any classification that is likely to be acceptable to clinicians and to survive over time. It is certainly related to medication costs, and although these are not a major component of the costs of an individual inpatient episode, PBS subsidies are a large item in total for acute treatment of high prevalence mental illnesses simply because of the volume. Diagnosis-specific medication is also a significant component of the cost of ongoing community management of the severe low prevalence illnesses, not just in itself, but because of the staff involvement in assisting consumers to adhere to medication plans.

Other prominent variables can be summarised here as: risk of harm to self or others; impairment of functioning in the ability to manage self-care (partially measured by tools such as the HoNOS, the Life Skills Profile and the RUG-ADL); co-morbidities; legal status under mental health legislation; age, indigenous status; carer availability; illness severity; socio-economic and family circumstances; the availability of social support services and accessibility of general practitioners who can offer the specialised care that may be needed. Each of these influences the extent of care that people with a mental disorder may require from hospital-based mental health care professionals.

Access to general practitioners and social support services are best addressed through broad scale resource allocation decisions rather than through a pricing structure. However socio-economic and family circumstances and illness severity are relevant consumer characteristics. Just as in general health care a patient's medical diagnosis predicts both the need for acute care and the cost of that acute care, factors (or cost drivers) such as these predict both the need for and cost of mental health services. These factors may or may not be amenable to incorporation in a patient classification system.

- **Service factors:** The second group of cost drivers are service, rather than consumer-related measures. These include, for example, *staff mix, care setting, shared care arrangements, service hours of operation (weekends only, weekends, evenings etc)* and so on. Service related cost drivers are more problematic as contenders for inclusion in a casemix classification because they can create undesirable incentives. However, as a minimum they need to be fully analysed so that variations in cost that are unarguably due to consumer-related factors can be elucidated.
- **Treatment factors:** The third group of cost drivers relate to the kind of care provided to an individual patient over a period of care, regardless of service setting. However, apart from the administration of ECT, there is currently little reliable data on the kinds of therapies that are used and their resource requirements. It is expected that this problem will be largely addressed in 2015 when a new set of mental health intervention codes are expected to be introduced into the Australian Classification of Health Interventions.
- **Legal Status, Safety, and Emergency Care:** Many cost drivers are associated with the operation of the involuntary care provisions of mental health legislation. In these cases the services are provided for management of the serious risk of harm to themselves or others that (in addition to diagnosis and unwillingness to receive care) has led to the legal requirement

for the person to receive care and for that care to be provided in the least restrictive environment consistent with the provision of effective treatment. Although the “risk of harm” aspects and functional impairment in managing one’s own healthcare can also be considered as consumer-related variables, the legislative requirements drive costs in complex ways that warrant separate attention. This area of work is almost entirely confined to specialised public sector services, where it accounts for about half of all stays in admitted patient care. Community Treatment Orders (CTOs) or equivalent apply to fewer than 10 per cent of consumers, but because of the intensity of treatment people under CTO’s consume a larger percentage of ambulatory care resources. Another essential feature of these services is that they are emergency mental health services^{9, 10} that have to be continuously available, and this demands consideration of availability costs as well as efficient pricing for utilisation.

- **Chronic Disease Management:** The last group of cost drivers might also be subsumed under previous headings, but warrant separate attention. They have to do with the early onset and lifetime impact of the most severe mental illnesses. For example, about 0.7% of the Australian population aged 16-64 is in receipt of the Disability Support Pension (DSP) for psychiatric reasons and the vast majority of consumers in this group have no other income or health insurance. They depend on public sector mental health services for any admitted patient care they require. Unlike general medical/surgical inpatient care, the market for mental health inpatient care is almost completely segmented, with insured patients being seen mainly in the private sector. Public sector mental health inpatient services are mainly treating “welfare” patients who have limited out-of-hospital resources to support them on discharge. Their demand on inpatient care is thus very dependent on other mental health care and support being provided to prevent relapse and support recovery. To some extent the availability of these other services affects the duration of an individual hospital stay because it impacts on discharge planning, but its main effect is on the annual consumption of healthcare by consumers. It is thus important that the cost drivers for the aggregate consumption of healthcare are separately identified and considered as well as those applicable to the individual components of care.

1.2.2 Previous reviews

There have been a number of previous reviews that have examined the cost-drivers of mental health services, each with a different conceptual or methodological focus:

1. Jones et al (2007)¹¹ reviewed 16 cost prediction studies published between 1990 and 2005 to identify predictors of psychiatric service utilization and costs and examine the methodological approaches employed. The authors found that previous psychiatric service utilization and psychiatric history were the most consistent predictors of higher psychiatric costs across studies. Clinical factors such as diagnosis and disease severity were not found to be good predictors of higher costs. Age and gender were usually significant predictors but had positive and negative effects in different studies.
2. Hermann et al (2007)¹² conducted a review of 36 studies published between 1980 and 2002 using risk-adjustment models examine the utilisation and costs for mental and/or substance use conditions. Clinical variables such as patient severity and DRGs were found to be strong predictors of costs. Models using administrative databases for demographic and clinical data only accounted for an average 6.7% variance, with more detailed datasets explaining on average 22.8%.
3. Mason et al (2011)¹³ analysed 5 international examples of activity-based funding systems for mental healthcare published between 2006 and 2008. Studies from Australia and New Zealand found that while patient characteristics (both demographic and clinical) were weak drivers of costs, provider-level variations in patient treatment were a stronger predictor of costs.

Further detail of these reviews is provided in Appendix 1. All authors identified the need for further, rigorous studies to be conducted; Jones et al ¹¹ identified a scarcity of truly predictive studies and lack of consensus on the most accurate methodology, with few studies cross validating results. Jones et al ¹¹ and Hermann et al ¹² both also flagged the paucity of studies focusing on children and older people. Jones et al ¹¹ suggested the scope of studies should be widened to identify significant, as yet unidentified, predictors such as socio-economic characteristics; environmental factors; and factors such as levels of social cohesion. Hermann et al ¹² advocated the development of a minimum clinical dataset to facilitate routine data collection by physicians and improve the usefulness of administrative databases in identifying predictor variables. Mason et al ¹³ highlighted the need for new mental health payment systems to take account of the economic incentives that may be inherent in the system, and to include appropriate adjustments to take account of variations in length of stay.

1.3 Purpose of this document

As an initial step in developing a new national classification for mental health services, IHPA has commissioned a consortium led by The University of Queensland to conduct a national and international review of the cost drivers of mental health care. This volume presents the results of a literature review based on documents obtained via a systematic search of the academic literature and a focussed web search.

1.4 Structure of this document

This remainder of this report is organised into a series of chapters:

- Chapter 2 summarises the methodology used to locate relevant documents and extract material from them.
- Chapters 3 present findings from the review.
- Chapter 4 presents an overview of the findings of the review and reflects upon their implications for the development of a classification system for mental health services.

Chapter 2: Method

2.1 Aim

The purpose of the literature review was to:

1. Review available literature regarding the cost drivers of mental health services in Australia; and
2. Consider the cost drivers of mental health services in international jurisdictions with a health system comparable to Australia's (or where relevant work has been undertaken).

2.2 Search strategy

The literature included in the review was identified using a two part strategy:

1. A systematic search of the published academic literature on mental health and costs; and
2. A focussed web-search for documents that describe studies of mental health cost drivers from selected, relevant countries.

2.2.1 Systematic search of academic literature

A systematic academic literature search was developed, informed by the methodology developed by the University of York⁵ and an iterative process of testing additional search terms. Electronic databases Medline, PsycINFO and EMBASE were searched via OVID and Econlit via EBSCOhost, using an expanded version of the following search string:

(mental health[Title/Abstract] OR behavioral health[Title/Abstract] OR psychiatric[Title/Abstract] OR psychiatry[Title/Abstract]) ...

AND

(financing[Title/Abstract] OR payment[Title/Abstract] OR funding[Title/Abstract] OR cost[Title/Abstract] OR casemix[Title/Abstract] OR risk adjustment [Title/Abstract] OR drg[Title/Abstract]) ...

The expanded search string is detailed in Appendix 2. The search was limited to studies published between 1995 and September 2012. There were no limitations to the language of publication. Initially, titles and abstracts were assessed for relevance. Full-text versions of potentially eligible papers were retrieved. Where potentially relevant secondary sources such as meta-analyses or reviews were identified, the primary articles from these were obtained. Reference lists of retrieved articles and key journals^b were hand searched to identify additional studies.

2.2.2 Focussed web-search

A focussed web-search was conducted for studies of mental health services cost drivers in relevant countries including Australia, New Zealand, England, U.S.A., Canada, the Netherlands, and Germany.

^b Relevant journals included: Health Affairs, Health Care Financing Review, Administration and Policy in Mental Health and Mental Health Services Research, Psychiatric Services

2.2.3 Inclusion/exclusion criteria

The review included articles meeting the following criteria:

1. The purpose of the study was to conduct a quantitative analysis to identify patient- or service-related characteristics that drive the costs (or proxy variables, such as length of stay, duration or quantum of outpatient treatment, or other service utilisation variables^c) of mental health treatment or services; or
2. The study population comprised:
 - a) People receiving mental health treatment from a specialised mental health service, regardless of diagnosis; and/or
 - b) People with a mental disorder^d receiving specialised or non-specialised mental health treatment.
3. Documents reporting cost/utilisation data collected entirely or primarily from 1995 onwards. 1995 was selected as the start date in order to capture relevant Australian work (the MH-CASC project) and because perusal of preliminary search results by year indicate that relatively little work on cost drivers in mental health was conducted prior to this date;
4. Documents examining mental health services in Australia, New Zealand, the United Kingdom, the Republic of Ireland, Canada, the United States, and Western Europe.

The review excluded articles that:

1. Reported on data not collected entirely or primarily from 1995 onwards, or the year of cost data could not reasonably be ascertained (if paper published before 2000).
2. Analysed data from a country other than those identified in the inclusion criteria.
3. Analysed data from a study population other than those identified in the inclusion criteria.
4. Examined the costs of general medical treatment, societal costs, or other costs for people with a mental disorder which are not the provider costs of delivering mental health treatment or services.
5. Were limited to describing the cost of delivering a single type of mental health service (e.g. the cost of inpatient care), without analysing cost drivers.
6. Were limited to a review or description of psychiatric financing models, diagnostic instruments, outcome measures, or other broad issues not directly relevant to the purpose of this review.
7. Analysed data for a purpose not directly relevant to this review, e.g.:
 - Calculated the burden and/or costs of mental disorder(s) at the population level.
 - Investigated the cost-effectiveness of a therapeutic intervention (e.g., medication type) for a mental disorder.
 - Investigated the effectiveness of a therapeutic intervention (e.g., medication type) or service.
 - Investigated changes in patient outcomes or service-level costs after implementation of a new financing mechanism for mental health services.
 - Followed up a patient group to examine long term treatment costs more than two years after the original data collection.
8. Material could not be obtained therefore could not judge eligibility (screening stage) or material could not be obtained in time for review (extraction stage).
9. Duplicated data from a document already included in the review.

^c Where these have been discussed in relation to costs or financing of services. The search terms specifically targeted papers discussing costs and mental health (or related terms).

^d May include individuals with substance use disorders.

2.2.4 Forensic mental health

It was noted that there was a gap in the identified articles on the cost drivers for forensic mental health services. A supplementary targeted search was conducted to specifically identify studies examining the drivers of cost in forensic settings or for forensic mental health patients. As the systematic search of the published academic literature found no such studies, an additional focussed web-search was conducted specifically for documents describing studies of drivers of the cost or service utilisation for forensic mental health care. In addition, relevant experts were contacted to identify any reports that could not be found through the searches. No studies were found that examined predictors of cost or utilisation of forensic mental health services and met inclusion criteria for the review. There is a need for further research in this important area.

2.3 Data extraction and synthesis

The following data were extracted from the included articles:

- Study identifiers (author/year)
- Country and/or region of study
- Year of outcome data
- Study population, including sample size
- Service setting
- Type of study (see below)
- Type of analysis
- Outcome variable (including time dimension) examined
- Potential predictors examined
- Significant predictors/cost drivers identified
- Variance explained
- Class-finding results (casemix studies only)
- Strengths
- Limitations
- Other notes

For the purposes of this review, documents were classified into three study types; explanatory, descriptive, and casemix approaches. The definitions for explanatory and descriptive were adapted from Mirandola et al (2004)¹⁴ and modified for the purposes of this project. Descriptive studies were defined as those that described differences in costs of different groups of patients, or analysed differences in outcomes (cost or service utilisation measures) between patient groups, adjusting for only one or two independent variables. Explanatory studies were defined as those that attempted to explain the variation of costs within and between patients, taking into account a more comprehensive set of variables. Casemix studies were defined as those that classified episodes of care based on variables that best predict the need for, and cost of, care¹⁵.

The information extracted from each document was then synthesised into a series of summary tables to assist interpretation:

- Firstly, to obtain an overall picture of the information available from the studies meeting inclusion criteria, the extracted data were further summarised into a table that identified the factors examined in each study and whether they were found to be significant cost drivers. Where there were multiple analyses emanating from a single study, all relevant analyses were included.
- Secondly, in order to focus on the most useful analyses, a series of exclusions were introduced: (a) studies classified as 'descriptive' were excluded; (b) because the results of multiple analyses from the same study would not be independent, only the most relevant

analysis from each document was included; and (c) where a study assessed, but did not disclose the impact of treatment characteristics, it was also excluded.

- Thirdly, in order to review the class-finding results from studies identified as casemix studies, these results were summarised separately.

Chapter 3: Results

3.1 Included studies

A total of 58 papers met inclusion criteria for the review. As shown in Figure 1, these were obtained via the following process:

- The search of Medline, PsycINFO, EMBASE identified 3413 citations, yielded 1880 records after adjusting for duplicates. The search of Econlit identified 73 citations. After manually removing further duplicates, the combined searches yielded a total of 1810 unique records.
- After the titles and abstracts of the articles were reviewed, 1601 were excluded because it appeared that these papers clearly did not meet the inclusion criteria. The full text of the remaining 209 papers was reviewed and a further 163 were excluded as they did not meet the inclusion criteria. 46 articles met criteria for inclusion in the review.
- An additional 12 papers were identified by manually searching the reference lists of accepted papers, searching for other papers the same author(s), searching relevant journals, and searching the grey literature.

3.2 Studies examining potential cost-drivers

3.2.1 Overview of identified studies

The studies identified in the literature search are described in Appendix 3 (Table A3). Of the 58 studies identified:

- *Countries from which data were collected.* A total of 32 studies reported on data collected from North America (USA and Canada), 18 studies used data from Western Europe, six used Australian data, one study used data from New Zealand, and one study used data from both the United States and Germany.
- *Study type.* Forty-seven (47) studies were classified as explanatory and 11 as descriptive. Ten of the explanatory studies were also classified as casemix, because they developed a casemix classification and presented the results of its performance.
- *Age-specific samples.* The vast majority of studies involved adult samples including older adults (n=9), working age adults (n=12), or “adults” not further defined (n=7). A small number included “adults and children” (n=1) or services for adults, children and older persons (n=6). Four studies included children and adolescents only, and two in samples comprising older persons. For the remainder, the age range was not stated (n=15).
- *Sample sizes.* Study designs ranged from small clinical samples (n= 89)¹⁶ to large samples sourced from administrative databases (n=914,225)⁴
- *Service settings.* A total of 24 studies involved cost or utilisation data from inpatient settings only, two studies involved data from outpatient or community settings only, with the remainder analysing data from a combination of different service settings.
- *Outcome variables.* The outcome variables examined varied across studies. Most studies (n=45) examined cost variables, either exclusively (n=31) or in addition to service utilisation variables (n=14). The other 13 studies examined outcome variables based on measures of service utilisation (most commonly inpatient length of stay) only.

- *Multiple relevant analyses.* Many studies reported more than one analysis relevant to this report. The individual analyses from the 58 studies are summarised in Appendix 4 (Table A4).

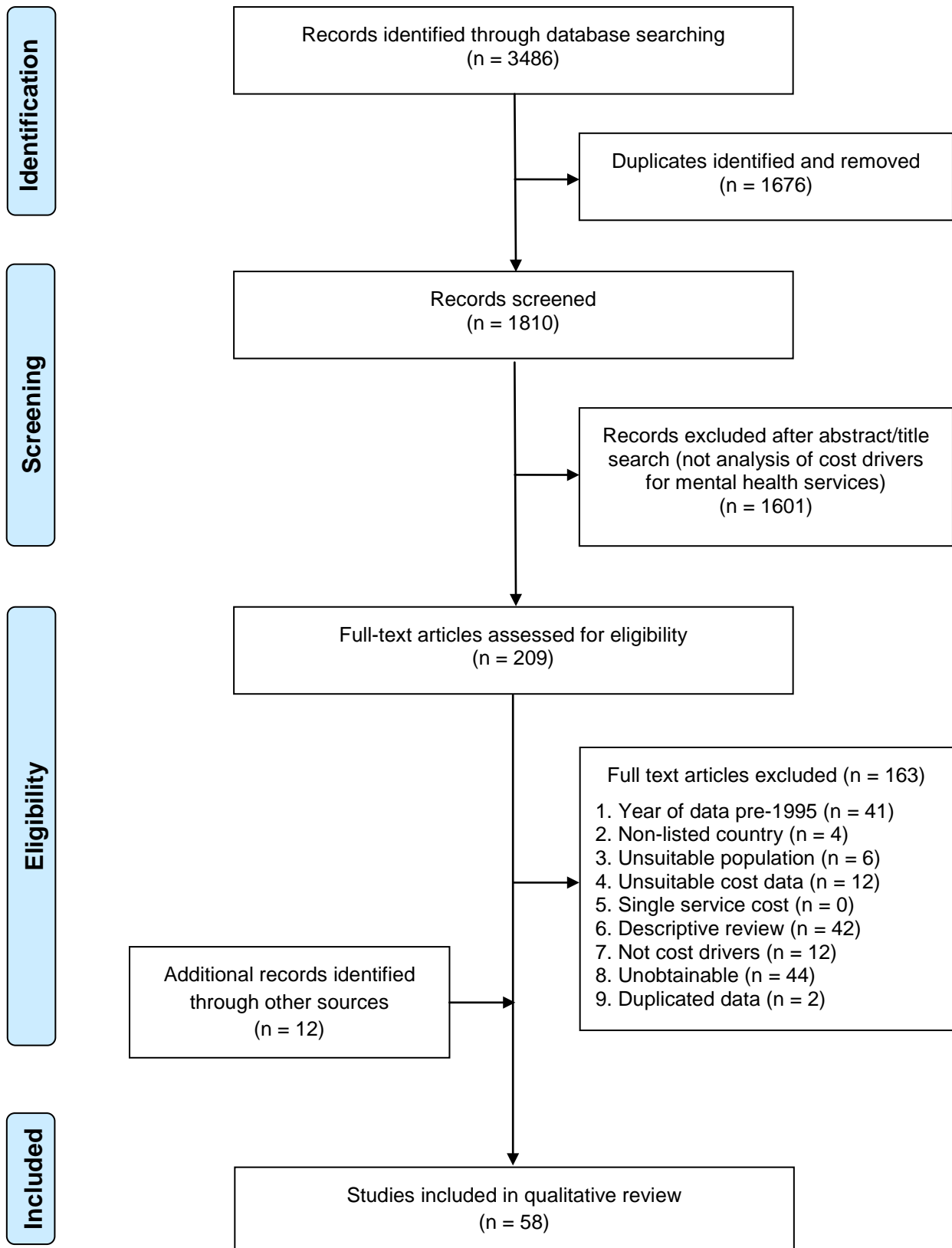


Figure 1: Flowchart describing the search strategy and results

3.2.2 Frequency of analysis of potential patient-related cost drivers

We sought to quantify, broadly, the relative frequency with which certain factors were examined in the available literature and, the extent to which these factors were found to be cost drivers. Our primary interest was in patient-related cost drivers. To do this, we took the following approach:

- Firstly, we narrowed the pool of analyses down to those with the information required. We excluded:
 - Analyses from studies classified as ‘descriptive’ were excluded as they did not attempt to control for any/sufficient factors that may also explain variation in cost/service utilisation.
 - Analyses for which only findings for a subset of the variables examined were reported. For example, the paper by Hirdes and colleagues¹⁷ assessed but did not disclose the impact of treatment characteristics, because they determined that only patient-related variables would be incorporated in the classification system.
 - Analyses that measured the effect of provider or treatment variables, but did not examine patient factors/characteristics, were not considered further.
 - Analyses from studies reporting on the same dataset or a subsample of the dataset used in another study; two studies were excluded on this basis.^{18, 19}
- Secondly, to facilitate interpretation, factors were grouped into four broad classes: patient illness factors; patient characteristics; treatment factors; and provider factors. Within each class, factors were grouped into sub-classes and, where relevant, into components within sub-classes. The choice of categories under which to assemble the results was, to a degree, arbitrary. In particular, there were many different ways of measuring some variables, notably the severity of a person’s illness and their level of functioning or disability. As a result there are different kinds of measures assembled under the headings of *disability/functioning*, *severity*, *comorbidity*.
- Thirdly, we created several, non-mutually exclusive categories of outcome^{e,f}: (1) All eligible studies (‘primary’ analysis, n=33); (2) Analyses examining inpatient outcomes (n=19); (3) Analyses examining outcomes measures across multiple settings (n=16); (4) Analyses examining cost (n=31) outcomes; and (5) Analyses examining service utilization outcomes (n=15). Because an individual study may report more than one analysis relevant to a category, and because analyses from within a study might not be independent of each other, the following criteria^g were employed to select the preferred analysis for each category:
 - Preference was given to analyses using cost measures as the outcome, over service utilisation measures.
 - Preference was given to analyses reporting total mental health costs as an outcome, or where total costs were not reported, to the analyses reporting inpatient costs.
 - Preference was given to the analyses examining the greatest number of variables or, where variables were the same, to the analyses which employed the most comprehensive method of grouping patients in the sample.

^e Based on there being at least 15 analyses available for any category of outcome. We examined other possible categories of outcome but the number of analyses relevant to each was considered too small.

^f Appendix 4 Table A4 shows the outcome category or categories assigned to each analysis.

^g Note that the analyses selected as the most appropriate for categories 2-5 may be different from those selected as the most appropriate in category 1.

- Individual analyses from the studies from Buckingham and colleagues² and Gaines and colleagues³ were considered independent, as each analysis was based on an independent patient subgroup.

Table 1 shows the number of analyses investigating each of the outcome categories, and provides a count of the factors examined as potential predictors of cost or service utilisation and factors found to be statistically significant. Notwithstanding the fact that the studies included varied in the exact nature of the measures they used to assess each of the factors described in Table 1, a number of observations can be made:

- Taking into account the 33 eligible studies, the most commonly identified patient-level cost drivers were:
 - *patient illness factors*: principal diagnosis/diagnostic cluster; functioning/disability; overall symptom severity; comorbidities; indicators of risk of harm to self or others, overall; and treatment history;
 - *patient characteristics*: socio-demographic factors overall; age; ethnicity/aboriginality; socio-economic factors overall; and employment status.

These factors, or groups of factors, were investigated in at least one-quarter of analyses, and found to be statistically significant predictors of outcome in at least one half of those.

- These patterns were broadly similar across the other outcome categories, although there were some variations, for example:
 - Amongst analyses examining inpatient outcomes only, legal status, aggressivity, ethnicity/aboriginality, and ECT administration were also commonly identified cost drivers in their own right, whereas treatment history, sex, and socio-economic factors overall were not.
 - Amongst analyses examining outcomes across multiple service settings, overall symptom severity and risk of harm to self or others were not commonly identified predictors.
- Principal diagnosis and patient age and sex were the most commonly *examined* factors, with diagnosis and age among the most commonly recognised patient-level cost-drivers. In most cases these factors also happen to be the most readily available and it is perhaps not surprising that they predominate in the literature.
- Treatment history was one of the more commonly investigated patient illness factors, however a range of variables was used for this purpose:
 - In some analyses, these measures could be interpreted as an indicator of whether the episode is the first time treatment (overall, or of a particular type, e.g., psychiatric inpatient admission) has been received. For example, proxy measures included prior lifetime psychiatric inpatient admissions as a dichotomous variable (Yes/No). Analyses using these variables did not tend to find a significant association between first time treatment and outcome.
 - The remainder of treatment history measures tended to be based on prior length or intensity of contact with services, or the number of psychiatric admissions and/or service contacts within a defined time period. Where analyses using these measures reported a significant association between treatment history and outcome, it was consistently in a positive direction:
- Support for other patient characteristic variables was less consistent. There was good support for age, employment status, and ethnicity/aboriginality. In contrast, marital/partner status, accommodation/living status, and educational status were relatively frequently investigated but were less often found to be significant predictors of outcome. Level of family/carer support

was investigated in relatively few analyses, but well supported among those. Having dependent children was investigated in only one study included in this review.

- Treatment factors were less commonly investigated, although this may to some extent reflect the criteria we used to include studies in this analysis. Of the studies that did investigate these factors, strongest support tended to be for treatment setting, ECT administration and treatment focus/stage of care, however the small number of included analyses makes it difficult to draw conclusions.

It should be noted that this summary relied on the assessment made by the original authors as to the statistical significance of particular factors examined. We made no assessment of the statistical reliability of the findings reported.

Table 1: Summary of cost drivers investigated in selected studies

	Type of outcome variable									
	Primary (n=33)		Inpatient (n=19)		Multiple settings (n=16)		Cost (n=31)		Service utilisation (n=15)	
	Inv.	CD	Inv.	CD	Inv.	CD	Inv.	CD	Inv.	CD
patient illness factors										
principal diagnosis/diagnostic cluster	26	21*	17	15*	11	7*	25	15*	10	10*
functioning/disability	15	13*	7	5*	7	6*	15	13*	7	6*
overall symptom severity	10	8*	10	5*	3	3	14	8*	5	4*
comorbidities	12	8*	7	5*	5	4*	7	5	7	5*
<i>incl comorbidities</i>	10	7*	7	5*	4	3*	5	4	7	5*
<i>substance use</i>	5	2	2	1	2	1	4	2	2	1
risk of harm to self or others	10	8*	12	11*	1	0	13	7*	5	5*
<i>incl legal status</i>	7	5	10	7*	1	0	12	5	3	3
<i>suicidality</i>	2	2	2	2	0	0	1	1	1	1
<i>aggressivity</i>	5	2	5	4*	1	0	5	3	2	1
treatment history	14	8*	6	1	8	8*	9	7*	6	2
<i>episode is first time treatment**</i>	5	1	3	0	1	1	2	0	3	1
<i>other measure of treatment history</i>	10	7*	3	1	8	7*	5	4	6	4*
duration of illness	4	2	1	1	3	1	3	1	1	1
medication compliance	4	2	2	1	3	1	3	1	2	1
patient characteristics										
socio demographic factors	31	26*	17	14*	16	12*	29	22*	15	12*
<i>age</i>	30	20*	17	13*	15	7*	28	17*	15	10*
<i>sex</i>	28	13	15	5	16	7	27	7	14	8*
<i>ethnicity or aboriginality</i>	11	7*	6	3*	6	4*	12	8*	5	3*
<i>marital/partner status</i>	14	4	2	1	10	3	10	2	5	2
<i>dependent children</i>	1	0	0	0	0	0	1	0	0	0
socioeconomic factors	18	14*	7	3	11	9*	16	9*	8	7*
<i>socioeconomic status</i>	5	0	4	0	3	0	6	0	3	0
<i>employment status</i>	13	8*	2	1	9	6*	10	7*	4	2*

	Type of outcome variable									
	Primary (n=33)		Inpatient (n=19)		Multiple settings (n=16)		Cost (n=31)		Service utilisation (n=15)	
	Inv.	CD	Inv.	CD	Inv.	CD	Inv.	CD	Inv.	CD
<i>accommodation status/living situation</i>	14	5	6	2	8	2	14	2	5	3*
<i>educational status</i>	11	3	1	0	9	2	8	1	4	3*
<i>level of family/carer support</i>	4	3	1	1	3	2	3	2	2	2
treatment factors										
treatment setting	4	3	4	1	2	2	8	3	0	0
ECT administration	4	3	6	3*	0	0	7	2	1	1
treatment focus/stage of care	4	2	7	2	1	0	12	4	0	0
treatment entry point	1	1	0	0	0	0	1	1	1	1
medication regime	5	2	6	1	1	1	7	1	2	1
treatment team type/specialty	4	1	4	0	1	1	7	1	3	0
seclusion or restraint	1	0	1	0	0	0	0	0	1	0
provider factors										
facility type	4	3	3	2	0	0	2	2	2	1
facility location	5	3	3	3	1	0	4	2	1	1
provider type	4	4	3	3	0	0	2	2	2	2
facility size	3	3	2	2	0	0	3	3	0	0
hospital teaching status	1	1	1	1	0	0	1	1	0	0
bed occupancy rate	1	1	1	1	0	0	1	1	0	0

Notes:

Inv. – refers to factors investigated in the analysis; CD – refers to factors identified as statistically significant cost drivers.

* - Indicates that the factor, or group of factors, was investigated in at least one-quarter of analyses, and found to be statistically significant predictors of outcome in at least half of those.

** Categorisation required some judgement as the purpose and operationalisation of the variable was not always clear.

3.2.3 Cost drivers identified in explanatory studies

Among the papers reviewed, the most common way of analysing cost drivers was a regression analysis, and 23 of the papers reported an R^2 value for at least one analysis, estimating the percentage of variance in costs (or proxy variables) explained by the model. Across the various analyses reported in these 23 papers, there was wide variability in the ability of the models examined to account for mental health service costs. Six papers reported maximum R^2 values of less than 25%, nine papers reported maximum R^2 values between 25- <50%, and eight papers reported maximum R^2 values of 50% or greater.

The eight papers that reported at least one analysis where the model accounted for at least 50% of the variance in the outcome measure were examined in more detail. Overall, these analyses tended to include patient demographic and clinical factors, as well as treatment history, provider factors, and sometimes treatment factors. Despite a wide range of cost drivers being investigated, it was generally

difficult to identify the variance explained by individual factors. Where the studies reported comparative analyses with different groups of cost drivers, the general pattern was that treatment history and provider factors tended to account for much more of the variance in costs than patient demographic or clinical characteristics. For example:

1. Cromwell et al (2005)²⁰ and Drozd et al (2006)¹⁹ examined the intensity-adjusted daily cost for 696 psychiatric inpatients. The casemix model developed in their study included five diagnostic groups, age, illness severity, deficits in daily living activities, use of ECT and dangerousness. Given that the studies were not independent, only the former study was considered here because it provided more comprehensive information regarding predictors. Cromwell et al (2005)²⁰ examined the explanatory power of the casemix classification on four different cost variables, with R^2 results ranging from 31.7 - 58.6%. The highest variance explained was for the combination of single facility-wide routine per diem cost and patient-specific average daily ancillary costs.
2. Gray (1998)²¹ analysed the predictors of mental health service costs over an 18 month period (including inpatient, day programs and outpatient services) for adults with severe and persistent mental illness treated in a community mental health service. Factors investigated included demographic, clinical and service/support characteristics (measures of past psychiatric service use and residential care). Gray found that although demographic and clinical factors alone each predicted only about 5% of the variance in costs, 57.3% of the variance in costs was accounted for both by service/support factors alone and also in the overall model including all three types of predictors.
3. Beecham et al (2003)²² examined the factors predicting cost per inpatient day for patients admitted to child and adolescent mental health units, based on facility characteristics and diagnosis. The model including facility variables accounted for 46% of the variance in costs, which increased to 55% when diagnosis was included in the analysis. The presence of a mood disorder, schizophrenia or a learning disability all predicted increased costs, but to a lesser extent than facility variables.
4. Donisi et al (2011)²³ looked at a number of different models of annual direct care costs for patients in contact with community mental health services, based on groupings of cost drivers, episode type and patient diagnosis. Cost drivers examined included socio-demographic and clinical factors as well as the episode type (first ever, new episode after 90-1095 days, new episode after 1096 days, ongoing). The authors found that a base model with age, gender, living situation, occupational status and diagnostic group as predictors accounted for only 5% of the variance in costs. When previous psychiatric history was added to the model, this amount of variance explained increase markedly to 41.9%, an R^2 increase of 36.9%. The addition of the final predictor, socioeconomic status, increased the variance explained very slightly, to 42.05%.

Within different patient groups, the full model had variable explanatory power. The model with the highest variance explained was for ongoing patients, at 56.4%, whereas the amounts of variance explained for first ever patients (6.8%), new episode patients after 90-1095 days (11.8%) and new episode patients after 1096 days (5.5%) were much lower. Additionally, the model accounted for 50% of the variance in costs for psychotic patients but only 27.7% of the variance in costs for non-psychotic patients.

5. Wanchek et al (2011)²⁴ analysed the predictors of both hospital days and number of outpatient visits. The model included patient demographic and clinical characteristics (gender, age, ethnicity, diagnosis, days in community, outpatient service visits) as well as service factors (average outpatient visits in region, current procedural terminology codes, crisis intervention service index, per capita clients, type of community service board, board budget per capita, per capita income, population density, cost of inpatient care). The model for

outpatient care accounted for more of the variance in service use, with an R^2 of 53.9% in the subsample of people with serious mental illness, and 38.8% in the whole sample. The inpatient model performed more poorly, with variances explained of 19.8% for the subsample and 13.4% for the full sample.

6. Bonizzato et al (2000)²⁵ found that 66% of the variance in annual psychiatric direct care costs was accounted for by their model which included patient demographic characteristics, clinical characteristics, and service utilization measures (admission to psychiatric hospital in past year, length of psychiatric history in years and length of past contact with the community mental health service). The significant predictors of cost in the model were: past psychiatric admission, past intensity of service contact, length of past service contact, Global Assessment of Functioning score, age, living with family, not being married, unemployment and diagnosis of affective disorder.

3.3 Casemix classifications

3.3.1 Overview of identified casemix studies

This section considers the nine^h of the 58 included studies that had casemix class finding as a specific goal. To this group we added two systems developed in The Netherlands, using information obtained from the report by Mason and Goddard (2009)⁵, plus a further system developed in the UK²⁶ ⁱ and one in the US⁶. Table 2 provides a highly distilled summary of the key features of each of these 13 classification systems in terms of their scope (patient and/or treatment setting), exclusions, the number of classes in the classification, whether the system is used for funding, and the splitting variables used at each level of the hierarchy.

^h Two studies described the development of a casemix classification in a sample of 696 Medicare patients in the US – Cromwell et al (2005) and Drozd et al (2006). For convenience, this section refers to the latter paper only.

ⁱ Describes the process of developing clustering service users on the basis of need, but does not provide quantitative analysis.

Table 2: Overview of class-finding results from documents describing the development of mental health casemix classifications

Country	System	Broad scope, including treatment setting	Exclusions	Number of classes	Used for funding?	Splitting variable(s) at specified level in hierarchy, or assessed relative dominance					
						1	2	3	4	5	6
Australia	MH-CASC ²	Specialised MH services, inpatient and community settings, all ages	MH clinical residential services, brief episodes, C&L, MH NGO community & residential services, AODT services, forensic MH	42 (23 inpatient, 19 community)	No	setting	age	episode duration, focus of care	diagnosis, HoNOS, legal status	functioning, psycho-social factors	
Australia	UoW (Green) ⁸ modified DRGs	Non-specialised services for people with a MH diagnosis, inpatient care, all ages	-	7	No	LOS, ECT	diagnosis				
Australia	Vic (Legge) ²⁷ modified DRGs	Specialised MH services, inpatient care, all ages	Forensic, sub-acute and non-acute inpatient care, and some very highly specialised inpatient units	31	No	diagnosis	age, ECT, legal status				
Canada (Ontario)	SCIPP ¹⁷	Specialised MH services, inpatient care, consumers >18 years	AODT services, child and adolescent MH services	47	No	diagnosis	day of stay	Range of patient attributes, variably located in classification tree.			
England	Care pathways and packages clusters ¹	Specialist (inpatient, outpatient and community-based) services, consumers >18 years	AODT services, all highly specialised services, incl child and adolescent, forensic, perinatal, eating disorders, acquired brain injury, etc	20	Yes, but with local not national tariffs	Diagnosis (assessed via HoNOS)	severity, chronicity, cognitive impairment				
Germany	Andreas ²⁸	Specialised MH services, inpatient care, adult services	-	17	No	diagnosis	age, illness duration	HoNOS, comorbidity, interpersonal problems	Relationship status, quality of life (mental), comorbidity, occupational status		

Country	System	Broad scope, including treatment setting	Exclusions	Number of classes	Used for funding?	Splitting variable(s) at specified level in hierarchy, or assessed relative dominance					
						1	2	3	4	5	6
New Zealand	NZ-CAOS ³	Specialised MH services, inpatient and community settings, all ages, incl forensic	Residential MH services, NGO MH services, AODT services	41 (20 inpatient, 21 community)	No	setting	age	episode duration	legal status, acuity, psychotic or non-psychotic (HoNOS-6)	Range of patient attributes, variably located in classification tree.	
The Netherlands	DBC (see Note 1) ⁵	Inpatient psychiatric care, all ages	-	>300	Yes	diagnosis	day of stay	Range of treatment attributes with variable location in funding model.			
The Netherlands	ZZPs (see Note 1) ⁵	Psychosocial care, all ages	-	38	Yes	Complex classification, based on psychosocial/cognitive functioning, social skills, mobility, ADLs, behavioural problems					
USA (Medicare)	IPF PPS ⁷	Specialised MH services, inpatient care, all ages, but mainly older patients	-	n/a (See Note 2)	Yes	diagnosis (MS-DRGs)	age	day of stay	loadings, rather than classes, for comorbidities, ECT, and facility factors		
USA	(Drozd et al) ¹⁹ - 696 Medicare Patients	Specialised MH services, inpatient care, all ages, but mainly older patients	-	16	No	diagnosis (DSM-IV axis 1 divided into 5 classes)	Age ADL deficits	Severity Comorbidity Age	Lower level splitters include ECT and detox treatment and patient dangerousness (self or others)		
USA (New York State)	(Gahan) ⁶ Medicaid inpatient funding	Specialised MH services, inpatient care, all ages, fewer older patients	-	n/a (See Note 3)	Yes	diagnosis (APR-DRGs)	illness severity (SOI index)	age	day of stay	loadings, rather than classes, for comorbidities, ECT, and facility factors	
USA (Veterans Health Administ'n)	PsyCMS ⁴	All settings, specialised and non-specialised, incl AODT services, adult veterans mostly male	-	46	No	diagnosis	Diagnosis defined all 46 classes based on an hierarchical assignment process				

Note 1: Refer to Table 7, Mason and Goddard (2009)⁵.

Note 2: The Medicare and New York State Medicaid models are classification and funding models wrapped together.

3.3.2 Casemix classifications

This section explores the way some of the most commonly identified cost drivers have been aggregated for use in each of the casemix classifications and their performance in that classification. This section focuses on the more widely used of these – diagnosis; symptom severity, disability/functioning, and comorbidity; and age.

Diagnosis

Information about the aggregations of diagnosis used in each of the casemix models is provided in Table 3. A key reason for classifying medical conditions is to help guide treatment and prognosis. It is therefore important to understand why the use of diagnosis in mental health casemix classifications has long been contentious. Potential reasons for this are as follows:

- a) When grouped as DRGs, mental health diagnoses have often not been found useful predictors of the cost of inpatient episodes.
- b) In the case of the less common mental disorders, which are main focus of public specialised mental health services, the principal diagnosis can change over time.
- c) While all involuntary patients treated by public specialised mental health services should be seen by a psychiatrist, many non-admitted voluntary patients will not, and so a proper diagnosis will not be possible.

In relation to (a), this issue can be strongly affected by the way DRGs are formed. For mental disorders, there are significant differences in the construction of Australian-refined DRGs (AR-DRGs), all patient refined DRGs (APR-DRGs) widely used in the USA for Medicaid, Medicare-severity DRGs (MS-DRGs) used in the USA for Medicare and healthcare resource groups (HRGs) used by the NHS in England.

There are clear anomalies in some of these systems. For example, in the MS-DRG system used by Medicare, MS-DRG 855 ('Psychoses'), which accounts for around three quarters of all specialised mental health admissions, includes major depressive disorder with no psychotic symptoms.

In the AR-DRG system, a study for the Department of Health in Victoria found that the length of stay profile of U63Z (major affective disorders) had an almost bimodal pattern.²¹ Depressive disorders with psychotic symptoms, bipolar disorders and mania generally had an average length of stay of around 14 days or more, whereas depressive disorders without psychotic symptoms, whether severe or otherwise, had an average length of stay of around 10 days or less. This is not surprising given that patients with psychotic depression generally require different pharmacotherapy and have different medical and nursing requirements. For patients aged 18-64, the coherence of the two mood disorder AR-DRGs was doubled by re-assigning depressive disorders without psychotic symptoms to the alternative affective disorder DRG (U64Z - other affective and somatoform disorders).

For mental disorders overall, the APR-DRG system (3M™) used in the mental health inpatient funding model for Medicaid patients seems to have the most sensible diagnosis assignment but patent restrictions prevent its composition being disclosed.

In relation to (b), while diagnosis may change over time, it tends to shift within an illness class, and so the assignment of diagnoses to more aggregated categories, whether DRGs or through an alternative grouping, can overcome this problem.

In relation to (c) the problem of MH clinicians who are not psychiatrists but who need to make a diagnostic judgement can be accommodated by requiring such judgments to be made at the highest class possible, using the most characteristic features.

For example, in the AR-DRG system the use of HoNOS item 6 (hallucinations and delusions), which is used in both the English PbR clusters and in the NZ-CAOS model is essentially a proxy for

'psychotic' (F20-F29, F30.2, F31.2, F31.5, F32.3, F33.3) and 'non-psychotic' disorders. This suggests that one of the issues with the predictability of DRGs can be dealt with by revising the current DRG assignment algorithms.

Symptom severity, disability/functioning, and comorbidity

Information about the aggregations of symptom severity, disability/functioning, and comorbidity used in each of the casemix models reviewed is provided in Table 4.

There is a wide range of tools used by mental health clinicians in different countries to assess a range of symptom, disability or functioning characteristics of mental health services. Many are designed to be used to assess symptom and behavioural aspects of patients with a particular mental disorder (e.g. depression or schizophrenia), with only some designed to be used across the spectrum of mental disorders. Some, such as the *RAI-MH* that underpins the SCIPP classification in Ontario, are quite long and detailed with many domains covered, whereas others, such as the *Mental Health Clustering Tool*, used in the English PbR system are relatively short.

These instruments have generally been developed for a variety of reasons. For example, the HoNOS was initially developed as means of recording progress towards the UK Health of the Nation target 'to improve significantly the health and social functioning of mentally ill people', whereas the RAI-MH was designed primarily to enable care planning, but also to support case-mix, quality improvement, and outcome measurement applications.

In discussing the approach taken to the development of the SCIPP system, the developers discuss some pros and cons of particular measurement methodologies:

Scales and individual items – There are a number of advantages to using scales rather than individual items for measuring patient characteristics. Whereas one might argue that using single items can reduce the burden of data collection because fewer items will mean shorter assessments, it can also be argued that systems employing a small number of items will be more vulnerable to reporting biases and measurement error. Scales based on multiple parallel items will tend to have better reliability than single-item measures of the same concept. In addition, scales with a broad range of response values may be more useful for detecting curvilinear effects than single items with a small (e.g., dichotomous) response set.

Index systems vs. groups – Indexing systems that provide a single summary score from the combined scores of a set of individual independent variables may be consistent with conventional approaches to statistical modelling in health services research or epidemiology. However, these models often explain less variance than they could have had they incorporated interaction terms. More importantly, these models can fail to detect rare but expensive groups of patients that have unique combinations of characteristics that make them substantially more expensive to care for than others. Analytic methods that rely on grouping methodologies (e.g., decision-tree analysis) have the further advantage that they can identify sets of patient characteristics that clinicians can recognize as "patient types" they encounter in normal clinical practice.

Gaming – One serious threat to the utility and viability of case-mix systems is the creation of financial incentives leading to systematic biases in response patterns for specific items. For example, variables that cannot be observed by an independent, external rater would be easy to manipulate in the hope of gaining additional funding. The greater the reliance on subjective interpretation by the assessor, the greater the risk that the variable can be systematically overestimated with relative impunity"¹²

In the case of comorbidity, for admitted patients this can be assessed via the morbidity coding at discharge, but for non-admitted patients, assessment of comorbidity can be more complicated because of the longer time spans involved, and the fact that assessment by a psychiatrist in some

cases can be infrequent. Moreover in the case of non-psychiatric comorbidities, these may not be able to be reliably assessed by the mental health clinicians, often because they are the subject of a separate treatment system (e.g. GP care). Apart from comorbidities like alcohol and drug use, or intellectual disability, including comorbidities in a casemix system applying to non-admitted patients can thus be problematic. The MHCT and the HoNOS, on which the MHCT is based, deal with this by incorporating an item that measures the level of incapacity attributable to physical ailments, although the suitability of this for a classification model to be used for funding purposes may need review.

Age

Information about the aggregations of age used in each of the casemix models reviewed is provided in Table 5.

Age is a patient variable that in the great majority of cases can be unambiguously and reliably measured. It is also a variable that was used in around half of all the casemix systems employed, and for those where it was not used, this was generally because the patients coming within the classification system only covered a particular set of ages. It also should be noted that certain mental disorders are already strongly associated with age, and in these cases assignment of diagnosis is already incorporating an age effect.

The age bands used vary with each study, although there are reasonably consistent partitions according to life-stage: child, adolescent, younger working-age adulthood, older working-age adulthood, and post-working age adulthood.

Table 3: Overview of aggregations of diagnosis used in mental health casemix classifications

Country	System	Aggregation
Australia	MH-CASC ² (for specialised MH care in all settings, excl MH residential)	Used a tailor-made system of 16 major categories and 61 individual codes based on ICD-10 clinical terms. <ul style="list-style-type: none"> • Schiz/Mood/Eating v Other in one mid-level branch of adult completed inpatient episodes • Various diagnosis group aggregates used in second level branch of adult ongoing episodes • Diagnosis not used for adult community episodes • Mood/Somatoform/Eating v Other in top-level branch of child and adolescent completed inpatient episodes • Diagnosis not used for child and adolescent community episodes
Australia	UoW (Green) ⁸ modified DRGs (for inpatient care in <u>non-specialised</u> MH units only)	System based on AR-DRGs aggregates, but only for long-stay episodes (LOS>4 days) <ul style="list-style-type: none"> • Dx Group 1: U66Z <i>Eating and Obsessive-Compulsive Disorders</i> • Dx Group 2: U61Z <i>Schizophrenia disorders</i>, U62A <i>Paranoia and Acute Psyc Disorder W CSCC or W MHLS</i>, U63Z <i>Major Affective Disorders</i> • Dx Group 3: U62B <i>Paranoia and Acute Psyc Disorder W/O CSCC W/O MHLS</i>, U64Z <i>Other Affective and Somatoform Disorders</i>, U65Z <i>Anxiety Disorders</i>, U67Z <i>Personality Disorders and Acute Reactions</i>, U68Z <i>Childhood Mental Disorders</i>
Australia	Vic (Legge) ²⁷ modified DRGs (for inpatient care in specialised MH units)	System based AR-DRG v6.0 as top-level splitter, but with modifications as follows <ul style="list-style-type: none"> • Regrouping of affective disorder DRGs • Splitting of all episodes with ECT into 2 new classes (adults and older persons) • Creation of new perinatal MH DRG • Various aggregations of DRGs outside MDC 19
Canada (Ontario)	SCIPP ¹⁷ (for inpatient care in specialised MH units)	System based DSM-IV categories, or category groups, as top-level splitter as follows <ul style="list-style-type: none"> • Schizophrenia and other psychotic disorders • Organic • Mood • Personality • Eating • Substance use • Other
England	Care pathways and packages clusters ²⁶	System based on HoNOS assessment of symptoms, proxies for certain diagnostic classes, as top-level splitter as follows: <ul style="list-style-type: none"> • Psychotic • Non-psychotic (excl organic) • Organic

Country	System	Aggregation
Germany	Andreas ²⁸	System based on ICD-10 groupings, using only first digit of admission diagnosis code only as top-level splitter as follows: <ul style="list-style-type: none"> • Eating • Somatic or substance use • Personality • Affective • Anxiety • Schizophrenia
New Zealand	NZ-CAOS ³	System based either on HoNOS assessment of symptoms, proxies for certain diagnostic classes, or direct diagnosis, as follows: <ul style="list-style-type: none"> • Psychotic v on-psychotic in top-level branch of adult completed inpatient episodes (HoNOS assessment) • Diagnosis not used for adult ongoing inpatient episodes • [Schizophrenia/Paranoia/Acute Psychotic, Eating, Organic and Disorders of Psychological Development] v [Disorders of Childhood and Adolescence/Mood Disorders] v [all other disorders] top level splitter for completed child and adolescent episodes. • Psychotic v Non-psychotic in second-level branch of child and adolescent (age 13-17) community episodes (HoNOS assessment)
The Netherlands	DBCs (see Note 1) ⁵	Diagnosis (system not apparent from review) used as top-level splitter for 14 of the 19 DBC classes
The Netherlands	ZZPs (see Note 1) ⁵	Diagnosis not used
USA (Medicare)	IPF PPS ⁷	MS-DRGs used as top component of combined classification and funding model, but one MS-DRG accounts for almost three quarters of all separations
USA	(Drozd et al ¹⁹) - 696 Medicare Patients	System based DSM-IV categories, or category groups, as top-level splitter as follows <ul style="list-style-type: none"> • Schizophrenia • Organic • Mood • Substance use • Other
USA (New York State)	(Gahan ⁶) Medicaid inpatient funding	APR-DRGs used as top component of combined classification and funding model, as follows: <ul style="list-style-type: none"> • Schizophrenia (30% of episodes, 41% of days) • Bipolar Disorders (22% of cases, 21% of days) • Major Depressive Disorders & Other/Unspecified Psychoses (21% of cases, 18% of days) • Depression Except Major Depressive Disorder (10% of cases, 6% of days) • Childhood Behavioral Disorders (5% of cases, 6% of days) • Adjustment Disorders & Neuroses (3% of cases, 1% of days) • [All other] (9% of cases, 6% of days)
USA (Veterans Health Administ'n)	PsyCMS ⁴ (System for MH care, incl AOD, in all settings, specialised and non-specialised)	System based ICD-9-CM groups, or group aggregates, as the only splitter.

Note 1: Refer to Table 7, Mason and Goddard (2009)⁵

Table 4: Overview of aggregations of severity/functioning/disability/comorbidity measures used in mental health casemix classifications

Country	System	Severity/functioning/disability/comorbidity measures
Australia	MH-CASC ² (for specialised MH care in all settings, excl MH residential)	Selected items or aggregates from all clinician-rated instruments that now form part of NOCC suite of measures used at various levels
Australia	UoW (Green) ⁸ modified DRGs (for inpatient care in non-specialised MH units only)	Not used
Australia	Vic (Legge) ²⁷ modified DRGs (for inpatient care in specialised_MH units)	Not used
Canada (Ontario)	SCIPP ¹⁷ (for inpatient care in specialised_MH units)	System based on the RAI-MH assessment of functioning, severity and disability, used at various levels
England	Care pathways and packages clusters ²⁶	System based on the <i>Mental Health Clustering Tool</i> (MHCT) (standard HoNOS plus 5 extra items) assessment of functioning, severity and disability, used at various levels
Germany	Andreas ²⁸	Selected items or aggregate score from HoNOS, clinician-rated quality of life (SF-8), interpersonal problems (IIP) and comorbidity from ICD-10 codes, used at lower levels
New Zealand	NZ-CAOS ³	Selected items or aggregates from all clinician-rated instruments that in Australia now form part of NOCC suite of measures used at various levels
The Netherlands	DBC's (see Note 1) ⁵	Not used
The Netherlands	ZZPs (see Note 1) ⁵	Psychosocial/cognitive functioning, social skills, mobility, ADLs, behavioural problems all assessed (not clear how) and used throughout classification
USA (Medicare)	IPF PPS ⁷	Medical comorbidity (ICD-9-CM) record used as a loading in the funding model
USA	(Drozd et al ¹⁹) - 696 Medicare Patients	Behavioural, severity and comorbidity information derived from medical record variously used to subdivide 4 of the 5 diagnostic groups that form the top-level classes: <ul style="list-style-type: none"> • Safety risk (suicidality, aggressivity, self-neglect and elopement risk) • Severity (five-digit DSM-IV codes with "severe," "profound," or "pervasive" qualifiers) • Medical comorbidity • ADL deficits
USA (New York State)	(Gahan ⁶) Medicaid inpatient funding	Severity measured according to the 4 severity of illness (SOI) classes that are part of the APR-DRG (3M™) system. Comorbidity (ICD-9-CM) record also included as loading in funding model
USA (Veterans Health Administ'n)	PsyCMS ⁴ (System for MH care, incl AOD, in all settings, specialised and non-specialised)	Only diagnosis used in this system

Note 1: Refer to Table 7, Mason and Goddard (2009)⁵

Table 5: Overview of aggregations of age used in mental health casemix classifications

Country	System	Setting	children	adolescents	working age adults		older adults	
Australia	MH-CASC ²	Inpatient	Age not used		18(?) -33	34-64	65-85	>85
		Non inpatient	<6	6-12	13-17(?)	>17(?)		
Australia	UoW (Green) ⁸ modified DRGs	Inpatient (non-specialised)	Age not used					
Australia	Vic (Legge) ²⁷ modified DRGs	Inpatient	excluded from study	13-17	18-49	50-64	>65	
Canada (Ontario)	SCIPP ¹⁷	Inpatient	excluded from study		Age not used			
England	Care pathways and packages clusters ²⁶	Cross-setting	excluded from study		Age not used			
Germany	Andreas ²⁸	Inpatient	Children probably not included but this not stated	Not clear if adolescents included	<29	>28	Only 4% of sample was people >65	
New Zealand	NZ-CAOS ³	Inpatient	14(?) -17(?)		18(?) -64		65-74	>74
		Non inpatient	<14	14-17	18-20	21-71	>71	
The Netherlands	DBC's (see Note 1) ⁵	Inpatient	Age not used					
The Netherlands	ZZP's (see Note 1) ⁵	Non-inpatient	Age not used					
USA (Medicare)	IPF PPS ⁷	Inpatient	Relatively few children and adolescents in Medicare		<45	45-64 (4 5y age bands)	65-79 (3 5y age bands)	>79
USA	(Drozd et al ¹⁹) - 696 Medicare Patients	Inpatient	Relatively few children and adolescents in Medicare		<65		>64	
USA (New York State)	(Gahan ⁶) Medicaid inpatient funding	Inpatient	<18		>17		Very few older adults in Medicaid	
USA (Veterans Health Administ'n)	PsyCMS ⁴	All settings	Not stated but assumed no veterans <18		Age not used			

Note 1: Refer to Table 7, Mason and Goddard (2009)⁵

3.3.3 Issues in interpreting findings from the casemix studies

One of the difficulties with analysing these papers is that while most of them detail the study procedures that were adopted, information on the underlying reasoning as to why particular splitting variables were used in preference to others is often harder to discern.

For example in both the NZ-CAOS and MH-CASC studies, it would have been helpful to have had some discussion around school attendance as a splitting variable for community episodes for children under 13 years of age but not for high school students below school leaving age where school refusal may be more common. In the NZ-CAOS classification of adult completed inpatient episodes, a discussion of why HoNOS item 6 (hallucinations and delusions) was used in preference to a diagnosis of a psychotic disorder (schizophrenia and related disorders plus affective disorders with psychotic symptoms) with which it is presumably closely associated. In the case of MH-CASC, having found that the hypothesised clinical groups developed by the clinical expert panel for adult completed inpatient episodes did not perform particularly well (untrimmed RIV=6.4%, trimmed RIV 11.6%), there is little discussion as to why it was then decided to develop an entirely different classification (untrimmed RIV 8.7%, trimmed RIV 16.3%) rather than endeavouring to refine the clinical panel's classes, with the prospect of an even better result. This question is particularly pertinent now, since an aggregated version of the hypothesized clinical groups could well resemble the 'clusters' now used for mental health PbR in England.

The authors of the SCIPP model provide a little more explanation for some decisions, but the application of such reasoning is not necessarily consistently applied. For example, in explaining why ECT should not be used as a splitting variable despite its higher attendant costs, the authors state:

"The inclusion of service variables (i.e., measures of treatments or interventions provided to patients) often encourages gaming or unwarranted changes in clinical practice. These variables in a case-mix system can encourage the use of these interventions whether or not they are needed or appropriate for a given patient. For example, while one might expect that patients who receive electroconvulsive therapy (ECT) may be more expensive to care for than other patients (e.g., because of greater severity of depression), even the perception of some profitability associated with a higher reimbursement rate for ECT may inadvertently increase the use of that treatment".

The first limb of this argument, that including service variables might 'encourage gaming or unwarranted changes in clinical practice' ignores some important facts. Firstly, the entire structure of DRG systems worldwide rest upon using treatment regime as a key variable. Many hospital funding regimes would therefore fail if different treatment needs were not recognised. Secondly, service variables are much less amenable to 'gaming' than many of the variables actually used in the SCIPP model. For example, assessment of symptom and functioning are potentially much more prone to gaming as a means of earning higher income than are treatment regimes, especially ECT, which in most countries is subject to strict clinical and quasi-judicial monitoring.

The adoption of the IPF-PPS used by Medicare in the USA followed a long and contested process and is chronicled in a report to the US Congress in 2002, by the then Secretary of Health and Human Services.²⁹ However even as Medicare was preparing to introduce the IPF-PPS as it currently stands, it had funded research to examine the development of a casemix classification system that took account of a wider set of variables, particular patient characteristics in addition to diagnosis, comorbidity and age.^{19, 20} It is important to note, however, that both systems used per diem cost, not episode cost as the dependent variable. It is not entirely clear why the more cost reflective classification was not ultimately adopted, but it is understood to be a result of both legislated time constraints on implementing the new system and the fact that the variables in the more elaborate system (ADL deficits, dangerousness, detox and illness severity) were not in any of the routine datasets then (or now) in existence. Apart from the requirement to oblige providers to collect and

submit these additional data items, the latter constraint was compounded by the lack of national agreement on the necessary assessment methods.

Interestingly the alternative proposal rejected by the US Medicare administration bears some resemblance to the PbR clusters now used in the NHS. The NHS 'clustering' model is also included in Table 2, although unlike the other studies it was developed based on clinical intelligence and cluster analysis rather than on a detailed examination of service costs.

The largest study in the set examined treatment records for almost 1 million US war veterans, accessing both specialised and non-specialised services, across all treatment settings including psychosocial rehabilitation, and included both mental health and substance abuse disorders²⁶. The classification system proposed (PsyCMS) was developed with substantial clinical input and while it was quite good at predicting overall costs and utilisation for defined classes of patients over a one year period, the low R^2 values mean that it would need further development before it could be used as patient-level case payment system.

Chapter 4: Summary

4.1 Summary of results

4.1.1 Key messages

This review considered a range of studies that had a common goal of seeking to identify factors that affected treatment cost, intensity or duration, whether for defined episodes, or specified periods, for people accessing mental health services.

We profiled 33 studies reporting the results of explanatory analyses that aimed to identify significant predictors of mental health service costs or service utilisation. We counted the number of analyses in which various patient-related variables were investigated and then shown to be significant cost drivers. This exercise showed that:

- The most commonly identified patient-level cost drivers were:
 - *patient illness factors*: principal diagnosis/diagnostic cluster; functioning/disability; overall symptom severity; comorbidities; indicators of risk of harm to self or others, overall; and treatment history;
 - *patient characteristics*: socio-demographic factors overall; age; ethnicity/aboriginality; socio-economic factors overall; and employment status.

These factors, or groups of factors, were investigated in at least one-quarter of analyses, and found to be statistically significant predictors of outcome in at least one half of those.

- These patterns were broadly similar across the other outcome categories, although there were some variations, for example:
 - Amongst analyses examining inpatient outcomes only, legal status, aggressivity, ethnicity/aboriginality, and ECT administration were also commonly identified cost drivers in their own right, whereas treatment history, sex, and socio-economic factors overall were not.
 - Amongst analyses examining outcomes across multiple service settings, overall symptom severity and risk of harm to self or others were not commonly identified predictors.
- Principal diagnosis and patient age and sex were the most commonly *examined* factors, with diagnosis and age among the most commonly recognised patient-level cost-drivers. In most cases these factors also happen to be the most readily available and it is perhaps not surprising that they predominate in the literature.
- Treatment history was one of the more commonly investigated patient illness factors, however a range of variables was used for this purpose:
 - In some analyses, these measures could be interpreted as an indicator of whether the episode is the first time treatment (overall, or of a particular type, e.g., psychiatric inpatient admission) has been received. For example, proxy measures included prior lifetime psychiatric inpatient admissions as a dichotomous variable (Yes/No). Analyses using these variables did not tend to find a significant association between first time treatment and outcome.
 - The remainder of treatment history measures tended to be based on prior length or intensity of contact with services, or the number of psychiatric admissions and/or service contacts within a defined time period. Where analyses using these measures

reported a significant association between treatment history and outcome, it was consistently in a positive direction:

- Support for other patient characteristic variables was less consistent. There was good support for age, employment status, and ethnicity/aboriginality. In contrast, marital/partner status, accommodation/living status, and educational status were relatively frequently investigated but were less often found to be significant predictors of outcome. Level of family/carer support was investigated in relatively few analyses, but well supported among those. Having dependent children was investigated in only one study included in this review.
- Treatment factors were less commonly investigated, although this may to some extent reflect the criteria we used to include studies in this analysis. Of the studies that did investigate these factors, strongest support tended to be for treatment setting, ECT administration and treatment focus/stage of care, however the small number of included analyses makes it difficult to draw conclusions.

We then examined the statistical performance of the models described in the studies. We found that the most common way of analysing cost drivers was a regression analysis, and 23 of the papers reported the R^2 value, estimating the percentage of variance in costs (or proxy variables) explained by the model. Across the various analyses reported in these 23 papers, there was wide variability in the ability of the models examined to account for mental health service costs. Six papers reported maximum R^2 values of less than 25%, nine papers reported maximum R^2 values between 25-<50%, and eight papers reported maximum R^2 values of at least 50%.

The eight papers that reported at least one analysis where the model accounted for more than 50% of the variance in the outcome measure were examined in more detail. Overall, these analyses tended to include patient demographic and clinical factors, as well as treatment history, provider factors, and sometimes treatment factors. Despite a wide range of cost drivers being investigated, it was generally difficult to identify the variance explained by individual factors. Where the studies reported comparative analyses with different groups of cost drivers, the general pattern was that treatment history and provider factors tended to account for much more of the variance in costs than patient demographic or clinical characteristics.

We also profiled 13 casemix classifications with respect to the way the most commonly identified cost drivers have been aggregated for use in each classification. We found that:

- Most systems were designed around inpatient care. Only five (Payment by Results¹ [PbR, England], MH-CASC² [Australia], NZ-CAOS³ [New Zealand], PsyCMS⁴ [USA], and ZZPs⁵ [The Netherlands]) included non-inpatient care.
- The utility of Australian Refined Diagnosis Related Groups (AR-DRGs) is limited, since they are based only or mainly on principal diagnosis.
- A new set of mental health DRGs that includes age, ECT, legal status and improved comorbidity assignment may have utility, but would only be applicable to acute inpatients.
- The English PbR is an attractive model since it spans settings and providers, includes social care, and uses a single simple symptom/disability/comorbidity rating instrument. However:
 - The PbR clustering tool includes the original 12 Health of the National Outcome Sales (HoNOS) items plus several additional patient level measures (referred to as the “extended HoNOS”). Unfortunately, in Australia, we are limited in our capacity to model those clusters since the National Outcomes and Casemix Collection (NOCC) and other National Minimum Data Set (NMDS) materials do not provide direct mappings to the additional PbR purpose specific “extended HoNOS”.
 - Another significant issue is how the assignment to clusters aligns with “episodes of mental health care”.

- Although it may be worth exploring how the severity of illness classes used in the US All Patient Refined DRG⁶ (APR-DRG; 3M™) system are assigned, intellectual property rights may prevent this.
- A per diem or day-of-stay funding approach was used in all systems where the mental health classification was used for funding purposes (Medicare⁷ [USA], Medicaid⁶ [USA, New York State], PbR¹, DBCs⁵ [The Netherlands]).

4.1.2 Limitations in the available literature

As noted earlier in this report, previous reviews¹¹⁻¹³ have identified a number of deficits in the scope of the literature regarding cost drivers of mental health services, including a lack of studies focusing on children and older people, and limited ability to address potentially important predictors such as socio-economic characteristics; environmental factors; and factors such as levels of social cohesion largely due to the limited scope of administrative datasets. The current review also observed other limitations in the available literature:

- The majority of studies focussed on specialised mental health services. Within this common thread, there was considerable diversity among the studies in terms of sample size, sample selection, variables examined and analytical methods.
- The papers that have been revealed are focussed disproportionately on the costs of care in inpatient settings, and where they are focussed on outpatient and community settings, they are limited by the lack of a standard episode period, comparable to the individual inpatient admission characterising inpatient care
- A minority of studies examined costs across the range of possible treatment settings, and of those that did only one, MH-CASC², sought to develop a classification spanning an episode of illness treated in multiple settings. That particular study was unable to develop meaningful classes for such patients. The MH clusters developed for the English NHS do span treatment setting but the clustering was based on clinician assessment of treatment regimens of which cost in terms of staff time is inevitably part.
- Not all studies analysed each cost driver independently, and some (e.g., SCIPP) deliberately excluded using clinical interventions such as ECT as independent variables, it is difficult to assess the comparative performance of the various cost drivers studied. Moreover not all the papers assessed statistical performance and among those that did the different sample scope and methodologies make it difficult to scale the overall results using statistical performance criteria.
- The assessment of the impact of service and treatment variables, and their association with patient variables, is not well illuminated by the literature that has been uncovered.
- Other factors found in the published literature to be important cost-drivers include symptom severity, risk of harm to self or others, level of functioning/disability and treatment history. However unlike age and diagnosis all these other factors have more disparate measurement methods.

4.2 Strengths and limitations of this review

This report provides considers cost drivers of mental health services identified by studies conducted in Australia and other relevant parts of the world. However a number of caveats apply to the scope review of documents presented in this report:

- For reasons of feasibility, the search strategy was restricted to documents that specifically referred to cost. This means that papers undertaken to examine factors associated with

various measures of service utilisation (where cost was not mentioned) would not have been not included.

- The search strategy identified a number of potentially relevant documents from other countries which were not published in the English language. Where possible, attempts were made to apply translation tools to these documents, however this did not usually results in sufficient clarity for the purpose of this review and these documents could not be included.
- Similarly, the strategy identified a number of potentially relevant documents that could not be obtained within the time frame available to this review (for example, papers not held by UQ that would need to ordered from overseas sources). These documents could not be included.
- The scope of the review focused on published material, either from academic sources on web pages. We included unpublished works where these were known to us and permission could be obtained for their use. However we acknowledge that there may be other unpublished materials relevant to this review that we are not aware of.
- The review methodology relied on the assessment made in each individual paper as to the significance or otherwise of particular factors examined. We have made no assessment of the comparative statistical reliability of the findings each paper has reported.

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Appendix 1: Summary of previous reviews

Table A1: Summary of previous reviews investigating cost drivers and casemix classifications

	Review		
	Jones et al (2007)	Hermann (2007)	Mason (2011)
Purpose of review	To critically review the published, predictive studies of psychiatric service utilization and costs to: a) identify cost drivers, particularly those with a clinical relevance, and; b) discuss current methodological developments in this field.	To review risk-adjustment models in mental health and substance-related care, that control for patient characteristics on outcomes (including expenditures for health care services).	To identify international examples of activity-based funding systems for mental health care to inform the development of a national tariff in England.
Specific aim(s)/ research question(s)	Review cost prediction studies to identify predictors of psychiatric service utilization and costs and examine methodological approaches used.	Evaluate the current models of risk-adjustment in view of health service needs, i.e., what has been accomplished, where are the gaps, future directions?	Economically appraise the international literature on payment systems for mental healthcare service (and examine variations in cost between English mental healthcare providers using routine inpatient data on LOS in 2007/8)
Type of material reviewed	16 peer-reviewed journal articles sourced from four electronic databases - Medline, PsycINFO, EMBASE, EconLit.	36 peer-reviewed articles that included 74 models of expenditures, 72 models addressing utilization and 15 models of clinical outcomes. Sourced from search of Index Medicus and PsycLit for studies published 1980-2002.	120 papers published either in a peer-reviewed publication or as a policy document. Search undertaken on relevant electronic databases (Medline, Embase, HMIC, Econlit and PsycInfo), for articles published between 2006 and 2008. Web search for relevant policy documents.
Brief summary of inclusion criteria	Peer-reviewed publications containing original primary data from empirical studies conducted in mental health care settings across the lifespan. Papers must have a predictive component. Dual diagnosis (alcohol or drug abuse problems PLUS mental health diagnosis) was included, any non-mental health studies or alcohol/drug abuse without a mental health diagnosis was excluded.	Publications that evaluate one or more multivariate models used to risk-adjust comparisons of utilization, cost or clinical outcomes of mental and substance abuse conditions across providers and includes quantitative assessment of proportion of variance explained (e.g., R ² or c-statistic).	Research on methods for commissioning mental health services to identify country-scale attempts to develop activity-based funding system for mental health (whether or not subsequently adopted).
Language	English-language papers only.	Not specified.	English-language papers only.
Date of material reviewed	Search date range: 1969-2006. Of the 16 publications reviewed, date range: 1990-2005.	1980-2002.	2006-2008 publication date (though the actual development of the activity-based funding system did not have to occur in those years).

Review

	Jones et al (2007)	Hermann (2007)	Mason (2011)
Material extracted	For each included study, the following information was tabulated: country, sample size/characteristics, setting, cost-prediction method(s), % variation in costs explained, type of costs data, whether cross-validation conducted; and significant predictors of cost.	Data were extracted into a table where, for each dependent variable considered, information was obtained on the population studies, the independent variables considered, and the variance reported. Where possible, the information for each study was aggregated at the level of the independent variable.	Papers (peer reviewed and policy documents) contained data from 5 countries that had developed activity-based mental healthcare payment systems. For each country, information was compiled about the characteristics of each payment system, the results of the class-finding analysis, and the factors found to be cost-drivers.
Summary of key findings (cost drivers only)	Most consistently significant variables were: age (significant in 10 studies); diagnosis (9); gender (8); and the variables of previous psychiatric service utilization and previous psychiatric history (7, when considered together). Having a history of previous psychiatric service use is the most consistent predictor of higher psychiatric costs. Age, gender and diagnosis can have either positive or negative effects on costs. Diagnosis was predictive of higher psychiatric costs in six of the studies, with inconsistent findings for the other three studies. Diagnosis was not always found to be very significant statistically in all of the studies; explaining less than 1% of variance in 1 study. Other clinical factors, such as disease severity, are again not always found to be good predictors of higher costs. It is obvious some predictive factors remain unknown with variables explaining less than half the variance in most studies.	Models of utilization: DRGs account for between 3.2-15% of the variance in LoS, hospital type was also significant predictor, which could be serving as a proxy for patient severity. Disease staging and other demographic info also augmented DRG models, which yielded some improvement, but no models explained >15% variance. PSI groups explained 34-50% variance. Models of expenditure: Models using only administrative data (demographic and clinical) only account for an average 6.7% variance (none explained >10%). more detailed datasets on average 22.8%. SCIPP with >80 socio-demographic and clinical attributes, explained 26%. DCG-HCCs found to predict lower proportion of variance in SU conditions than non-MH/SU populations.	Australia: Casemix classification based on patient features only was found to be a weak driver of costs. Provider-level variation (i.e., differences in providers' treatment of similar patients) was stronger predictor of costs. New Zealand: 9 potential cost drivers assessed, included service attributes, patient attributes -personal and clinical (e.g., age, ethnicity, diagnosis (for paediatric inpatients only) and HoNOS) and other factors such as legal status. Results found that patient attributes do drive costs (e.g., ethnicity related to increased case complexity) but significant and apparently random variation between providers' episode costs not explained by patient/casemix drivers. USA: (Medicare Inpatient services only) The approach of per-diem payments (based on federal average routine cost of an inpatient day of psychiatric care) and the many adjustment factors (see notes) explain 85% cost variation. No empirical evaluation of individual cost drivers. Canada and Netherlands: currently have no empirical evaluations of cost drivers of activity-based funding.
Directions for future research	Authors drew attention to the scarcity of truly predictive studies and highlighted the need for more research into the area. Current studies do not explain large% of variance so future predictive studies need to broaden their scope in the exploration of potential predictive factors (e.g. socio-economic characteristics of people and the places where they live ; environmental factors ; and levels of social cohesion within neighbourhoods) - paucity of predictive studies that focus on children, older people and indirect costs. There was also a lack of consensus on the most accurate methodology.	Some US states used risk adjustment measures for mental health payment but without rigorous studies to measure variance explained- need for empirical evaluation. Need for development of minimum clinical data sets (data useful for assessing risk adjustment, with the aim of standardizing clinical data collected by physicians). Noted the lack of studies in children and the elderly. (NB. Doesn't specify what predictors minimum clinical data set includes).	Independent empirical evaluations for countries using activity based funding are needed. Identified need for mental health payment mechanisms to include appropriate adjustments for LOS.

	Review		
	Jones et al (2007)	Hermann (2007)	Mason (2011)
Explanatory Notes		MH/SU = mental health/substance abuse; PSI = Psychiatric Severity of Illness Index grouped patients into categories based on symptoms, complications, comorbidities, support networks and treatment response; DCG/HCC - diagnostic costing group/Hierarchical Coexisting Condition; DRG – Diagnosis Related Group; LoS – length of stay; SCIPP – The System for Classification of Inpatient Psychiatry.	Aus & NZ= inpatient and community. Canada (Ontario) = inpatient care only. Netherlands= dual insurance system: 1 system for acute/inpatient care, and another for community and long stay patients. US= Medicare inpatients only. Both Aus and NZ trialled new mental health classification systems, but did lead to implementation for payment purposes. The payment systems in Canada, the Netherlands and the US are newer and have no empirical evaluations. "Patient features" : clinical attributes, such as diagnosis, severity and functioning, 'focus of care' (i.e. the primary treatment objective such as functional gain or maintenance), legal status and other psychosocial factors. Provider-level variations : not formally identified - hypothesized by Mason et al to be due to differences in mental health policies regionally or in implementation of national policy, local resource availability, or clinician-level factors. cost adjustments in the USA Medicare Inpatients service : patient characteristics: e.g. age, diagnosis-related group (DRG), comorbidity, use of ECT and provider characteristics: e.g. rurality, teaching status, local wage rates, emergency department and cost-of-living adjustment. Canada: classification takes account of both clinical factors and resource use; initial casemix classification based on diagnosis, but weighted by LoS (by separating into 3 episode phases -admission, post-admission and long-stay), and patient characteristics. No empirical evaluation. Netherlands: In first system (acute inpatient<1 yr) providers assigned different fixed tariffs (based on Diagnostic Combination groups) for intervention and LoS. 2nd system (long term stay >1year, and non-medical care)= providers paid by classification of "care packages" (based on client profile , including DSM diagnosis and functioning, care hours and care setting characteristics) and each package assigned maximum tariff. No empirical evaluation of cost-drivers.

Appendix 2. Full search string for cost drivers literature review

The following search strings were used:

OVID – Medline, EMBASE, PsycINFO

1. (financing adj6 (mental health\$ or mental disorder\$ or mental illness\$)).ti,ab.
2. (financing adj6 behavio?ral health\$).ti,ab.
3. (financing adj6 (psychiatric or psychiatry)).ti,ab.
4. 1 or 2 or 3
5. (payment\$ adj6 (mental health\$ or mental disorder\$ or mental illness\$)).ti,ab.
6. (payment\$ adj6 behavio?ral health\$).ti,ab.
7. (payment\$ adj6 (psychiatric or psychiatry)).ti,ab.
8. 5 or 6 or 7
9. (funding adj6 (mental health\$ or mental disorder\$ or mental illness\$)).ti,ab.
10. (funding adj6 behavio?ral health\$).ti,ab.
11. (funding adj6 (psychiatric or psychiatry)).ti,ab.
12. 9 or 10 or 11
13. (cost? adj4 (service? or driver? or care or treatment? or episode? or unit? or intervention?) adj6 (mental health\$ or mental disorder\$ or mental illness\$)).ti,ab.
14. (cost? adj4 (service? or driver? or care or treatment? or episode? or unit? or intervention?) adj6 behavio?ral health\$).ti,ab.
15. (cost? adj4 (service? or driver? or care or treatment? or episode? or unit? or intervention?) adj6 (psychiatric or psychiatry)).ti,ab.
16. 13 or 14 or 15
17. ((casemix\$ or case-mix\$) adj6 (mental health\$ or mental disorder\$ or mental illness\$)).ti,ab.
18. ((casemix\$ or case-mix\$) adj6 behavio?ral health\$).ti,ab.
19. ((casemix\$ or case-mix\$) adj6 (psychiatric or psychiatry)).ti,ab.
20. 17 or 18 or 19
21. (risk-adjustment\$ adj6 (mental health\$ or mental disorder\$ or mental illness\$)).ti,ab.
22. (risk-adjustment\$ adj6 behavio?ral health\$).ti,ab.
23. (risk-adjustment\$ adj6 (psychiatric or psychiatry)).ti,ab.
24. 21 or 22 or 23
25. ((drg or diagnos\$-related group\$) adj6 (mental health\$ or mental disorder\$ or mental illness\$)).ti,ab.
26. ((drg or diagnos\$-related group\$) adj6 behavio?ral health\$).ti,ab.
27. ((drg or diagnos\$-related group\$) adj6 (psychiatric or psychiatry)).ti,ab.
28. 25 or 26 or 27
29. 4 or 8 or 12 or 16 or 20 or 24 or 28
30. limit 29 to yr="1995 -Current"
31. remove duplicates from 30

EBSCOhost - Econlit

1. AB (financing N6 ("mental health*" or "mental disorder*" or "mental illness*")) OR TI (financing N6 ("mental health*" or "mental disorder*" or "mental illness*"))
2. AB (financing N6 "behavio#ral health*") OR TI (financing N6 "behavio#ral health*")
3. AB (financing N6 (psychiatric or psychiatry)) OR TI (financing N6 (psychiatric or psychiatry))
4. S1 or S2 or S3

5. AB (payment* N6 ("mental health*" or "mental disorder*" or "mental illness*")) OR TI (payment* N6 ("mental health*" or "mental disorder*" or "mental illness*"))
6. AB (payment* N6 "behavioral health*") OR TI (payment* N6 "behavioral health*")
7. AB (payment* N6 (psychiatric or psychiatry)) OR TI (payment* N6 (psychiatric or psychiatry))
8. S5 or S6 or S7
9. AB (funding N6 ("mental health*" or "mental disorder*" or "mental illness*")) OR TI (funding N6 ("mental health*" or "mental disorder*" or "mental illness*"))
10. AB (funding N6 "behavioral health*") OR TI (funding N6 "behavioral health*")
11. AB (funding N6 (psychiatric or psychiatry)) OR TI (funding N6 (psychiatric or psychiatry))
12. S9 or S10 or S11
13. AB ((cost# N4 (service# or driver# or care or treatment# or episode# or unit# or intervention#)) N6 ("mental health*" or "mental disorder*" or "mental illness*")) OR TI ((cost# N4 (service# or driver# or care or treatment# or episode# or unit# or intervention#)) N6 ("mental health*" or "mental disorder*" or "mental illness*"))
14. AB ((cost# N4 (service# or driver# or care or treatment# or episode# or unit# or intervention#)) N6 "behavioral health*") OR TI ((cost# N4 (service# or driver# or care or treatment# or episode# or unit# or intervention#)) N6 "behavioral health*")
15. AB ((cost# N4 (service# or driver# or care or treatment# or episode# or unit# or intervention#)) N6 (psychiatric or psychiatry)) OR TI ((cost# N4 (service# or driver# or care or treatment# or episode# or unit# or intervention#)) N6 (psychiatric or psychiatry))
16. S13 or S14 or S15
17. AB ((casemix* or case-mix*) N6 ("mental health*" or "mental disorder*" or "mental illness*")) OR TI ((casemix* or case-mix*) N6 ("mental health*" or "mental disorder*" or "mental illness*"))
18. AB ((casemix* or case-mix*) N6 "behavioral health*") OR TI ((casemix* or case-mix*) N6 "behavioral health*")
19. AB ((casemix* or case-mix*) N6 (psychiatric or psychiatry)) OR TI ((casemix* or case-mix*) N6 (psychiatric or psychiatry))
20. S17 or S18 or S19
21. AB (risk-adjustment* N6 ("mental health*" or "mental disorder*" or "mental illness*")) OR TI (risk-adjustment* N6 ("mental health*" or "mental disorder*" or "mental illness*"))
22. AB (risk-adjustment* N6 "behavioral health*") OR TI (risk-adjustment* N6 "behavioral health*")
23. AB (risk-adjustment* N6 (psychiatric or psychiatry)) OR TI (risk-adjustment* N6 (psychiatric or psychiatry))
24. S21 or S22 or S23
25. AB ((drg# or "diagnos*-related group*") N6 ("mental health*" or "mental disorder*" or "mental illness*")) OR TI ((drg# or "diagnos*-related group*") N6 ("mental health*" or "mental disorder*" or "mental illness*"))
26. AB ((drg# or "diagnos*-related group*") N6 "behavioral health*") OR TI ((drg# or "diagnos*-related group*") N6 "behavioral health*")
27. AB ((drg# or "diagnos*-related group*") N6 (psychiatric or psychiatry)) OR TI ((drg# or "diagnos*-related group*") N6 (psychiatric or psychiatry))
28. S25 or S26 or S27
29. S4 or S8 or S12 or S16 or S20 or S24 or S28 (Limiters - Published Date from: 19950101-)

Appendix 3: Included studies – study descriptors

Table A3: Summary of included studies – study descriptors

Author/Year	Country/ region	Year of outcome data	Sample (including size)	Service setting	Type of study
Alimohamed-Janmohamed et al (2010) ³⁰	Santa Barbara, California, USA	2000-2002	2343 outpatients (50.5% female) aged 18+ years, who commenced treatment after 30/6/2000 - 1564 entered through Chemical Addiction (CA) system, 779 through Mental Health (MH). MH entry patients were on average older, more likely to be white and had more years of education than CA entry patients	outpatient services contracted by the County (public)	Explanatory
Amaddeo et al (2007) ³¹	Italy	2000	2962 patients aged 16-65+ years in 265 non-hospital residential facilities (RFs) from the PROGRES study (63% male; 68% schizophrenia; 88% unemployed; 75% on disability pension for mental disorder)	nonhospital RFs (includes group homes, supervised apartments, sheltered accommodation, intermediate facilities, wards in the community, board and-care homes, supervised hostels and hostels)	Explanatory
Andreas et al (2009) ²⁸	Germany	2003-2004	1,677 patients aged <29 to >65 years undergoing inpatient treatment in 11 psychotherapeutic hospitals (of the original 2386 patients invited to participate, 19% declined or exited prematurely)	Inpatient -specialised MH admitted patient care, adult sector	Explanatory, Case mix
Auffarth et al (2008) ³²	New Orleans, USA and Hannover, Germany	1996-2001	Hospitalised patients at single sites in the US (n=11,937) and Germany (n=5544) [age range not stated]	Inpatient units in teaching hospitals in Hanover and New Orleans	Descriptive
Baca-Garcia et al (2008) ³³	Madrid, Spain	2000-2004	4448 patients meeting criteria as being high or medium costs, drawn from a larger pool of 22,859 patients aged 18+ years receiving 365,262 consultations in a Madrid hospital catchment area	Multiple settings- 354304 outpatient consultations, 9132 ED visits, 1826 Psych hospitalisations	Explanatory
Bagalman et al (2011) ³⁴	USA	2004-2007	19,191 commercial health plan members aged 18-64 years with a diagnosis of BPAD-I (ICD-9) and one or more inpatient or outpatient medical claim and one or more prescription for antipsychotic or mood stabilising medication. Study compared 2 groups within the sample: patients with FPIs (defined as 2 or more clinically significant events [e.g. psychiatric hospitalization, ED visits, change in psychotropic medications] in a 1-year period) and patients without FPIs (0 or 1 clinically significant event in the 1-year period)	Inpatient or outpatient	Explanatory
Balkin (2006) ¹⁶	Mid-Southern	not stated	89 adolescents (52 females, 37 males) aged 12-18 years admitted to	Inpatient - "psychiatric acute care programs" –	Descriptive

Author/Year	Country/ region	Year of outcome data	Sample (including size)	Service setting	Type of study
	USA		"psychiatric acute care programs"	short-term (usually < 15 days) 24 hour supervised crisis intervention programs.	
Becker et al (2002) ³⁵	Florida, USA	1997-1998	4091 people aged 18-65+ years living in assisted living facilities (ALFs) with at least one Medicaid mental health service (MHS) claim during the 12 month period, and 63,692 MHS users not in ALFs	Residential - ALFs	Descriptive
Beecham et al (2003) ²²	United Kingdom (England and Wales)	2000	58 child and adolescent MH units	Inpatient - Child and adolescent units	Explanatory
Bonizzato et al (2000) ²⁵	South Verona, Italy	1996	339 adult patients (aged 14 to 65+ years) in contact with the South-Verona CMHS during the last quarter of 1996 who received an ICD-10 diagnosis and completed 3-month follow-up interview	Inpatient or outpatient - University-run CMHS	Explanatory
Boot et al (1997) ³⁶	Australia	1995 (assumed)	1359 consecutive overnight admissions [assume adults due to use of HoNOS]	Inpatient - General hospital, psychiatric and private hospital psychiatric units	Explanatory
Brown (2001) ³⁷	Maryland, USA	1998	Administrative discharge data on 30,121 adult (18+) psychiatric patients, who were further categorized as elderly (65+ years) and non-elderly (18-64 years)	Inpatient - Adult and elderly units in general hospitals	Descriptive
Buckingham et al (1998) ²	Australia	1996	18,002 consumers receiving 20,553 'episodes' of care (5449 acute inpatient; 1055 non-acute inpatient; and 14,049 community) over a three month period. Included services for children and adolescents, adults and older persons	Multiple settings - Public specialised MHSs (inpatient and non-inpatient) and specialised private hospital acute units	Explanatory, Case mix
Cotterill & Thomas (2004) ⁷	USA	1999	~18,000 inpatient discharges from MH inpatient facilities billed to Medicare from patients aged <12 to >76 years	Inpatient - Psychiatric hospitals and mental health units in general hospitals; Public and private	Explanatory, Case mix
Cromwell et al (2005) ²⁰	USA	2001-2002	696 patients; 4149 Medicare and 4667 non-Medicare patient days [age range not stated but includes people up to 75+ years]	Inpatient - 66 psychiatric units within 40 psychiatric facilities	Explanatory, Case mix
Dellario et al (1999) ³⁸	Baltimore County and Baltimore City, Maryland, USA	1997	322 persons who were participants in the community-based psychiatric rehabilitation programs of Alliance Inc.[age range not stated]	Community-based psychiatric rehabilitation services	Explanatory
Donisi et al (2011) ²³	Verona, Italy	2002-2003	4420 patients with an ICD-10 psychiatric diagnosis, who had ≥ 1 contact with community-based psychiatric services. Patients were further categorised into the following groups based on previous psychiatric history: First ever episode n=1647; Ongoing episode n=1551, New episode after 90-1095 days n=897, New episode after 1096 days n=325 [age range 14 to >65 years]	Multiple settings – any contact with community-based psychiatric services in Verona Health District (includes public, NGO, and private hospital, outpatient services, sheltered accommodation, but not private psychologists or psychiatrists)	Explanatory

Author/Year	Country/ region	Year of outcome data	Sample (including size)	Service setting	Type of study
Drozd et al (2006) ¹⁹	USA	2001-2002	696 patients, assembled over 7 days [includes services for adults and older persons]	Inpatient - 40 psychiatric facilities	Explanatory, Case mix
Drozd et al (2008) ³⁹	USA	2004	501,770 discharges with an IPF-PPS DRG [age range not stated]	Inpatient - Psychiatric hospitals and units	Explanatory
Fontanella (2008) ⁴⁰	Maryland, USA	1996-1998	522 adolescents aged 11-17.999 years enrolled in Medicaid and admitted to three inpatient psychiatric hospitals (index admission)	Inpatient - Adolescent admissions to three psychiatric hospitals (Medicaid reimbursed)	Explanatory
Forma et al (2009) ⁴¹	Pirkanmaa Hospital District, Finland	2003	25,738 visits by 10,265 patients. "Wide" definition of mental health including "positive mental health", mental disorders and drinking problems. Attempted to collect questionnaire from all presentations to municipal health providers [age range not stated]	Community-based primary social and health care services in a Finnish municipality (includes physicians, nurses, psychologists, social workers, physiotherapists, home care assistants, nursing students and clerical workers; outpatient)	Explanatory
Gaines et al (2003) ³	New Zealand (8 district health boards (Northland, Waitemata, Auckland, Counties-Manukau, Waikato, Lakes, Capital and Coast, Otago)	2003	19,239 episodes of care over six months provided to 12,576 individual consumers, included services for children and youth, adults and older persons. A restricted set of 16,665 completed episodes were used for class finding.	Inpatient and community MHSs (including shared care and consultation-liaison)	Explanatory, Case mix
Garattini et al (2004) ⁴²	Italy	1998-1999	643 patients aged ≤ 34 and ≥ 45 years attending a follow up consultation for schizophrenia or related disorders (schizoaffective, schizophreniform)	Multiple settings - 14 Italian community mental health centres (CMHCs)	Explanatory
Gilmer et al (2006) ⁴³	San Diego, California, USA	2003-2004	2616 patients aged 60+ years receiving community MHSs	Multiple settings - Publicly funded inpatient, rehabilitative, community, and outpatient MHSs	Explanatory
Glied & Neufeld (2001) ⁴⁴	USA	1996	6323 children aged 18 years and under in the MEPS sample, of which 267 (4.5%) had a mental health diagnosis at one or more medical encounter, 54 (0.8%) having a diagnosis of Depression and Manic Depression (DMD)	Multiple settings - Child and Adolescent inpatient, outpatient, community and other MH services.	Descriptive
Gray (1998) ²¹	Little Rock, Arkansas, USA	1995-1996	100 people aged 24-82 years with severe and persistent mental illness (SPMI)	Multiple settings – Case management at a community MHS (includes hospitalizations, outpatient and other services)	Explanatory

Author/Year	Country/ region	Year of outcome data	Sample (including size)	Service setting	Type of study
Green (2012) ⁸	Australia	2009-2010	61,558 episodes in NHCDC, with 3.5% excluded due to anomalous cost vs. LOS data [age range not stated]	Non-specialised MH inpatient settings	Explanatory, Case mix
Grigoletti et al (2010) ⁴⁵	Avellino, Rome, Verona, Bologna, and Legnano, Italy	2002	1250 patients in five Italian CMHCs, comprising the first 250 patients having contact with facilities at each site from Oct 1 2002 [age range not stated]	Multiple settings - CMHC services include acute psychiatric ward in general hospitals, out-patient department, a MH centre and sheltered apartments	Explanatory
Han et al (2011) ⁴⁶	USA	2004-2007	479 adults aged 65+ years with serious psychological distress recruited from a nationally representative survey of drug use and health in the civilian, non-institutionalized US population (N=9957)	Multiple settings – inpatient, outpatient and other MH services received by community dwelling population not in nursing homes or long term care	Explanatory
Hirdes et al (2003) ¹⁷	Ontario, Manitoba and Alberta, Canada	1999-2000	1,998 consumers aged 18 and over who were inpatients in one of 34 psychiatric hospitals [age range not stated, includes services for older persons]	Inpatient - Acute, forensic, long-stay and geriatric psychiatry admitted patients	Explanatory, Case mix
Hwang et al (2011) ⁴⁷	Toronto, Canada	2002-2007	Discharges from 90,345 housed and 3081 homeless patients (from 72,324 unique patients) aged 18+ years	Inpatient admissions to teaching hospital in Canada (including medical admissions)	Explanatory
Iglesias & Alonso Villa (2005) ⁴⁸	Asturias, Spain	not stated	163 patients (94 males and 64 females) aged 32 to 96 years	Long-term inpatients from one psychiatric hospital	Descriptive
Kilian et al (2002) ⁴⁹	Liepzig, Germany	1998-1999	254 patients 18-64 years with an ICD-10 F 20.0 diagnosis of schizophrenia (Scz) recruited from outpatient clinics, CMHCs and private practitioners, psychiatric hospitals, and psychiatric day hospitals	Multiple settings – Inpatient, outpatient and community based treatment from various service providers	Explanatory
Kisely et al (2000) ¹⁸	Perth, Australia	1996	All (N=2691) patients (47% Male, 53% Female) attending two specialised MHSs over the study period; part of the Mental Health Classification and Services Cost Project [age range not stated, average age 43.3 years]	Multiple settings - Public MHSs (inpatient and outpatient) in the south metropolitan area of Perth	Explanatory
Knapp et al (2002) ⁵⁰	Netherlands, Denmark, England, Spain, Italy	1996-2000 (dates identified from companion paper)	404 people in 5 cities in Europe. Only patients aged 18–65 years with schizophrenia (ICD-10 F20) research diagnosis were included. Individuals residing in prison, secure residential services or hostels for long-term patients and hospital in-patients continuously resident for more than 1 year were excluded	Multiple settings - Inpatient, outpatient and community	Explanatory
Lee et al (2012) ⁵¹	Pennsylvania,	2006	106 hospitals from which 45,497 adults aged 18-78 with Scz or major affective	Inpatient - Psychiatric and general acute care	Explanatory

Author/Year	Country/ region	Year of outcome data	Sample (including size)	Service setting	Type of study
	USA		disorder were discharged in 2006	hospitals in Pennsylvania (public and private payments)	
Legge (2011) ²⁷	Victoria, Australia	2008-2010	26,181 acute episodes excluding same day episodes, episodes with LOS>90 and episodes in designated highly specialised units (adult, older person and adolescent)	Public specialised MH acute inpatient settings	Explanatory, Case mix
McCracken et al (2006) ⁵²	Ireland, Finland, Norway, Spain, UK	1996-1999	427 people aged 18-65 years with a diagnosis of ICD-10 or DSM-IV depressive or adjustment disorders	Multiple settings - Primary/ generic healthcare, psychiatric care (community, inpatient and outpatient care), social care (public)	Explanatory
McCrone & Lorusso (1999) ⁵³	Camberwell, Southern London, UK & Pavia, Northern Italy	Italy: 1996; UK data out of scope (1992-1994)	308 inpatient episodes recorded for 179 patients from Pavia and 523 (169 patients) from Camberwell [age range not stated]	Inpatient (public)	Explanatory
Mihalopoulos et al (2005) ⁵⁴	Australia	1997	National Survey of Mental Health and Wellbeing - adults aged 18+ years who reported admission to hospital for MH condition and/or contact with MH professionals in the community	Multiple settings,-Inpatient, outpatient, community and other MH services (includes public and private)	Descriptive
Minsky et al (2011) ⁵⁵	New Jersey, USA	2006-2008	682 outpatients presenting for services who kept at least one appointment after intake phone interview [age range not stated]	Multiple settings - Community (CMHC) - public integrated behavioural healthcare service including outpatient, day hospital and inpatient services. (clients: 56% Medicaid/Medicare, 20% uninsured/self-pay)	Explanatory
Percudani et al (2004) ⁵⁶	Magenta and Abbiategrasso areas, Italy	1999	120 patients aged 21 to 51+ years utilising services from an Italian CMHC	Multiple settings - Inpatient, residential, CMHC (integrated public community MH)	Explanatory
Pertile et al (2011) ⁵⁷	Veneto region, Italy	2007	All hospital discharges with a psychiatric diagnosis (excluding day hospitalisation) N=8,789, from patients aged 15 to >84 years	Inpatient - 40 general hospital psychiatric units in 21 local health districts (public)	Explanatory
Robst (2009) ⁵⁸	Florida, USA	2003-2005	99,049 Medicaid patients aged 0-64 years in prepaid MH plans	Multiple settings - Inpatient, outpatient and community (public)	Explanatory
Rosenheck & Seibyl (1998) ⁵⁹	USA	1995	9108 homeless and domiciled veterans hospitalized in psychiatric and substance abuse (SA) units at Department of Veterans Affairs (VA) medical centres, nationwide (64% were discharged from general psychiatry programs,	Psychiatric inpatient units (VA)	Explanatory

Author/Year	Country/ region	Year of outcome data	Sample (including size)	Service setting	Type of study
			36% from SA programs) [age range 21 to >65 years]		
Rothbard et al (2005) ⁶⁰	Florida, Pennsylvania and Oregon, USA	1997	338 patients with SPMI enrolled in Medicaid in 3 states [age range not stated]	Multiple settings - Inpatient, outpatient and community (Medicaid reimbursed patient)	Explanatory
Salize et al (2009) ⁶¹	Granada (Spain), Groningen (Netherlands), London (UK), Lund (Sweden), Mannheim (Germany), Zurich (Switzerland), urban and mixed urban-rural areas	2003-2005	422 patients aged 18-65 years with Scz	Community psychiatric services	Explanatory
Seder (2011) ⁶²	USA	2007-2008	13,417 adult aged 18-89 years members of a managed behavioural healthcare company who went to at least one outpatient MH session and reported a significant level of psychological distress	Multiple settings- Behavioural healthcare service (outpatient, inpatient, residential, ED and other behavioural health care)	Explanatory
Simon et al (2006) ⁶³	Washington state, USA	1991-2004	1814 patients treated for depression (meeting DSM-IV criteria) over 3-4 months and then measured for service use in the subsequent 6 months (data from 9 longitudinal trials) [age range not stated]	Multiple settings - Any contact with MHSs paid for by health plan (antidepressant prescriptions, primary care visits, outpatient visits, inpatient visits, day of hospital stay, ED visits, diagnostic tests, other expenses)	Explanatory
Sloan et al (2006) ⁴	USA	1998-2000	914,225 veterans aged 18+ years using VA services in financial year 1999, who had an ICD-9-CM diagnosis of MH/SA	VA health system - inpatient and outpatient services (public integrated service provider)	Explanatory, Case mix
Stensland et al (2007) ⁶⁴	USA	2004	60,643 depression patients and 6072 BPAD patients (ICD-9-CM diagnoses) aged 18-64 years who are members of 1 of 6 US health plans	Inpatient or outpatient (health insurance covered healthcare)	Descriptive
Stensland et al (2012) ⁶⁵	USA	2006	261,996 hospitalizations with a primary psychiatric diagnosis and a 2006 discharge date from Premier's Perspective Comparative Database [age range not stated]	Inpatient - 418 community-based hospitals (excluding state-run psychiatric hospitals)	Descriptive

Author/Year	Country/ region	Year of outcome data	Sample (including size)	Service setting	Type of study
Wanchek et al (2011) ²⁴	Virginia, USA	2005-2008	11,107 Medicaid eligible individuals aged 18-64 years with ICD-9 diagnosis of mental illness and less than six months of hospitalization in the past year, of whom 6,324 had 'serious mental illness' (at least two ICD-9 diagnoses of Scz or affective disorders)	Multiple settings - Public CSBs in Virginia, falling into 1 of 3 types: operative, administrative policy, or policy-advisory (where provision of services remains the role of the government)	Explanatory
Warnke et al (2011) ⁶⁶	Zurich, Switzerland	2008-2009	2939 inpatient episodes (excluded admission >180 days or <5 days [age range not stated])	Inpatient - Public psychiatric university hospital	Explanatory
Watkins & Pincus (2011) ⁶⁷	USA	2007-2008	906,394 war veterans aged 18-65+ years with a MH or SU diagnosis	Multiple settings- Any VA funded treatment services	Descriptive
Williams et al (2011) ⁶⁸	Midwestern USA	2004-2007	Patients enrolled in a Midwestern health insurance plan comprising patients with BPAD (N=122); Depression (N=1,290); NB: other non-MH chronic disorders (asthma, diabetes etc.) also included for comparison purposes in this study [age range not stated]	Multiple settings - Midwestern, employer-sponsored, self-funded health plan serving approximately 80,000 enrollees in a defined geographic area with recommended providers (primary care and MH) and hospitals.	Descriptive
Wu C-H et al (2012) ⁶⁹	USA	2003-2007	3083 Medicaid patients 18-64 years of age, with an inpatient or outpatient diagnosis of MDD and who filled at least 1 newly prescribed antidepressant between January 1, 2004, and December 31, 2006	Inpatient and outpatient treatment settings, and prescription expenditures (public, Medicaid)	Explanatory
Zhu et al.(2008) ⁷⁰	Northeast, Southwest, Mid-Atlantic, and Western USA (6 study sites)	1997-2003	1557 people 18 years or older with DSM-IV diagnosis of Scz, schizoaffective, or schizophreniform disorder	Multiple settings - Any contact with MH settings (MH treatment centres, or systems including VA hospitals, CMHCs, community and state hospitals, university healthcare service systems)	Explanatory

Notes:

ALF – Assisted Living Facilities

BPAD – Bipolar Affective Disorder

BPAD-1 – Bipolar Affective Disorder Type 1

CA- Chemical Addiction

CMHC – Community Mental Health Centre

CMHS – Community Mental Health Service

CSB – Community Service Board

DMD – Depression and Manic Depression

DRG- Diagnosis Related Group

DSM – Diagnostic and Statistical Manual of Mental Disorders.

ED – Emergency Department
FPI – Frequency Psychiatric Intervention
HoNOS – Health of the Nation Outcome Scale
ICD – International Classification of Diseases (ICD-9 refers to version 9, ICD-10 to version 10)
IPF-PPS – Inpatient Psychiatric Facilities – Prospective Payment System
LOS – Length of Stay
MDD – Major Depressive Disorder
MEPS – Medical Expenditure Panel Survey
MH- Mental Health
MHS – Mental Health Services
NGO – Non-Government Organizations
NHCD – National Hospital Cost Data Collection
RF - Residential Facilities
SA – Substance Abuse
Scz – Schizophrenia
SU – Substance Use
SPMI – Severe and Persistent Mental Illness

Appendix 4: Included studies – analyses and results

Table A4: Summary of included studies – analyses and results

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
Alimohamed-Janmohamed et al (2010) ³⁰	GLM regression	(1) Total treatment cost (direct service costs only, patient out-of-pocket costs excluded) in a 2 year period (1 st July 2000 to June 30 th 2002)	Service factors: Point of entry (CA vs. MH services); Level of functional impairment (scale based on employment, education and homelessness); type of service (individual, group, rehabilitation therapy or medication) Amount of service (duration and number of contacts for each type of service); re-entry into the treatment system at a second, different point of entry); Patient factors: ethnicity; age, education, employment, gender, homelessness	Predictor of higher costs: middle aged patients (45-54> 55-64 >35-44 > 25-34 > 18-24. 65+ is n.s); female gender; fewer years of education (<12 years, c.f. 12 or more) unemployment; ethnicity is white (c.f. Hispanic, NS for other ethnicities); lower level of functional impairment; entry point through MH c.f. CA; second treatment re-entry point.	NS	P, C
		(2) Total minutes of treatment received	as above	Predictors of higher minutes of treatment: 55-64 age group (c.f. to all younger age groups),N.B 65+ age group is a predictor of fewer minutes of 18-24 age group (reference category)<12 years of education; unemployment; lower level of functional impairment; second treatment re-entry point.	NS	-
		(3) Total number of services received	as above	Predictors of more services received: age 25-64 (vs. 18-24); < 12 years of education; unemployment; ethnicity 'other' (c.f. white, other ethnicities NS); lower level of functional impairment; second treatment re-entry point.	NS	S
Amaddeo et al (2007) ³¹	Ordinary least squares regression	(1) Annual community psychiatric services (CPS) costs (including all contacts with day hospitals, day-centres or out-patient clinics outside the RF, all days spent in general hospital acute psychiatric wards, as well as the provision of medical and social services by psychiatrists,	Patient variables: age, marital status, self-aggressive behaviour, diagnosis, previous accommodations, previous history of psychiatric admission, GAF, LSP and HoNOS score. RF variables: location, facility type, size, presence of cases discussion meetings, management	Predictors of higher CPS costs: geographical location; from RF with more frequent case meetings; from RF managed by NHS (cf. private or voluntary, NGO, local board, other); facility having >14 beds; younger patients; affective disorder > Scz > other diagnosis; previous accommodation in an acute psychiatric ward; lower GAF score.	R ² =0.19	P, C

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
		nurses, psychologists, social workers and other psychiatric staff outside the RF) (2) Annual RF costs (based on costs of all days spent in an RF during the study year, on which basis annual costs were calculated)	as above	Predictors of higher RF costs: urban location (c.f. suburban or rural); geographical location; high-staffed RFs; more frequent case meetings; managed by NHS (cf. private or voluntary, NGO, local board); facility having > 14 beds; younger patients; affective disorder > Scz >; no history of psychiatric admission; accommodation in a psychiatric ward prior to admission (c.f. transferred from home); higher LSP score.	R ² =0.45	-
Andreas et al (2009) ²⁸	Development of case mix model using regression tree analysis	LOS (as cost proxy) per inpatient episode	37 attributes across the following categories: patient-rated clinical factors (symptom severity, medication, treatment history), patient socio-demographics, clinician-rated factors (diagnosis, symptom severity of symptoms, motivation for treatment, employment prospects)	17 case mix groups were developed. 9 of the 37 attributes were significant contributors to the model: Diagnosis at admission, age, illness duration, symptom severity (HoNOS-D), interpersonal problems, comorbidity, health-related quality of life (SF-8 mental health summary scale, self-assessment), current partner situation and current occupational status.	R ² =0.17	P, I, S
Auffarth et al (2008) ³²	t-tests comparing US and Germany LOS	LOS (days)	Diagnosis (Scz, BPAD or MDD)	Longer LOS by diagnosis: Scz: USA < Germany BPAD: USA < Germany MDD: USA < Germany	N/A	-
Baca-Garcia et al (2008) ³³	Multivariate logistic regression	Binary cost variable: "High cost" (total cost per patient higher than \$7263 in 2000 International Dollars) vs. "Medium cost".	Gender, age at first consultation, current employment status (including disability/no disability), marital status, education, living situation, disability, ICD-10 diagnosis	Predictors of being "high cost" are Male gender ; First contact with mental health services at age 0-14 years (c.f. older) ; Permanent disability (c.f. no disability); Actively working (c.f. not working); having any of the following ICD-10 diagnoses (c.f. not having the diagnosis)- Organic, including symptomatic, mental disorders; Mental and behavioural disorders due to psychoactive SU; Scz, schizotypal and delusional disorders; Behavioural syndromes associated with physiological disturbances and physical factors; External causes of morbidity and mortality; and Factors influencing health	NS	P, M, C

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
				status and contact with health services		
Bagalman et al (2011) ³⁴	GLM regression	(1) Psychiatric-related and all cause health care costs over a 12 month period	FPI status, adjusting for age, sex, geographic region, urbanicity, health plan with capitation, Charlson comorbidity index (CCI, measure of burden associated with chronic disease), mental and physical comorbidities, first observed medical class.	Costs significantly higher for FPI group (c.f. non-FPI group). N.B Significance of other variables not stated	NS	-
	GLM regression	(2) Hospitalisation over a 12 month period	as above	Factors associated with greater likelihood of hospitalisation: FPI group (c.f. non-FPI group); younger age; female sex; higher CCI; presence of depression, SA disorder and/or hypertension. Factors associated with lower likelihood of hospitalization: use of lithium, conventional antipsychotic, atypical antipsychotic and/or antidepressant	NS	P, I, S
	GLM regression	(3) Psychiatric-related ED visits over a 12 month period	as above	Factors associated with greater likelihood of ED visit: FPI group (c.f. non-FPI group); younger age; female sex; higher CCI; presence of depression, SA and/or anxiety disorder. Factors associated with lower likelihood: use of lithium or antidepressant	NS	-
Balkin (2006) ¹⁶	Chi-square	LOS	Insurance (Medicare/private insurance), diagnosis (mood disorders/disruptive behaviour disorders), ethnicity (Caucasian/minority)	Medicare patients had longer mean LOS than patients with private insurance Minority patients had longer mean LOS than Caucasians There was no significant difference with diagnosis.	N/A	-
Becker et al (2002) ³⁵	Chi-square	Average annual costs per MH service user for Medicaid funded services, not including medication costs, health maintenance organization (HMO) hospital and primary care costs, or out-of-pocket dollars.	ALF vs. not in ALF	Per-person costs for community MH, inpatient and targeted case management were all higher for ALF residents (c.f. non-ALF residents). Significance not tested.	N/A	-
Beecham et al (2003) ²²	Ordinary least-squares multiple regression	Estimated cost per in-patient day for child and adolescent psychiatric in-patient services. Includes activity and total cost (staffing costs, other revenue and overhead costs and capital costs)	Public management (NHS vs non-NHS); proportion of unit costs absorbed by salary costs; geographical location (London vs other UK location); number of day care places, number of therapy and other (non-bedroom)	Predictors of higher cost: management by NHS, higher proportion of therapy and other rooms per available bed, specialist services, located in London, presence of mood disorder, Scz or learning disability.	Equation 1 (service variables only) Adjusted R ² =0.46; Equation 2 (includes service and diagnosis)	P, I, C

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
		for a financial year	rooms available per bed, available beds, specialist unit (yes/no), diagnosis (presence of mood disorder, conduct disorder, Scz, eating disorder, self-harm, learning disability)	Predictors of lower cost: Higher absolute number of available beds, number of day care places	variables) adjusted R ² =0.55	
Bonizzato et al (2000) ²⁵	Weighted backward regression	Annual psychiatric direct care costs (inpatient (public and private), sheltered accommodation, day-patient, outpatient including ED, and community including home visits)	Demographics: gender, age, marital status, living condition, education level, employment status. Service utilization: psychiatric history (years), length of contact with CMHS. Clinical: diagnosis, GAF score, BPRS score and subscale scores, DAS score, CAN score	Predictors of higher cost: admission to hospital in the previous year; higher intensity and duration of CMHS contacts; unemployed; affective disorder; lower GAF score; younger age. Predictors of lower cost: unmarried; living with family. N.B. Scz not a significant predictor but associated with almost all variables in model	R ² =0.66	P, M, C
Boot et al (1997) ³⁶	Repeated measures MANOVAs & Cox regression	LOS	Type of hospital, HoNOS, age, gender, primary diagnosis and secondary diagnosis (diagnostic groups categorised into case-mix categories)	Model containing certain primary DRGs (eating and OCD, Scz, anxiety and Major affective disorders); admission to a private or psychiatric hospital and older age was significant predictor of longer LOS, (significance of individual variables not stated) Only five of the 12 HoNOS items further increased the predictability of LOS. HoNOS items assessing housing and locality, function and mood disturbance were associated with longer stay; while self-harm and aggression were predictive of shorter stay	NS	P, I, S
Brown (2001) ³⁷	Chi-square & t-test	1) Average inpatient cost [assume per episode], based on all 1998 Maryland inpatient admissions to general hospitals of adult patients with primary psychiatric diagnosis	Age category (elderly and non-elderly), type of disorder, insurance category (public, private or no insurance)	Average cost and LOS was longer for the elderly (65+) in the following diagnoses: All disorders, Scz, other psychotic disorders, BPAD, MDD, Other depressive disorders, Anxiety, Substance related disorders, all other disorders. Average cost and LOS was shorter for the elderly (c.f. non-elderly) in dementia and other organic disorders.	N/A	-
		2) Average LOS	As above	Average cost and LOS was longer in patients with public insurance (c.f private insurance or no insurance) The only exception was the disorder category "other organic disorders", where costs were highest for those with no insurance.	N/A	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
Buckingham et al (1998) ²	CART Development of case mix model	Total cost per episode	Diagnosis (ICD-10), legal status (voluntary/involuntary), symptom severity and functioning (HoNOS/HoNOSCA, RUG-ADL and RCI for patients 65+ or with chronic organic brain syndrome, LSP, CGAS for C&A services), focus of treatment, sex, age, Target population (child & adolescent v adult), staff time disposition,	42 groups (23 for inpatient and 19 for community) across three episode types: completed inpatient, ongoing inpatient (8 week period), and 8 week care period for non-inpatients (community) were developed. Completed inpatient episodes: Adult: 8 classes split on Age, Diagnosis, Legal Status, HoNOS Total and RUG-ADL Completed inpatient episodes: C&A: 3 classes split on Diagnosis and HoNOSCA item (Disruptive/Aggressive Behaviour) Ongoing inpatient episodes: Adult: 12 classes split on Age, Legal Status, Diagnosis and HoNOS item, (Aggression/Disruptive behaviour), RUG-ADL Community episodes: Adult: 10 classes split on Focus of Care, Legal Status, HoNOS Total and LSP total C&A: 9 classes split on Age, HoNOSCA Total, HoNOS item (School Problems), CGAS, and Psychosocial factors	NA	-
	Performance of case mix groups by Multivariate regression	as above	3 episode types – Completed inpatient episode (adult and C&A), Ongoing inpatient episode (adult) and Community episode (adult and C&A) – these 3 episode types encompass all (n=42) case mix groups	NA	Overall: 78% [RIV]of total variance (63% for inpatients and 15% for community) By episode type: Completed inpatient episodes: Adult: (8 classes) 16.3% RIV C&A: (3 classes) 14.5% RIV Ongoing inpatient episodes: Adult: (12 classes)19.1% RIV	P, I, C I, C I, C

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
					Community episodes: Adult: (10 classes) 12.7% RIV C&A: (9 classes) 18.8% RIV	C C
Cotterill & Thomas (2004) ⁷	Multivariate regression	(1) Cost per inpatient discharge	Service factors: Wage Index facility type, location, teaching status, bed occupancy. Consumer factors: patient age (>65/65+), comorbidities (17 groups), DRG (14 DRGs),	All factors measured	R ² =0.12	-
	Multivariate regression	(2) Cost per bed day	Service factors: Wage Index , facility type, location, facility size (MH beds), teaching status, bed occupancy. Consumer factors: LOS (4 bands), patient age (>65/65+), comorbidities (17 groups), DRG (14 DRGs),	All factors measured	R ² =0.31 (without including facility size), 0.47 (with facility size)	P, I, C
	Performance of case-mix model (degree of precision in the payment system)	3) cost-payment precision per day	NS	Payments are adjusted for wage index, rural location, teaching intensity, age, DRG, comorbidity and LOS, plus outlier payments of 2% of total payments	R ² =0.75	-
Cromwell et al (2005) ²⁰	Development of case mix groups using CART	See Drozd (2006)				-
	Performance of case mix model by Multivariate regression,	Routine cost = Intensity-adjusted per diem cost, based on patient and staff time spent of selected activities over 7 days.	Medical domain: patients categorised as "HiMed" based on nursing-intensive comorbid conditions (ICD-9-CM); Behavioural domain: safety risk (suicidal, assaultive, elopement, self-neglect), cognitive impairment, first admission status, commitment status; Diagnostic characteristics: 5 DSMV-IV diagnostic groups with indicators for severity and intensity of resource use (e.g. dual diagnosis of SU and psychiatric disorder; GAF scores); Treatment indicators including medications, detox, ECT; Other patient	16 case mix groups were examined. When individual patient routine cost included, 10 case mix groups were significant predictors of cost. Components of case mix groups were diagnosis, age, ECT, Detox, ADL, comorbid medical conditions, HiDanger (suicidal or combative), HiPsy (at least 1 severe psychiatric condition). The highest costs were associated with the group Scz with HiADL, Age>65 and HiMed. Lowest costs associated with Scz; Age <65 (LoADL; LoPsync or HiADL).	R ² ranges between 0.32 where variations in patient routine cost within facility is included in costs, and 0.57, in models where variations in routine patient cost are excluded)	P, I, C

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
Dellario et al (1999) ³⁸	Multiple linear regression	Average annualized cost of community-based psychiatric rehabilitation services (based on 1997 Medicaid data)	characteristics: age, gender, deficits in ADLs, history of falls; Facility factors: Medicare vs. non-Medicare payment, day of stay. Age; gender; history of alcohol and/or drug use; primary diagnosis (schizophrenia, bipolar, other); DSM-IV/Axis V diagnosis (level of functioning); presence of developmental disability; presence of physical impairments; marital status (single, married, divorced); race (Caucasian, African-American, other); number of dependents; size of family	Positive predictors: gender, being African-American; having a developmental disability; not having an Axis V diagnosis; not having Bipolar disorder.	R ² =0.22	P, C
Donisi et al (2011) ²³	Multilevel multiple regression	One year's total cost of direct care (includes inpatient care, sheltered accommodation, day-patient, outpatient inc. ED, and community care inc. social care).	Socio-demographic factors: including age, gender, marital status, living situation, education, employment; clinical including diagnosis (Scz vs. affective, neurotic and somatoform, and other); local socioeconomic characteristics: including SES and catchment area; previous psychiatric history: days spent in hospital in previous year, admissions in previous year, day contacts in previous year, outpatient contacts in previous year, community care contacts in previous year, sheltered accommodation contacts in previous year.	1) 5 models were developed based on psychiatric history groups: For all patients, predictors of higher costs: previous psychiatric history (i.e. higher use of inpatient and outpatient psychiatric service use in previous year), younger age, being unemployed, Scz diagnosis (vs. affective or neurotic/somatoform or other). Highest costs incurred in patients with Ongoing episode (c.f. other groups) For first-ever patients, predictors of higher costs: unemployment (vs. employment), Scz diagnosis (vs. affective or neurotic/somatoform or other). For ongoing episode patients, predictors of higher costs: all previous psychiatric history variables (i.e. ., higher use of inpatient and outpatient psychiatric service use in previous year), younger age, Scz (vs. other diagnosis only, NS for affective disorders and neurotic/somatoform disorders). For patients presenting with a new episode after 90-1095 days after remission: predictors of higher costs: higher number of inpatient days and admissions, higher number of day contacts, younger age, Scz diagnosis (vs. affective or neurotic/somatoform or other). For patients presenting with a new episode after >1096 days remission: predictors of higher costs:	All patients R ² =0.43 First-ever - R ² =0.68; Ongoing - R ² =0.56; New ep. 90-1095 days - R ² =0.12; New ep. 1096 days - R ² = 0.56	P, M, C -

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
			As above	Scz diagnosis (vs. affective or neurotic/somatoform or other). 2) 2 models were developed based on grouping of "psychosis" and "not- psychosis diagnoses": For patients with psychosis, predictors of high costs: Inpatient days, admissions, day contacts, outpatient contacts, community care contacts and sheltered accommodation contacts (all in previous year); female gender, occupational status of retired, student or housewife, voluntary (c.f. employed). For non-psychotic patients, predictors of higher costs: inpatient days, admissions, day contacts and outpatient contacts (all in previous year) only. Higher costs in Psychosis (c.f. non-psychosis diagnostic groups)	Psychosis group – R ² =0.50; Non-psychosis group - R ² =0.28	-
			As above	3) Hierarchical regression models were developed for all patients. Significant predictors were not stated.	Model 1: gender, age, living situation, occupational status, diagnosis had an R ² = 0.05. Model 2: Model 1 + previous psychiatric history R ² = 0.42. Model 3: Model 2 + SES index R ² =0.42.	-
Drozd et al (2006) ¹⁹	Development of case mix model (using CART), linear regression	Intensity-adjusted daily cost (i.e. average per diem cost per unit divided by patient-specific resource intensity)	Patient factors: Diagnostic characteristics including diagnostic groups by severity and intensity of resource use, GAF score, mania indicator, Physical/medical factors including complicating conditions, age, deficits in ADLs, history of falls; Behavioural factors including 4 indicators of safety risk suicidal, assaultive, likelihood of elopement and presence of self-neglect, observation/monitoring requirements, compliance, disruptiveness, cognitive impairment; Treatment indicators including medications, detox, ECT; Status indicators including gender, prior residence, commitment type (voluntary/involuntary). Facility factors: day of stay, weekend	16 case mix groups were constructed based on psychiatric diagnosis, age, illness severity, deficits in ADLs, detox, ECT use, dangerousness, medical comorbidity	R ² =0.40 due to patient factors included in case mix (a maximum R ² of 0.76 is possible when facility characteristics are included)	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
Drozd et al (2008) ³⁹	Development of alternative comorbidity adjusters for existing IPF-PPS payment model: Regression. Taylor linearization method assuming clustered un-stratified sample design	Natural log of per diem inpatient cost for psychiatric services	indicator, facility ownership, teaching status, size, urbanicity, area hospital wages, occupancy rate, Medicare disproportional share ratio. Facility factors including rural location, teaching status, occupancy. Indicators of age, LOS, ECT, DRG, psychiatric and medical comorbidities (17 IPF-PPS comorbidity adjusters and 16 alternative adjusters).	In models controlling for facility, LOS, age, ECT, DRG, plus relevant interactions, the inclusion of the alternative comorbidity adjusters (which applied to 35% of the sample) improved the predictive power of the models compared to the IPF-PPS adjusters (which applied to only 11% of the sample).	R ² =0.33 for model with alternative comorbidity adjusters (compared to 0.32 for IPF-PPS adjusters)	-
Fontanella (2008) ⁴⁰	Multivariate cox regression	Time to first readmission, ranges from 1-365 days (all cases are censored at 1 year). Dichotomous variable coded as 1 for any readmission during study period and 0 for no readmission	Age at index admission; race or ethnicity(Caucasian/not Caucasian); gender; clinical symptom severity (mild, moderate, severe); comorbidity: substance abuse (none or mild/ moderate or severe), mental retardation (yes/no); history of suicidality or violent behaviour (no history, history, or recent suicidal or violent behaviour); history of abuse; family characteristics: family risk index (scale based on history of: parental mental illness, parental alcohol or drug abuse, family violence, or severe family dysfunction); treatment characteristics (hospital provider, LOS, multiple prior hospitalizations, type of aftercare services within 30 days post discharge, involvement with multiple service systems, residence at discharge, history of medication non-compliance); healthcare system characteristics (sum of mental health providers per 10,000 adolescent population in the county of residence)	Predictors of readmission: age:(varies over time: older age increases risk at days 5-17 post discharge; younger age increases risk 17 days post-discharge onwards), female gender; neuropsychiatric disturbance, severe emotional disturbance; severe behavioural disturbance, mental retardation, hospital provider (reasons unknown); suicidality (varies over time: recent suicidal behaviour is a positive predictor up to day 53 post discharge, subsequently becomes a negative predictor of readmission); high family risk index, medication noncompliance, length of stay>18 days; lower level of aftercare (outpatient or day treatment, therapeutic foster care, therapeutic group home, no change in residence at discharge). NB: history of abuse was significant in earlier models, became NS when Health care system characteristics were incorporated into the model.	NS	P, I, S

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
Forma et al (2009) ⁴¹	Linear regression of log transformed time spent	(1) Total clinician/worker time spent on mental health or drinking problem (inpatient and outpatient)	Age, gender, GAF, homecare (yes/no), specialist health care (yes/no),	Predictors of higher log-time spent: younger age, female, poorer functioning (GAF), home care and psychiatric specialised care.	R ² =0.11	-
	OLS Linear regression of log transformed costs	(2) Costs of total clinician/worker time spent on mental health or drinking problem ((inpatient and outpatient; adjusted for overhead costs)	as above	Predictors of higher log-time spent: younger age, female, poorer functioning, home care and psychiatric specialised care.	R ² =0.06	P, M, C
	Negative binomial regression	(3) Total number of visits (inpatient and outpatient)	as above	Predictors of more visits: poorer GAF; home care.	R ² =0.50	S
Gaines et al (2003) ³	Development of case mix groups	Cost of an episode of care (period of contact between consumer and provider in a single treatment setting; ≤ 91 days)	Patient characteristics reported to Mental Health Information National Collection system (age, sex, ethnicity, diagnosis, socioeconomic, legal status, living arrangements); HoNOS/HoNOS 65+/HoNOSCA; LSP-16; RUG-ADL; CGAS; Focus of Care (FoC); Factors influencing Health status, Treatments and tests (pharmacy, ECT, imaging, pathology); Service type (inpatient, day program, community); treatment team type;	42 case mix groups were constructed: (20 for inpatient and 22 for community) Predictors of cost:		P, I, C
				Complete inpatient: adults: 12 complete classes split on age, certain HoNOS, FoC, legal status, ethnicity;		I, C
				Inpatient: Children and youth- 4 classes split on- diagnosis		I, C
				Ongoing inpatient: adult: 4 classes split on legal status and ethnicity		-
				Child and youth: 1 class		C
				Community: adult: 13 classes split on legal status, FoC, age and ethnicity		C
	Community: Child and youth: 9 classes split on age, certain HoNOSCA items.					
Performance of case mix model	As above	42 case mix groups (20 for inpatient and 22 for community)	NS	R ² =0.64 for total adult inpatient (complete and ongoing);	-	

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
					Complete inpatient (adult): R ² =0.15	
					Ongoing inpatient (adult): R ² =0.10	
					Child inpatient (complete and ongoing): R ² =0.57	
					Community overall (adult and children) R ² =0.16.	
					Adult community R ² =0.15	
					Youth community R ² =0.14	
Garattini et al (2004) ⁴²	Chi-square & Wilcoxon rank sum	Direct costs including inpatient, outpatient, day hospital, lab tests, medications and home visits in a 12 month period.	Diagnostic subgroup - Scz or related disorders (Schizoaffective, schizophreniform)	Significant differences between the two groups for total costs (Scz > related) and for the components of hospital admissions (day-hospital days), laboratory tests and drug therapy (related disorders > scz)	NS	-
Gilmer et al (2006) ⁴³	Multivariate generalized linear models	Total mental health service costs including inpatient/crisis residential, Psych emergency response team, Psych ED, outpatient and case management in a 12 month period.	Age bands and diagnosis, controlling for ethnicity and living situation	Total expenditure declined with age (From the graph this appears to be due to reduction in outpatient costs, however significance not stated). Total expenditure by diagnosis: Scz and BPAD >MDD> other psychotic>other depression/anxiety/SA (all significant at p<0.05) Emergency services increased with age (significance not stated). Older adults with Scz had the highest mean cost of case management and inpatient / crisis residential services. (significance not stated) Clients with BPAD had the highest mean cost associated with outpatient service use, whereas those with cognitive disorders had the least.(significance not stated)	NS	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
				NB: not all variables were reported		
Glied & Neufeld (2001) ⁴⁴	t-test	Total annual mental health costs	Diagnosis Depression and Manic Depression (DMD) vs. Other mental illness	Total costs and mental healthcare costs of children with DMD > other mental illness. Compared to all children with MH diagnosis, children with DMD spent greater percentage on inpatient services but smaller percentage on drug prescriptions (significance not tested)	N/A	-
Gray (1998) ²¹	Multiple linear regression and logistic regression	Total cost of mental health services in a 6 month period	Age, gender, ethnicity, marital status, educational status, vocational status, insurance, residential placement, involuntary treatment, diagnosis, SA, dangerous behaviour, SA, medication compliance, psychiatric hospitalisations, intensive psychiatric treatment, other mental health services	Greater time since last use of intensive services (hospitalization and 24 hour supervision) and longer LOS in stable residences and without 24-hour supervision predicted lower costs. Past psychiatric hospitalisation and LOS (in hospital) and more use of services were associated with greater costs.	Demographic, clinical and service/support factors, adjusted R ² = 0.57 Demographic factors only, adj. R ² =0.06 Clinical factors only, adj. R ² =0.05 Service/support factors only, adj. R ² =0.57	P, M, C
Green (2012) ⁸	Episode cost variance	Cost per separation	Diagnosis, LOS, ECT administration, current DRGs	Developed a set of DRGs for episodes for patients with a mental health diagnosis who are not managed in a specialist mental health unit. Proposed 7 DRGs including splits by LOS (same day vs. not), ECT administration, LOS for overnight episodes (short vs. long) and diagnosis (3 broad classes).	NS [Coefficients of variation for new classes substantially better than current DRGs]	P, I, C
Grigoletti et al (2010) ⁴⁵	Logistic regression (forward stepwise)	Binary indicator of service use over 6 months (low [\leq 26 outpatient contacts or \leq 52 psychotherapist contacts or \leq 7 days in hospital] vs. frequent [all others]).	Sex; age; marital status; living conditions; education; employment status; professional status; diagnosis; GAF; previous service contacts; previous psychiatric admissions; previous compulsory admissions; previous year's use of services.	Frequent service use predicted by male gender, living alone, Scz diagnosis, lower education level, lower GAF, higher no. of previous psychiatric admissions/day care contacts/outpatient visits, previous psychiatric contacts.	R ² ~0.37	P, M, S

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
Han et al (2011) ⁴⁶	Multivariate Logistic regression	Past year mental health service use in older adults with serious psychological distress	Age, gender, ethnicity, education, marital status, income, health insurance, depression, ED visits, self-rated health, number of medical conditions	Predictors of higher service user: Female gender; race is non-Hispanic white (Non-Hispanic black, Hispanic and non-Hispanic other all separately lower than non-Hispanic white); College educated (c.f. less than high school educated) (but large Confidence Intervals and significance not stated); Married (c.f. non-married); Medicaid plus Medicare (c.f. Medicare only), diagnosis of MDD (c.f. no MDD) With each incremental increase in the number of past-year general medical conditions, older adults were 1.3 times more likely to have received mental health services in the past year	NS	P, M, S
Hirdes et al (2003) ¹⁷	1) Multiple linear regression	Per-diem resource use	Provisional diagnosis, age, gender, GAF scores	NS	R ² =0.03	-
	2) Decision tree analysis	Per diem resource use	RAI-MH variables, including patient (e.g psychotic symptoms, aggression, suicidality), facility or service (e.g nursing procedures, non-nursing professional contact, and close/constant observation) variables.	NS	R ² =0.32 (patient variables only); R ² =0.33 (patient and some service variables included), R ² =0.38 (patient, service and a facility variable included)	-
	3) Development of Case mix algorithm for decision-tree analysis. The primary criterion for variable selection was statistical variance reduction.	Cost per diem (several day of stay bands) modulated by wide range of patient variables	47 groups based on 7 levels; initial split by provisional psychiatric diagnosis, further splits made by clinical variables (aggression, suicidality, psychotic/affective symptoms, extrapyramidal symptoms, disability, medical problems) or factors such as economic status and number of prior admissions.. Day of stay was used in a limited number of cases. ECT, restraint use, chemical restraint use, close observation, constant observation, nursing procedures, non-nursing staff involvement, therapeutic programs, physician visits, medication use, and GAF scores	symptom severity, depression rating scale, suicidality, unrealistic fears, insight, cognitive performance scale, functioning (ADL/IADL, symptoms of impairment), behaviour (aggressive/disturbed), danger to self/others, day of stay, diagnosis, forensic status, employment/economic status, prior admission history, history of abuse, other health problems. Many factors that were collected were excluded because they were seen to be service, rather than patient factors. The excluded factors were ECT, restraint use, chemical restraint use, close observation, constant observation, nursing procedures,	R ² =0.26	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
Hwang et al (2011) ⁴⁷	Linear regression	Total costs of hospital admission until discharge – includes direct costs of providing care and indirect costs such as administration and housekeeping but does not include physician salaries.	Homeless status, controlled for age, sex, LOS, resource intensity weight (ratio expressing case's expected use of hospital resources relative to an average hospitalization)	non-nursing staff involvement, therapeutic programs, physician visits, medication use, and GAF scores Higher cost of psychiatric admission for homeless patients (even after adjustment for LOS). NB not all variables reported.	NS	-
Iglesias & Alonso Villa (2005) ⁴⁸	Chi-square	Average per-day nursing staff time consumed per patient	RUG-T18 group, ADL, age and sex.	Generally, within each clinical category, staff time increased with level of ADL dependency. Hierarchically higher RUG-T18 categories show higher consumed time of care. Of the 9 RUG-T18 groups used in this study, only 3 showed acceptably low intragroup variability (CV < 50%) - Reduced Physical Function with mild disability, Reduced Physical Function with severe disability, and Clinically Complex with mild disability. NB: RUG-T18 groups not designed to be used in psychiatric settings.	N/A	-
Kilian et al (2002) ⁴⁹	3 different models: A linear OLS regression model with non-parametric standard errors, a log-transformed OLS model and a generalized linear model with a log-link and a gamma distribution	Annual mental health service costs (based on actual fees and charges paid by the German sickness funds) =sum of Psychiatric inpatient treatment, psychiatric day hospital treatment, sheltered accommodation, psychiatric outpatient treatment provided by outpatient clinics, community mental health centres, and office based psychiatrists, psychiatric medication prescribed in outpatient treatment, work rehabilitation, legal supervision, ambulant occupational therapy, and ambulant psychotherapy) measured using the Client Service Receipt Interview	Age, gender, employment status, living situation, education, having a partner, GAF, BPRS 4.0 (Brief Psychiatric Rating Scale for psychopathology) mean global score, met/unmet service needs, global Quality of life (short form of the WHO Quality of Life questionnaire)	All three methods found increased costs in patients with higher psychiatric symptoms (BPRS 4.0) and met psychiatric service needs. Only the log- transformed OLS model showed decreased cost with increased age (employment status approached significance), and only the GLM shows a decreased cost with the variables for being employed and having a partner.	All three models had R ² ~0.31	P, M, C
Kisely et al (2000) ¹⁸	Logistic regression,	(1) Length of treatment (short vs. long)	Sex, HoNOS; age; ICD-10 diagnosis; marital status (never, once or currently married);	Predictors of longer care: receiving pension; past history of inpatient care; schizophrenia;	NS	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
	adjusted for potential confounding factors	(2) 3-month cost per day (high vs. low)	As above	high LSP score. Predictors of shorter care: inpatient stay during episode; organic disorders, SU, personality or adjustment disorder.	NS	-
Knapp et al (2002) ⁵⁰	Multivariate OLS regression methods (log-normal transformed)	Mean annual service cost in UK pounds (or its natural logarithm)	Age, education level attained, gender, marital status, ethnic group, language, living situation, accommodation type, employment status, number of previous psychiatric admissions, years of contact with psychiatric services, GAF score, BPRS mean score, number of met needs and number of unmet needs (CAN-EU), average global wellbeing and average quality of life score (LQoLP-EU), global and average satisfaction scores (VSSS- EU).	Predictors of higher costs (controlled for site) Male gender, number of previous psychiatric hospital admissions, lower GAF, met needs (CAN-EU) Predictors of higher cost at each site: Amsterdam: white European ethnicity, employment status of not employed, living with others, higher BPRS mean score. Copenhagen: living with others, lower GAF score London: Language other than English, previous psychiatric admissions, met needs (CAN-EU) Santander: younger age, previous psychiatric admissions, met needs (CAN-EU) Verona: Male gender, previous admissions, lower GAF and met needs (CAN-EU)	No R ² reported for the model fitted to pooled site data. • Amsterdam R ² = 0.32 • Copenhagen R ² = 0.23 • London R ² = 0.32 • Santander R ² = 0.16 • Verona R ² = 0.08	P, M, C
Lee et al (2012) ⁵¹	Hierarchical linear modelling	Variations in hospital LOS	Hospital characteristics: patient case mix (age, gender, race, diagnosis, admission type, insurance status, readmission rate, % of patients with SMI), and organizational factors (hospital type, hospital size, psychiatric bed count, psychiatric discharges,	Predictors of increased LOS: community MH expenditure, hospital type (psychiatric > general acute), insurance status (Medicare > privately insured and uninsured), % of patients with SMI and readmission rates, decreasing % of the county MH budget	NS	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
			staffing levels, contract status with a HMO, psychiatric occupancy rate, and daily reimbursement). Regional and county MH program characteristics: community MH expenditures (dollar expenditures per 10000 population), % of the county MH budget spent on residential care, poverty rate and county size.	spent on residential care.		
Legge (2011) ²⁷	Episode LOS variance, with LOS as cost proxy	LOS per separation	Patient age, AR-DRG v6.0, ICD-10-Am diagnosis, legal status, client history, HoNOS, ECT administration, patient seclusion, hospital location (metro/rural).	Developed 31 classes split on legal status, +/- ECT, diagnosis, patient age	NS [RIV=24%]	P, I, S
McCracken et al (2006) ⁵²	Logistic regression	Six month use of psychiatric care services (including community MH teams, community MH nurses, psychiatrists, psychologists, inpatient and outpatient care, accident and emergency services and day hospitals). Six month use of psychotropic drugs analysed separately.	Age, gender, marital status and number of people able to provide support, SF-36 domain scores, number of life events, baseline BDI scores, country.	Lower likelihood of using psychiatric services associated with: country (Ireland > UK), and increased SF-36 social functioning and general health scores. Increased likelihood of using psychiatric services associated with: higher SF-36 MH and BDI scores. For psychotropic drugs, use increased with age, BDI score, gender (female > male), being in the category of having life events and lots of support. Drug use decreased with increases in SF-36 social function and general health perception scores.	NS	S
	Multiple linear regression	Standardised service costs based on the Unit Costs of Health and Social Care of services used in the last 6 months. Inclusive of primary, generic, psychiatric and social care services. Psychotropic drug costs derived from the British National Formulary were analysed separately.	As above.	Increased service costs associated with: country (Ireland > other countries due to more inpatient days), increasing MH scores, and being in the category of having both life events and lots of help. Reduced service costs associated with: increasing SF-36 general health score, increasing social function score, and living in the UK. Costs of psychotropic drug use increased with BDI score and marital status (being widowed associated with greater drug costs).	NS	P, M, C
McCrone & Lorusso (1999) ⁵³	Multiple linear regression	LOS	Diagnosis, age, gender.	The only significant predictor of higher LOS in the Italy sample was diagnosis of "Acute paranoid and psychotic reaction"	R ² = 0.04 (Italy data)	-
Mihalopoulos	Descriptive	Estimated costs of service - MH	Diagnosis.	Admissions costs	N/A	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
et al (2005) ⁵⁴		admissions; MH community contacts; and total costs		<p>Anxiety only < SU disorders only < Anxiety and affective disorders < Anxiety, affective and SU disorders < Affective only < Affective and SU disorders < Anxiety and SU disorders</p> <p>Community Costs SU disorders only < Anxiety only < Affective only < Affective and SU disorders < Anxiety and SU disorders < Anxiety and affective disorders < Anxiety, affective and SU disorders</p> <p>Total Costs SU disorders only < Anxiety only < Affective only < anxiety and SU disorders < Anxiety and affective disorders < Affective and SU disorders < Anxiety, affective and SU disorders</p>		
Minsky et al (2011) ⁵⁵	Multiple regression	(1) Number of MH services used, including outpatient visits, partial hospital days, and inpatient days over a 12 month period	Number of physical symptoms on the PHQ-15: ≥3 vs. <3; or ≥6 vs. <6. Covariates: gender, age, language, diagnosis.	After adjusting for covariates, higher service use was associated with the presence of ≥3 physical symptoms vs. <3, and ≥6 physical symptoms vs. <6 (stronger effect).	NS	-
		(2) Cost of MH services (estimates derived by multiplying units of service used by an estimated average cost for each service type) over a 12 month period	Number of physical symptoms on the PHQ-15: ≥3 vs. <3; or ≥6 vs. <6. Covariates: gender, age, language, diagnosis, program type (inpatient and partial hospitalization vs. outpatient).	<p>After adjusting for covariates, higher costs were associated with the presence of ≥3 physical symptoms vs. <3; and ≥6 physical symptoms vs. <6 (stronger effect).</p> <p>NB: variance for covariates not reported separately</p>	NS	-
Percudani et al (2004) ⁵⁶	Mann-Whitney & Kruskal-Wallis tests	Average monthly service costs (including costs of inpatient and outpatient community psychiatric services, drugs, general practitioner services, emergency services and out-of-pocket expenses)	Gender, age, accommodation, employment status, diagnosis, length of illness, care-giver status, length of education.	Greater service costs associated with diagnosis (Scz > other diagnoses), length of illness (> 10 years > 10 years or less), and employment status (not employed > employed).	NA	-
	Multiple linear regression analysis using a non-parametric	3 month service costs (including costs of inpatient and outpatient community psychiatric services, drugs, general practitioner services, emergency services and out-of-pocket expenses).	As above.	Greater service costs associated with employment status (not employed > employed).	NS	P, M, C

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
	bootstrapping method					
Pertile et al (2011) ⁵⁷	Hierarchical multiple regression on log-transformed LOS	LOS	(1) Individual: age, gender, DRG, health district, severity of hospitalization (planned, urgent, or compulsory admission); (2) District level: staff endowment in MH department, population structure by age and marital status, number of outpatient contacts in area.	Full model including individual and district variables: Longer stay: (1) Females > males, 25-44, 45-64 and 65-74 yrs > 15-24 yrs, psychosis > all other diagnostic groups, compulsory admission > planned, admitted to hospital in district of residence (yes > no). (2) Psychiatric unit with more psychiatrists and/or occupational therapists; more outpatient contacts per 1000 residents; more divorced people in population. Shorter stay: (2) Psychiatric unit with more psychologists and/or nurses and/or social workers; more single people in population.	Full model R ² =0.20; DRGs alone R ² = 0.15	P, I, S
Robst (2009) ⁵⁸	Multivariate regression	Cost-predictive risk scores for prepaid MH plans, based on enrolled patient characteristics	Age, gender, race, Medicaid eligibility criterion, ICD-9-CM diagnosis cluster.	All factors in model predicted expenditure (younger age groups (c.f older age), ethnicity "black" and "other" (c.f "white"), males (c.f. females) eligibility due to supplemental security income and foster care (c.f. aid to families with dependent children). N.B. many diagnostic clusters had expenditure coefficients that were not significantly different from each other. Scz, episodic mood disorders, personality disorders and eating disorders were among the highest expenditure diagnostic groups.	NS	P, M, C
Rosenheck & Seibyl (1998) ⁵⁹	Analysis of variance	(1) 12 month inpatient and outpatient MH service use (LOS, inpatient days, outpatient contacts, readmission rates)	Residential status (homeless vs. living with family vs. domiciled vs. in transition vs. unknown). Other variables adjusted for: age, gender, race, marital status, income, VA compensation, diagnosis, dual diagnosis, medical diagnosis.	Among veterans discharged from general psychiatry programs, literally homeless veterans had greater psychiatric inpatient days and readmission rates than domiciled veterans.	N/A	-
	Analysis of covariance	(2) Cost (determined by multiplying the units of service by the average national cost of each service)	As above.	Adjusting for differences in income, socio-demographic and diagnostic characteristics, homelessness in general psychiatry programs was associated with higher annual	N/A	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
				costs (literally homeless >staying with family or domiciled). NB: no other variables were reported		
Rothbard et al (2005) ⁶⁰	OLS regression	Total cost incurred during 6 month period following initial outpatient interview. Costs calculated for inpatient hospital stays, partial hospitalization, outpatient therapy, medication management and case management.	Age, gender, race, site, diagnosis, severity, medication switch, prior inpatient use, prior outpatient use, medication type.	For atypical only and atypical/ typical combination groups costs were > typical only. Controlling for demographic and clinical variables, medication group continued to predict higher expenditure. Other predictors of higher cost included psychosis diagnosis, prior inpatient use and prior outpatient use. African American race was associated with lower costs (< Caucasian).	R ² = 0.35 (hierarchical modelling: demographics only 0.11, + severity 0.13, + utilisation 0.22, + medication switch variables 0.35)	P, M, C
Salize et al (2009) ⁶¹	GLM (gamma distribution)	(1) Total cost of care: weighting all service contacts during 12 month follow-up with country- or centre-specific unit-cost estimates, which were derived from national data sources.	Age, gender, marital status, living situation, main income source, diagnosis, length of illness, number of hospital admission, PANSS scale scores, treatment adherence, allocation to experimental group, location, quality of life, satisfaction with treatment, and unmet need.	Total costs decreased with older age, and main source of income (self-earned salary). Total costs increased with living situation (sheltered accommodation), treatment compliance, and negative symptoms (PANSS).	NS	P, M, C
	Linear regression (log-normal model)	(2) As above.	As above.	Total costs decreased with: older age and main source of income (self-earned salary). Total costs increased with living situation (sheltered accommodation) and negative symptoms (PANSS).	NS	-
Seder (2011) ⁶²	Multiple regression	(1) Four month outpatient treatment cost	SU risk, age, gender, MH and medical comorbidity status, diagnosis.	Greater outpatient service cost: increased SU risk, younger age, gender (unspecified), medical comorbidity, adjustment disorder, anxiety disorder, eating disorder, mood disorder, Scz.	Adjusted R ² =.03	-
		(2) Four month facility/other treatment cost - inpatient, residential, ED	As above.	Greater facility/other service cost: increased SU risk adjustment disorder, anxiety disorder, Scz.	Adjusted R ² =.01	P, M, C
		(3) Four month outpatient treatment utilization	As above.	Greater outpatient service utilisation: increased SU risk, younger age, gender (unspecified), medical comorbidity, anxiety disorder, mood disorder, Scz.	Adjusted R ² =.02	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
		(4) Four month facility/other treatment utilization - inpatient, residential, ED	As above.	Greater facility/other service utilisation: increased SU risk, medical comorbidity, Scz. Less service utilisation: adjustment disorder, anxiety disorder, mood disorder.	Adjusted R ² =.01	S
Simon et al (2006) ⁶³	GLM using a log link	(1) Health service costs (per unit, 2003 \$US) to health funds over 6 months following 3-4 months of acute-phase treatment. Unit=antidepressant prescriptions, primary care visits, outpatient visits, inpatient visits, day of hospital stay, emergency room visits, diagnostic tests, other 'non-depression' expenses	Depression Remission status (DSM-IV criteria) after treatment (divided into 3 groups: full remission, improved but not in remission i.e., partial remission, and not improved i.e., persistent depression). The cost for each group was adjusted for age, sex, baseline depression severity, costs incurred in prior 6 months before study enrolment, RxRisk score, year of treatment.	Significantly lower costs found between all outcome groups, with remission < partial remission < persistent depression N.B no other variables were reported	NS	-
	Descriptive (means)	(2) Utilisation of health services over 6 months following 3-4 months of acute-phase treatment. Services included primary care visits, specialty visits, emergency/ urgent care visits, inpatient visits. Values expressed as means (number of visits or inpatient days)	As above.	In general, mean utilisation rates were lower for patients with more favourable clinical outcomes (i.e. remission).	N/A	-
Sloan et al (2006) ⁴	Development of case mix model	MH/SA total per diem costs – concurrent & prospective, outpatient encounters – concurrent & prospective, and inpatient residential days – concurrent & prospective,	Age, gender, diagnostic information (ICD-9-CM), including primary and secondary diagnoses, but excluding ancillary (e.g. laboratory) services.	"PsyCMS" categories (46-category diagnostic classification system, organised by hierarchy reflecting severity and specificity of diagnosis) including 20 age/gender categories,	N/A	
	Assessing performance of case mix model using Weighted least squares regression	(1) MH/SA total per diem costs - concurrent	As above	Psychotic disorders > mood disorders or SU disorders > anxiety disorder (except PTSD); more severe conditions > less severe or specific conditions.	R ² =0.11	-
		(2) MH/SA outpatient encounters - concurrent	As above.	Outpatient/inpatient utilisation showed similar patterns to costs although some diagnostic groups showed particular intensity	R ² =0.22	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
				of use, e.g., opioid disorders, PTSD had higher outpatient use.		-
		(3) MH/SA Inpatient/residential bed days - concurrent	As above.	Outpatient/inpatient utilisation showed similar patterns to costs although some diagnostic groups showed particular intensity of use, e.g., homeless and jobless categories had higher inpatient use.	R ² =0.13	-
		(4) MH/SA total per diem costs - prospective (1 year)	As above.	Psychotic disorders > mood disorders or SU disorders > anxiety disorder (except PTSD); more severe conditions > less severe or specific conditions.	R ² =0.06	-
		(5) MH/SA outpatient encounters - prospective (1 year)	As above.	Outpatient/inpatient utilisation showed similar patterns to costs although some diagnostic groups showed particular intensity of use, e.g., opioid disorders, PTSD had higher outpatient use.	R ² =0.07	-
		(6) MH/SA Inpatient/residential bed days - prospective (1 year)	As above.	Outpatient/inpatient utilisation showed similar patterns to costs although some diagnostic groups showed particular intensity of use, e.g., homeless and jobless categories had higher inpatient use.	R ² =0.05	-
Stensland et al (2007) ⁶⁴	2-sample t test and chi-squared test and Wilcoxon rank-sum test.	Mean direct per-patient costs paid by health plan (mean psychiatric hospital days, psychiatric and medical emergency room visits, medication and psychiatric office visits).in a 12 month period	Diagnosis (ICD-9-CM) of BPAD or depression.	Mean total direct cost associated with BPAD was significantly > costs associated with depression, with higher costs mainly coming from psychiatric hospitalization and medication costs.	N/A	-
Stensland et al (2012) ⁶⁵	Means and 95% confidence intervals, weighted to be nationally representative	(1) Cost to provide care (each hospital's estimate of expenses incurred to provide services, including pro-rated fixed costs of maintaining facilities and variable per-patient care costs). In a 12 month period	Payer: Medicare, Medicaid, private insurance, uninsured, and other (worker's comp., charity, other government payers, and other). Primary psychiatric diagnosis (ICD-9-CM): Scz, BPAD, depression, alcohol use, or drug use.	The average cost to deliver care was highest for Medicare and Medicaid, then private insurance, and lowest for the uninsured. Diagnosis in order of highest to lowest cost: Scz, BPAD, depression, alcohol use disorder, drug use disorder.	N/A	-
		(2) LOS	As above	Data on LOS followed the same pattern as cost (above), suggesting that costs were	N/A	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
Wanchek et al (2011) ²⁴	Multiple linear regression	(1) Annual number of outpatient visits	Average outpatient visits in region, current procedural terminology codes, crisis intervention service index, per capita clients, type of CSB (operative, administrative policy, or policy-advisory), CSB budget per capita, per capita income, population density, gender, race, age, ICD-9 diagnosis code, days in community, cost of inpatient care (/ \$100).	largely driven by LOS. Predictors of receiving outpatient care: positive correlation with male gender, white race, diagnosis of Scz or affective disorders, and greater availability of services. Subsample also found positive correlation with age.	Outpatient services: Full sample R ² =0.39; Subsample with SMI R ² =0.54	-
		(2) LOS (days hospitalized)	As above.	Predictors of hospitalization: positive correlation with male gender, younger age, diagnosis of Scz or affective disorders. Negative correlation with receipt of outpatient services, cost of inpatient care (/ \$100).	Hospitalisation: Full sample, R ² =.13; Subsample with SMI, R ² =.20	P, I, S
Warnke et al (2011) ⁶⁶	Multivariable regression analyses	LOS	Psychopathology at admission (AMDP system - syndromes and symptoms), psychosocial functioning (GAF), illness severity (CGIS), SU disorder diagnosis, personality disorder diagnosis, treatment variables at discharge (crisis intervention, psychotherapy, integrated psychiatric treatment, social interventions, acute care, specialised care, long-term care, care due to substance disorders, compulsory treatment), gender, marital status, living situation, employment status, way of referral, legal basis of admission, previous admission, health insurance status.	Predictors of longer LOS (Models 5-8) psychopathological syndromes or symptoms, severity of illness and psychotherapy. Predictors of shorter LOS: Crisis intervention, acute care, substance abuse, compulsory admission and diagnosis of personality disorder	R ² =0.25	P, I, S
Watkins & Pincus (2011) ⁶⁷	Utilisation profile	Total 1 year treatment costs (not further defined)	Diagnosis, including MH (Scz, BPAD, PTSD and MDD), SU disorder, and co-occurring MH and SU disorder.	Across MH/SU diagnostic categories, the majority of healthcare costs were attributable to non-MH/SU services. Scz had the highest total costs, followed by co-occurring SU disorder, BPAD, SU disorder, MDD and PTSD.	N/A	-
Williams et al (2011) ⁶⁸	GLM using a gamma distribution	Unit of service paid for by the health plan (including both plan and enrollee component) to capture the costs	Diagnosis. Also included gender and co-morbidities.	Diagnosis: BPAD lead to greater costs than depression for inpatient and outpatient psychiatric costs, pharmacy costs.	NS	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
	and a log link. Adjusted for age, sex, co-morbidities	utilizing the Berenson– Eggers Type of Service classification system used by Medicare. Unit = an outpatient visit, prescription, inpatient day. Total costs were adjusted for age and co-morbidities.		Depression resulted in greater costs than BPAD for primary care utilization and non-psychiatric inpatient admissions. Top 20% (by cost) of the BPAD group accounted for 64% of total costs of speciality care. This group was more likely to be female, with more co-morbidities, hospital admissions and hospital days (compared with remaining 80%).		
Wu et al (2012) ⁶⁹	Multivariable regression analyses	(1) Health care costs for 12 month period following identification as a new antidepressant prescription user - included patients' inpatient, outpatient, and prescription expenditures during the study period.	Age, gender, race (white or African-American), co-morbid anxiety, interaction effects (race x comorbid anxiety), type of the health plan, (FFS or capitation payment health coverage), co-morbid painful symptoms, the total number of prescriptions used during the pre-index period, hospitalization during the pre-index period (any vs none), and ED visits during the pre-index period (any vs none), medication adherence and number of co-morbid conditions other than MDD or anxiety.	Increased costs associated with: gender (male > female), type of health plan (FFS > capitation), race (African American > Caucasian), co-morbid anxiety (yes > no), older age (41-50 > 18-30), number of co-morbid conditions (≥ 3 > 0), pre-study hospitalisation (yes > no), pre-study ED visit (yes > no), medication adherence (adherent > non-adherent). Costs decreased with the number of pre-study prescriptions used.	NS	P, M, C
		(2) 12 month MH related health care utilisation – office visits (ever vs. none)	As above.	Odds of having a MH related office visit increased with: race (Caucasian > African American), comorbid anxiety disorders (yes > no), younger age (18-30 > 41-50 and 51-60), gender (female > male), comorbid painful symptoms (yes > no), number of co-morbid conditions (≥ 3 > 0), and type of health plan (FFS > capitation)	NS	-
		(3) 12 month MH related health care utilisation – office visits (at least one)	As above.	Expected number of MH related office visits increased with: race (Caucasian > African American), comorbid anxiety disorders (yes > no), older age (41-50 > 18-30), gender (female > male), comorbid painful symptoms (yes > no), number of co-morbid conditions (1, 2 and ≥ 3 > 0 conditions) and type of health plan (FFS > capitation), number of pre-study prescriptions used and medication adherence (adherent > non-adherent).	NS	-
		(4) 12 month MH related health care	As above.	Odds of visiting the ED increased with: race	NS	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
		utilisation – ED visits (ever vs. none)		(African American > Caucasian), co-morbid anxiety disorders (yes > no), gender (male > female), co-morbid painful symptoms (yes > no), number of co-morbid conditions (2 and $\geq 3 > 0$), pre-study ED visit (yes > no) and medication adherence (adherent > non-adherent). Odds decreased with the number of pre-study prescriptions used.		
		(5) 12 month MH related health care utilisation – ED visits (at least one)	As above.	Expected number of ED visits increased with: co-morbid painful symptoms (yes > no), number of co-morbid conditions (2 and $\geq 3 > 0$), pre-study hospitalisation (yes > no), pre-study ED visit (yes > no).	NS	-
		(6) 12 month MH related health care utilisation – hospitalisation (ever vs. none)	As above.	Odds of hospitalisation increased with: race (African American > Caucasian), co-morbid anxiety disorders (yes > no), younger age (18-30 > 51-60), gender (male > female), number of co-morbid conditions ($\geq 3 > 0$), pre-study hospitalisation (yes > no), pre-study ED visit (yes > no) and medication adherence (adherent > non-adherent). Odds decreased with the number of pre-study prescriptions used. Interaction effect between race and comorbid anxiety disorder leads to a statistically significant reduced risk of African Americans with comorbid anxiety being hospitalized than would be expected when the two variables (race and comorbid anxiety) are considered separately.]	NS	I, S
		(7) 12 month MH related health care utilisation – hospitalisation (at least one)	As above.	Expected number of hospitalisations increased with: number of co-morbid conditions ($\geq 3 > 0$) and pre-study hospitalisation (yes > no).	NS	-
Zhu et al.(2008) ⁷⁰	Propensity score-adjusted bootstrapping method to analyse cost differences between event	Total annual direct costs=sum of medication costs, costs of psychiatric hospitalization and costs of other MH services (including emergency services, day treatment, outpatient medication management by a physician, individual outpatient	5 categories of recent crisis events: suicide attempt in the past 4 weeks, psychiatric hospitalization in the past 6 months, arrest in the past 6 months, violent behaviours in the past 4 weeks, co-occurring SU disorder.	For each category of event (except co-occurring SU disorder), costs were higher for patients who experienced the event, compared to propensity-matched samples of persons who did not. Rank of costs for crisis groups: persons who attempted suicide > psychiatric hospitalization in the past 6	N/A	-

Author/Year	Type of analysis	Outcome variable(s) (including time dimension)	Potential predictors examined	Significant predictors/cost drivers	Variance explained	Outcome category
	groups	therapy, outpatient psychosocial group interventions, and case management)		months > persons with prior arrests > persons with violent behaviours.		

Notes:

Outcome category: P – ‘primary’ analysis from all eligible studies; I – inpatient; M – multiple settings; C – cost; S – service utilisation.

Abbreviations:

ADL – Activities of Daily Living

ALF – Assisted Living Facilities

AMDP - “Arbeitsgemeinschaft für Methodik und Dokumentation in der Psychiatrie”

AR-DRG – Australian Refined Diagnosis Related Groups

BDI – Beck Depression Inventory

BPAD – Bipolar Affective Disorder

BPRS – Brief Psychiatric Rating Scale

CA – Chemical Addiction

CAN-EU – Camberwell Assessment of Need

CART - Classification and Regression Trees

CCI – Charlson Comorbidity Index

CGIS – Clinical Global Impressions Scale

CGAS – Children’s Global Assessment Scale

CPS – Community Psychiatric Services

CSB – Community Service Board

CV - Coefficient of variation

DAS – Disability Assessment Scale DRG – Diagnosis Related Group

ECT – Electroconvulsive therapy

ED – Emergency Department

FFS – Fee for service

FOC – Focus of Care

FPI – Frequent Psychiatric Interventions

GAF – Global Assessment of Functioning

GLM – Generalized Linear Models

HMO – Health Maintenance Organization

HoNOS – Health of Nation Outcome Scale

ICD – International Classification of Diseases (ICD-9 refers to version 9, ICD-10 to version 10, ICD-10-AM refers to the Australian Modification)

IED – Intermittent Explosive Disorder

IPF-PPS - Inpatient psychiatric facility prospective payment system

LOS – Length of Stay
LQoLP-EU – Lancashire Quality of Life Profile
LSP – life skills profile
MDD – Major Depressive Disorder
MH – Mental Health
N/A – not applicable
NHS – National Health Service
NS – not stated
OLS – ordinary least squares
PsyCMS - "psychiatric case mix system"
PANSS – Positive and Negative Symptom Scale
PHQ-15 – 15 – item Patient Health Questionnaire
PTSD – Post-Traumatic Stress Disorder
RF – Residential Facility
RUG-ADL - Resource Utilization Groups – Activities of Daily Living Scale
RUG T-18 - Resource Utilization Groups T-18. Classifies patients into one of 20 mutually exclusive groups determined by five clinical complexity categories and four personal autonomy/ADL items.
SA – Substance Abuse
SES – Socioeconomic status
SMI – severe mental illness
SU – Substance Use
Scz – Schizophrenia
SF-8 – 8-Item short form General Health Survey
SF-36 – 36-Item Short Form General Health Survey
SMI – Serious Mental Illness
VSSS-EU – Verona Service Satisfaction Scale