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A SYSTEMATIC REVIEW OF THE PREDICTORS OF HEALTH SERVICE UTILISATION BY ADULTS WITH MENTAL DISORDERS IN THE UK

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Author Contributions

CT, AC and DSB conceived the paper. CT and AC designed the paper and undertook analysis and interpretation of data. CT drafted the paper. MH and DSB inputted into the literature search process. All authors critically reviewed the paper and suggested revisions. All authors gave final approval for the paper for submission.

Abstract

Background

In developing a 'payment by results' health financing system, it is important to make evidence-based decisions about which variables are important for resource allocation purposes. In this regard, important variables are those predictive of health service utilisation (HSU). This is because resources are allocated towards categorical 'mental health clusters' of patients with distinct HSU patterns, which are derived from a range of 'case-mix' variables (e.g. diagnosis, age).

Aims

To identify variables which predict HSU by adults with mental disorders in the UK, and to determine the evidence level for these predictors.

Method

A systematic review of peer-reviewed published studies.

Results

Taking into account study quality, 28 studies identified a range of variables with good preliminary evidence supporting their ability to predict HSU. Of these variables, comorbidity, personality disorder, age (heterogeneous age ranges), neurotic symptoms, female gender, a marital status of divorced, separated or widowed, non-white ethnicity, medication, high previous HSU, and activities of daily living were associated with increased HSU. Moreover, good preliminary evidence was found for associations of accessing a primary care psychological treatment service and medication use with decreased HSU.

Conclusions

These variables can inform decisions about which variables might be used to derive mental health clusters in payment by results systems in the UK. The findings support the need to investigate whether combining broad diagnoses with care pathways is an effective method for mental health clustering, and the need for research to further examine the association between mental health clusters and HSU

Declaration of interest

None.

Strengths and limitations of the study

- The review was limited to UK studies only, meaning the list of identified variables is not exhaustive and the findings may not be applicable to services in other countries.
- There was wide heterogeneity in the operationalisation of HSU by included studies, which limits the validity of comparisons across studies. Addressing this issue, the operationalisation of HSU in included studies was documented in considerable detail (Table 3).
- The study benefits from its use of structured checklists for assessments of study quality.
- The majority of literature searching was undertaken by one study author. However, in order to minimise bias and error, 20% of abstracts were independently screened by another author.

Introduction

Many stakeholders with differing needs are involved in the delivery of public health services. Patients seek the best obtainable care, providers aim to deliver optimal care but also strive for self-regulation and autonomy, and policy-makers need to balance meeting high public demand with controlling health service expenditure.[1] To meet these differing needs, fair and efficient health service payment systems are required. Contemporary, 'activity-based' payment systems aim to achieve this fairness and efficiency by financially incentivising competing providers to treat more patients, cut costs, and reduce waiting list times.[2]

In typical activity-based payment systems, resources are allocated towards distinct patient 'clusters' (or groups). These clusters are comprised of patients with similar clinical characteristics and expected health service utilisation (HSU) patterns.[3] Each patient treated by a health service provider is assigned to a specific cluster based on collected information about a range of 'case-mix' variables (e.g. diagnosis, comorbidity, age) which are associated with HSU.[4] Thereafter, health service providers receive a fixed payment based on the cluster each patient is allocated to, with clusters with higher expected HSU generating higher payments than those with lower expected HSU.[5] Paying providers fixed payments based on 'clustering' of treated patients allows policy-makers to distribute resources in a systematic and equitable manner.[3]

In recent years, there have been ongoing efforts by the National Health Service (NHS) in England to develop (a potential UK-wide) activity-based payment system for its mental health services, in what is referred to as *Mental Health Payment by Results*. Initially, the system will cover secondary care services with various service types excluded (e.g. those relating to primary care psychotherapy, acquired brain injury, and autism).[6] A subject of much debate in this development surrounds how to define 'mental health clusters' for use in this system. In contrast to typical activity-based payment systems, diagnostic information has so far not been used to define these clusters. Instead, clusters have been defined using the newly-developed *Mental Health Clustering Tool* (MHCT). The MHCT assesses the domains of behaviour, symptoms, impairment, social functioning, and risk factors, and is used to assign patients to one of 21 clusters, falling under one of three broad 'super-classes' (non-psychotic, psychotic and organic).[7]

One of the main reasons for not using diagnostic information for clustering in *Mental Health Payment by Results* was that mental disorder diagnosis was shown to be a poor predictor of HSU in studies involving national and multi-site trial datasets.[8-11] On the other hand, it has been argued that although mental disorder diagnosis alone is not sufficient for clustering purposes, information about broad diagnoses and care pathways can be combined, in a simple and practical manner, to form reliable clusters with homogenous resource patterns.[12] Moreover, the MHCT has also been criticised because its development did not take HSU and costs into account,[13] and there currently exists very little evidence for the ability of the MHCT to predict HSU in patient populations.

In the context of the ongoing development of *Mental Health Payment by Results*, and the debate surrounding the use of diagnostic information and the MHCT, it is important to provide evidence that can inform decisions about which variables might be used to derive mental health clusters. To date, no UK-based systematic reviews informing this process have been undertaken. A review of relevant studies set in the UK would address UK-specific HSU patterns, increasing the applicability of findings to the *Mental Health Payment by Results*

system. Therefore, the general objective of this systematic review is to identify variables with sufficient evidence supporting their ability to predict HSU. The review has two specific aims. First, to identify the variables examined in relation to the prediction of HSU by adults with mental disorders in the UK. Second, to determine the level of evidence that exists for identified predictors of this HSU.

Method

Inclusion and exclusion criteria

Only the following types of studies were included in the review: (1) studies that predicted HSU by adults with mental disorders. (For the purposes of this review, mental disorders included adults experiencing elevated symptoms of mental disorders, or adults formally diagnosed with a mental disorder. Intellectual disability was not classed as a mental disorder); (2) studies based in the UK, with UK participants; (3) peer-reviewed studies published in scientific journals, in the year 2000 or after. (This cut-off point was chosen so that included studies were approximately in line with the overall *Payment by Results* scheme introduced in 2003. Intervention costing studies which did not predict HSU were excluded).

Literature search

Based on these criteria, the first author searched four databases: *PsycINFO, CINAHL Plus with full text, MEDLINE,* and *EMBASE.* Additional records were identified from hand-searching reference lists of included studies. Search terms and database subject headings related to HSU (i.e. health care utilisation [subject heading] OR health care utili* OR health service utili* OR health care use OR health service use) were combined with those terms for mental disorders (i.e. Mental disorders [subject heading] OR psychiatric) and the UK location (i.e. UK [subject heading] OR NHS). Due to the differing search procedures deployed by the four databases, slightly altered versions of this search strategy were used in each database. Independent screening of 20% of abstracts was undertaken by the third author. When the first author and third author disagreed regarding the screening outcome of an abstract, the abstract was included in screening at 'full-text' level (by the first author).

Data extraction

Data from included studies were extracted using an Excel spreadsheet. Extracted data pertained to basic study description, study design, records source, data collection times, participants, mental disorder investigated, operationalization of HSU outcomes, the prediction of HSU, and statistics. In addition, each study was assessed for quality using the STROBE statement[14] (for observational studies) and the National Institute for Health and Clinical Excellent (NICE) checklist for Randomized Controlled Trials (RCTs).[15] The former is a checklist of 22 items related to the reporting of title (one item), introduction (two items), methods (nine items), results (five items), discussion (four items), and funding information (one item).[14] The latter assesses bias in RCTs in four sections- selection bias, performance bias, attrition bias, and detection bias.[15]

RESULTS

Literature search flow

The literature search flow is displayed in Figure 1. In total, 1,364 records were identified. Database-searching yielded 1,347 records and hand-searching yielded 17 additional records. After duplicates were removed, 928 studies were screened at 'abstract' level. For screening of abstracts, there was a 94.1% agreement rate between the first author and the third author. After abstract screening, 133 studies were assessed for eligibility at 'full-text' level. 28 studies were included in the final review.

INSERT FIGURE 1 HERE

Overview of included studies

To provide an overview of included studies, extracted data were summarised in two tables (Tables 1 and 2). Table 1 summarises observational studies of HSU, and Table 2 summarises studies of interventions (of both observational and experimental design) aiming to reduce HSU. As can be seen in both tables, the data source of included studies varied. Most frequently it included routine NHS service data or databases (n = 14), different versions of the *Adult National Psychiatric Morbidity Survey* (n = 6) and other household and postal surveys (n = 3). The sample composition also varied and included adults with a psychotic disorder (n = 7), personality disorder (n = 5), depression (n = 3), an anxiety disorder (n = 2), an eating disorder (n = 1), 'common mental health problems' (n = 2) and dementia (n = 1). It also included health service users (n = 6) and former adolescent psychiatric patients (n = 1). The quality of included studies was mixed. STROBE statement[14] scores for observational studies (n = 25) ranged from 9-20 (mean *[M]* = 15.5; standard deviation *[SD]* = 3.05), out of a possible maximum score of 22. Of the three RCTs assessed using the NICE checklist,[15] two indicated the absence of bias, and one indicated the possible presence of bias. As can be seen in Tables 1 and 2, both the operationalisation of HSU outcomes and the identified predictors of HSU in individual studies varied widely.

INSERT TABLES 1 AND 2 HERE

Operationalisation of HSU outcomes

To determine the level of evidence for identified predictors of HSU, it was beneficial to first summarise the operationalisation of HSU outcomes across included studies. This summary is provided in Table 3. Across the 28 studies, 60 different HSU outcome variables were assessed 155 times in total: 24 of these related to primary care HSU, 79 to specialist HSU, 40 to inpatient HSU, and 12 to 'total and other' HSU. Across all categories apart from the 'total and other' HSU category, 65 outcomes related to mental health HSU and 78 related to general health HSU.

HSU outcomes used in three or more studies were: medication usage (n = 12); inpatient days (n = 9); accident and emergency (A & E) admissions (n = 8); inpatient admissions (n = 8); total HSU (n = 8); GP contacts (n = 7); GP contacts for psychological problems (n = 6); psychotherapy attendances (n = 6); community psychiatric nurse contacts (n = 5); psychiatrist contacts (n = 5); psychiatric inpatient admissions (n = 5); psychologist contacts (n = 5); nurse

contacts (n = 4); outpatient attendances (n = 4); counsellor contacts (n = 3); and home carer visits (n = 3). Remaining HSU outcomes are shown in Table 3.

Summary of evidence for identified predictors of HSU

INSERT TABLE 4 HERE

Table 4 provides a summary of the evidence for identified predictors of HSU. The table is structured as follows. First, identified predictors are categorised by 'demographics', 'diagnosis', 'interventions', 'symptoms', 'functioning', and 'behaviour'. Second, the table displays the number of times each identified predictor variable was assessed in relation to HSU, and the number of times each identified variable significantly predicted HSU (and vice versa). Third, using the broad categories of 'primary care HSU', 'specialist HSU', 'inpatient HSU', and 'total HSU', the table documents the operationalisation of HSU outcomes in relation to the prediction of HSU. Fourth, study quality information is provided to aid evaluation of the evidence. For simplicity, a study was arbitrarily deemed to be of 'satisfactory' quality if it scored ≥16 on the STROBE statement, [14] or if bias was not present on three out of four domains on the NICE checklist for RCTs.[15]

As an overview, the review identified 31 predictor variables that were examined in relation to the prediction of HSU. By category, these were: twelve demographic variables, six intervention variables, five diagnostic variables, four symptom variables, three functioning variables and one behavioural variable.

The 12 demographic variables significantly predicted increased HSU 41 of 65 times assessed (63.1%). Six demographic variables predicted increased HSU in two or more assessments and in over 50% of assessments made. These variables, in order of frequency of increased HSU prediction, were: comorbidity (both mental and physical), age (heterogeneous age ranges), female gender, a marital status of divorced, separated or widowed, non-white ethnicity, and high previous HSU. Regarding the age variable, several heterogeneous age ranges (e.g. 35-54, 31-49, 35+, 50-64) were associated with increased HSU, thus it was not possible to draw conclusions relating to specific age ranges. Specific age ranges associated with increased HSU in individual studies are viewable in Table 1. As study quality was satisfactory in the vast majority of these assessments, it can be concluded that there exists good preliminary evidence for these six demographic variables in relation to the prediction of increased HSU.

The six intervention variables significantly predicted decreased HSU 10 of 17 times assessed (58.8%). Two intervention variables predicted decreased HSU in two or more assessments and in over 50% of assessments made. These variables, in order of frequency of decreased HSU prediction, were: accessing an *Improving Access to Psychological Therapies* (IAPT) service, and medication. As study quality was satisfactory in all but one these assessments (an assessment of IAPT), it can be concluded that there exists good preliminary evidence for both IAPT and medication in relation to the prediction of decreased HSU.

The five diagnostic variables significantly predicted increased HSU 13 of 15 times assessed (86.6%). Two diagnostic variables predicted increased HSU in two or more assessments and in over 50% of assessments made. These variables, in order of frequency of increased HSU prediction, were: personality disorder, and obsessive compulsive disorder. Whereas all (eight) assessments of personality disorder came from studies of satisfactory quality, none of the

(four) assessments of obsessive compulsive disorder came from studies of satisfactory quality. Therefore, it can only be concluded that there exists good preliminary evidence for personality disorder in relation to the prediction of increased HSU.

The four symptom variables significantly predicted increased HSU 7 of 15 times assessed (46.6%). One symptom variable - neurotic symptoms- predicted increased HSU in six of six assessments made. Although two assessments came from studies of unsatisfactory quality, it can be concluded that there exists good preliminary evidence for neurotic symptoms in relation to the prediction of increased HSU.

The three functioning variables significantly predicted increased HSU 5 of 9 times assessed (55.6%). Two functioning variables predicted increased HSU in two or more assessments and in over 50% of assessments made. These variables, in order of frequency of increased HSU prediction, are: cognitive deficits and activities of daily living (ADLs). Whereas all (two) assessments of ADLs came from studies of satisfactory quality, none of the (three) assessments of cognitive deficits came from studies of satisfactory quality. Therefore, it can only be concluded that there exists good preliminary evidence for ADLs in relation to the prediction of increased HSU.

In the final variable category, a behavioural variable- self-harm- significantly predicted increased HSU one of one time assessed. This assessment came from a study of satisfactory quality. However, as just one assessment was undertaken, it cannot be concluded that there exists good preliminary evidence for self-harm in relation to the prediction of increased HSU.

In summary, taking into account frequency of prediction and study quality, several predictor variables have good preliminary evidence supporting their ability to predict HSU by adults with mental disorders in the UK. Of these variables (in order of frequency of prediction), comorbidity, personality disorder, age (heterogeneous age ranges), neurotic symptoms, female gender, a marital status of divorced, separated or widowed, non-white ethnicity, medication, high previous HSU, and activities of daily living were associated with increased HSU. Moreover, good preliminary evidence was found for associations of accessing a primary care psychological treatment service and medication use with decreased HSU. Figure 2 illustrates the relative frequencies of predictors of HSU, by category.

INSERT FIGURE 2 HERE

DISCUSSION

Summary of main findings

Taking into account study quality, 28 studies identified a range of variables with good preliminary evidence supporting their ability to predict HSU. Of these variables, comorbidity, personality disorder, age (heterogenous age ranges), neurotic symptoms, female gender, a marital status of divorced, separated or widowed, non-white ethnicity, medication, high previous HSU, and activities of daily living were associated with increased HSU. Moreover, good preliminary evidence was found for associations of accessing a primary care psychological treatment service and medication use with decreased HSU.

Comparison of main findings with other reviews

Few existing reviews of the predictors of HSU in mental health populations were available for comparison of results. Nevertheless, comorbidity- the most evidenced predictor of increased HSU in the present review- was also shown in a review of 72 studies to predict increased psychiatric service utilisation by 'heavy users' of psychiatric services.[16] This previous review found that several variables not examined by studies in our review (i.e. substance abuse, psychotic illness, isolation, homelessness, and social support) were predictive of increased psychiatric service utilisation. In line with the present review, another review of eight studies found that high previous utilisation predicted increased psychiatric service utilisation.[17] On the other hand, this review found that the variables of living alone and psychosis diagnosis- not examined by studies in the present review- were predictive of increased psychiatric service utilisation.

Overall, the findings from previous reviews add robustness to our finding of good preliminary evidence for the variables of comorbidity and high previous HSU in relation to the prediction of increased HSU by adults with mental disorders in the UK. In addition, despite the sole focus of the previous reviews on psychiatric services which limits their comparability, it is possible that several additional variables- in particular, a psychosis diagnosis- may also predict increased HSU by adults with mental disorders in the UK.

Comparison of main findings with international studies of HSU

As the review was limited to UK studies only, it is informative to compare the findings with those from international studies of HSU by adults with mental disorders. Three recent international studies with large samples comprising adults with a range of mental health problems were selected for comparative purposes.[18-20]

The first was set in Canada, and had a sample of 243 adults diagnosed with various mental disorders.[18] In line with our review, it found that increased social withdrawal, female gender, and (mental disorder) comorbidity were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were emotional problems, income, major depression diagnosis and alcohol dependence.

The second study was set in Australia and had a sample of 822 adults who had previously participated in an school-based epidemiological study in their youth.[19] In line with our review, it found that age (treated as continuous variable), comorbidity, and a marital status of divorced, were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were psychological distress, affective disorder diagnosis, exposure to childhood trauma, while rural living predicted reduced HSU .

The third study[20] used data from a cross-national health survey and involved 8688 adults from the USA and Canada. It found that comorbidity (various health comorbidities), female gender, and non-white ethnicity were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were emotional problems, income, having a regular doctor, and having insurance.

The findings from these international studies add robustness to our finding of good preliminary evidence for the variables of comorbidity, female gender, and a marital status of divorced in relation to the prediction of HSU by adults with mental disorders in the UK. In addition, it is possible that several additional variables identified in international studies- in particular, emotional problems- may also predict HSU by adults with mental disorders in the UK.

Implications of findings for Mental Health Payment by Results

Our findings can inform the debate surrounding the use of diagnostic information and the MHCT for clustering purposes. The findings also highlight several additional variables that are worthy of consideration in the clustering process.

Regarding the use of diagnostic information, in contrast to previous large-scale studies which showed mental disorder diagnosis to be a poor predictor of increased HSU,[9-11] the review yielded good preliminary evidence for personality disorder diagnosis in relation to the prediction of increased HSU. In addition, it is noted that diagnoses of psychosis, major depression and affective disorder were identified as predictors in previous reviews and international studies.[16-19] Although methodological differences (e.g. in the operationalisation of HSU) in these reviews and studies mean that firm conclusions cannot be drawn, a possible explanation for the discrepancy in findings is that some but not other mental disorder diagnoses may be significantly associated with increased HSU. The uncertainty regarding the ability of mental disorder diagnoses to predict increased HSU means that this review neither refutes nor supports the argument that reliable mental health clusters can be formed by combining broad diagnoses with care pathways, in a simple and practical manner.[12]

Findings relating to the domains of the MHCT (i.e. behaviour, symptoms, impairment, social functioning, and risk factors) can aid assessments of its suitability for clustering purposes. Although some variables relating to these domains were examined, good preliminary evidence for the prediction of increased HSU was found for just two relevant variables- neurotic symptoms and ADLs. Therefore, this review does not provide sufficient evidence to settle the debate regarding the use of the MHCT. However, it highlights the need for further

investigation of the link between the MHCT and increased HSU, especially since this link was not taken into account in the initial development of the MHCT.[13]

Regarding additional variables worth considering in the clustering process, various demographic (i.e. comorbidity, age, female gender, marital status, non-white ethnicity, high previous HSU) and intervention (i.e. IAPT, medication) variables with good preliminary evidence relating to their ability to predict HSU were identified. Future research could investigate if adding these variables into the 'case mix' of the MHCT adds to the economic validity and reliability of mental health clusters. However, it should be noted that the benefit of using intervention variables for clustering purposes is somewhat limited because it is relatively easy for providers to use these variables to 'game' the system (i.e. when patients are inappropriately and deliberately allocated to clusters that attract higher fixed payments). Although there exists no recorded evidence that 'gaming' has so far occurred in the Mental Health Payment by Results system, it is likely to occur due to its associated benefits. [7]

Methodological considerations

Various methodological factors should be taken into account when interpreting our findings. First, the quality of included studies was mixed. Specifically, using arbitrarily cut-off points on the STROBE statement[14] and the NICE checklist for RCTs,[15] 18 of the 28 studies (64.2%) were deemed to be of 'satisfactory' quality. This mixed quality limits the strength of conclusions that can be drawn. Second, there was wide heterogeneity in the operationalisation of HSU by included studies, which limits the validity of comparisons across studies. A possible reason for this heterogeneity is that 23 out of 28 (82%) of studies collected secondary data from NHS service databases or household surveys, and thus their operationalisation of HSU was constrained. Addressing this issue, the operationalisation of HSU in included studies was documented in considerable detail (Table 3). Third, the review was limited to UK studies only, meaning the list of identified variables is not exhaustive and the findings may not be applicable to services in other countries. Fourth, the majority of literature searching was undertaken by one study author. However, in order to minimise bias and error, 20% of abstracts were independently screened by another author. Fifth, the age variable was reported with heterogeneous age ranges across studies. Thus, conclusions in relation to specific age ranges could not be made. Finally, the study benefits from its thorough reporting process and use of structured checklists for assessments of study quality.

Additional future research directions

Two future research directions not directly related to *Mental Health Payment by Results* are provided. First, as the operationalisation of HSU in included studies was largely constrained by the use of secondary data from service databases, future HSU studies may benefit from the administration of measures such as the *Client Services Receipt Inventory*,[21] alongside secondary data. Second an international systematic review of the predictors of HSU by mental health populations could provide a more comprehensive list of predictor variables.

Conclusions

This review provides evidence that can inform decisions about which variables might be used to derive mental health clusters in the *Mental Health Payment by Results* system. Several variables- in particular comorbidity, female gender, age (heterogeneous age ranges) high previous HSU, and a marital status of divorced- have good preliminary evidence supporting their ability to predict HSU by adults with mental disorders in the UK, and thus are relevant for clustering purposes. The findings support the need to investigate whether combining broad diagnoses with care pathways is an effective method for mental health clustering, and the need for research to further examine the association between mental health clusters and HSU. Overall, this review has highlighted important unresolved issues related to the *Mental Health Payment by Results* system. Addressing these issues could improve how health service resources are distributed, helping to ensure that people experiencing mental health problems can access the most appropriate services at their time of need.

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Statement

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Competing interests.

All authors have completed the ICMJE uniform disclosure form and declare no support from any organisation for submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

Transparency

I, Conal Twomey (lead author and guarantor), affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained .

Ethical approval

None sought for this review of secondary published data that did not involve participants or any identifiable participant information.

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Data sharing

No additional data available.

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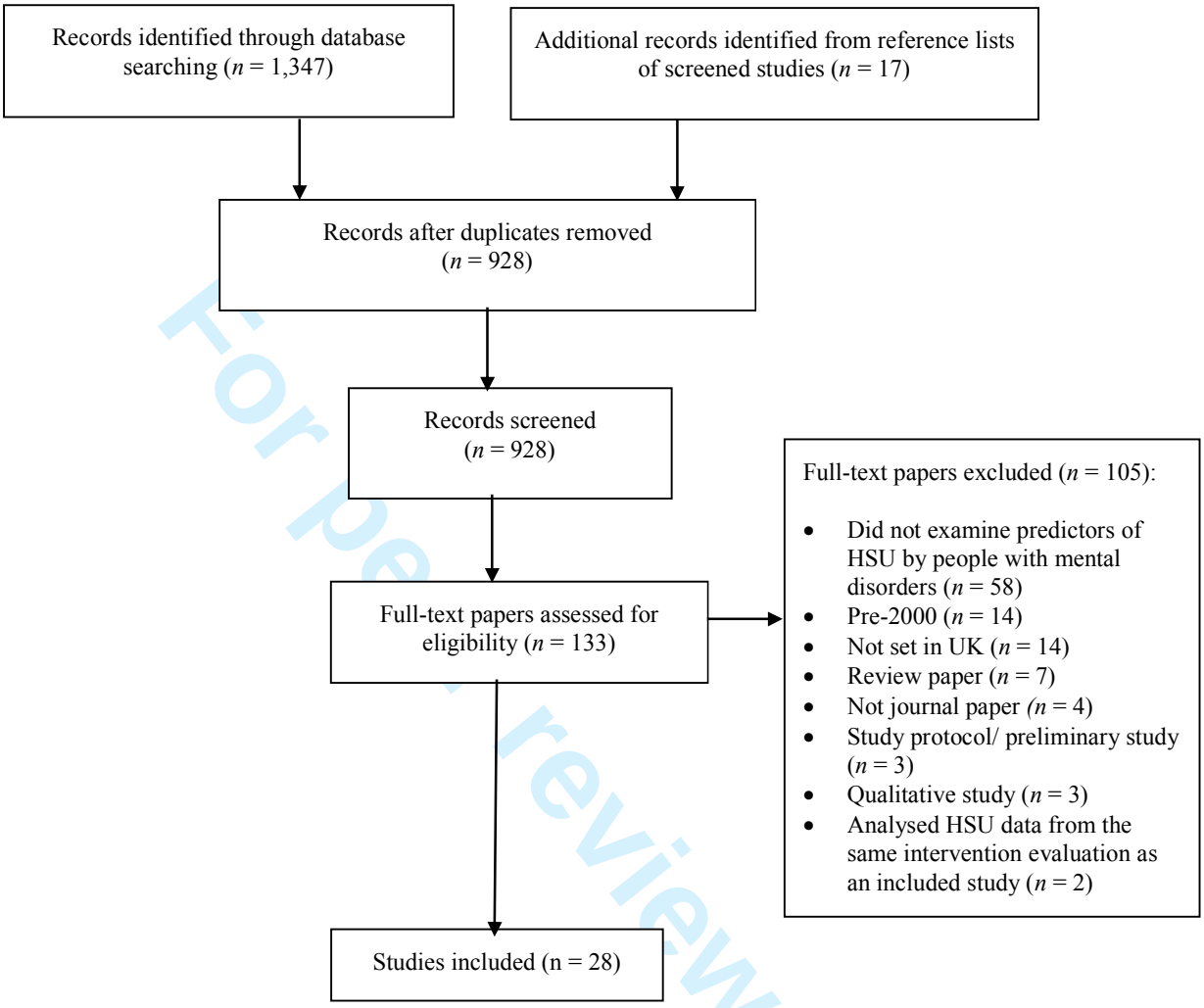

Figure 1: Literature search flow

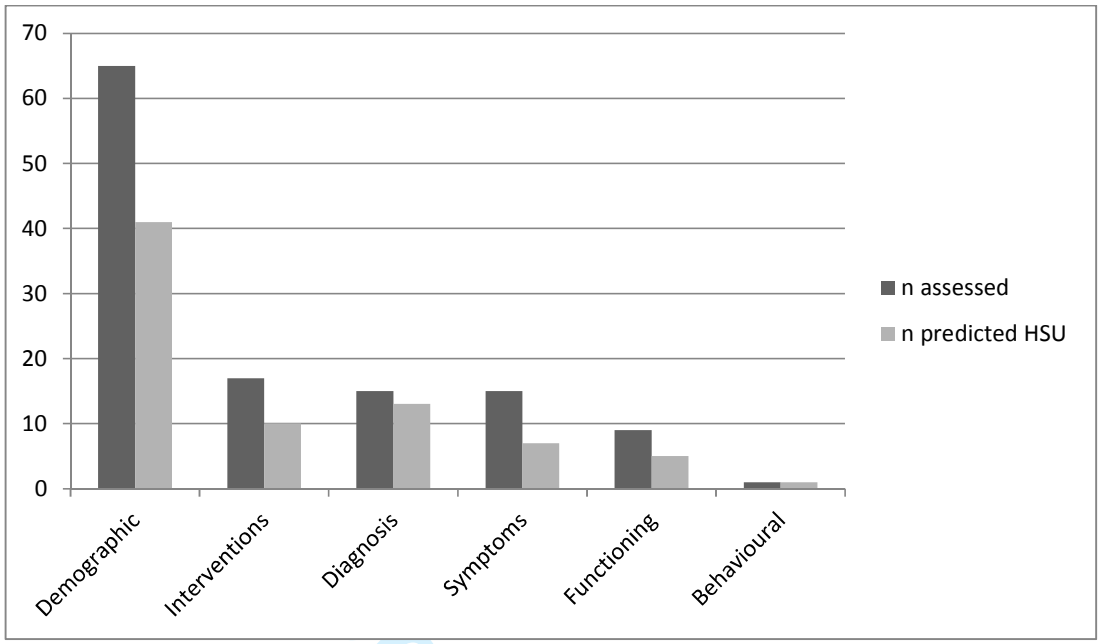

Figure 2: Frequency of HSU prediction by variable category.

Note: HSU= health service utilisation; frequencies were obtained by counting some studies various times for one variable category; for interventions, the count concerned the prediction of decreased HSU.

Table 1. Observational studies of HSU (*n*=17)

Study	Design	Data Source	Participants				Q	HSU outcomes	Predictors of increased HSU	Not predictive of increased HSU
			Composition	*N*	Age	%f	ST			
Button (2005) [22]	Cohort	NHS eating disorders clinic	Eating disorder patients	147	26.3 (*SD* not stated)	96	9	• Total HSU	-	• Type of eating disorder diagnosis
Byford (2010) [23]	Cohort	NHS primary care database	Depressed patients	88935	44.4 (*SD*= 16.75)	68	18	• A&E attendances • GP phone calls • GP visits • Inpatient days • Medication usage • Other specialist contacts • Psychiatrist contacts • Psychologist contacts	• Non-remission (after antidepressant treatment)	• Remission (after antidepressant treatment)
Chollet (2013) [24]	Cohort	NHS primary care database	GAD patients	29131	48.5 (*SD*= 17.5)	67	18	• Total HSU	• Aged 31-49 • Aged 50-64 • High previous HSU • High previous medication use • Male • Two comorbidities	• Aged 18-30 • Aged >65 • Lower previous HSU • Lower previous medication use • FemaleNo, one, or three comorbidities
Coid (2009) [25]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents (some with BPD)	8397	16-74 (*M* not stated)	53	18	• Community psychiatric nurse contacts • Counsellor contacts • GP contacts for psychological problems • Psychiatric inpatient admission • Psychiatrist contacts • Total HSU	• Diagnosis of BPD	• No diagnosis of BPD
Coid (2006)	Cross-sectional	Adult Psychiatric	UK residents with a PD	626	16-74 (*M* not	56	17	• Community psychiatric nurse contacts	• Cluster A, B, and C PD diagnoses	• No comorbidity

[26]		Morbidity Survey			stated)			• Counsellor contacts • GP contacts for psychological problems • Medication usage • Psychiatric inpatient admission • Psychiatrist contacts	• Comorbid mental disorder and substance abuse	
Cooper (2010) [27]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents (some with CMPs)	7461	16+ (*M* not stated)	51	18	• PCT attendance • GP contact for psychological problems • Medication usage	• Aged >35 • ADLs • Widowed / divorced/ separated • Elevated neurotic symptoms • Female • Non-white ethnicity •	• Aged <35 • No ADLs • Marital status other than widowed / divorced/ separated • Non-elevated neurotic symptoms • Male • White ethnicity • Any home ownership status • Number of qualifications
Cooper (2013) [28]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents (some with CMPs)	22196	16+ (*M* not stated)	52	19	• PCT attendance • GP contact for psychological problems • Medication usage	• Aged 35-54 • Aged 75+ • Divorced/ separated/ widowed • Elevated neurotic symptoms • Female • Non-home owner • Non-white ethnicity •	• Aged 16-34 • Aged 55-74 • Marital status other than widowed / divorced/ separated • Male • Non-elevated neurotic symptoms • Home owner • White ethnicity

Foster (2003) [29]	Cross-sectional	Government surveys: adults in private households; adults with psychosis in households and adults in mental institutions	Adults with psychosis	470	16-64 (*M* not stated)	NS	10	• GP contact for psychological problems • Psychiatric inpatient admission • Any service use for a psychological problem	• Aged 16-34 • Aged 45-54 • Elevated neurotic symptoms • White ethnicity	• Aged 35-44 • Aged 55-64 • Family circumstances • Gender • Household type • Living arrangements • Marital status • Non-elevated neurotic mental health symptoms • Non-white ethnicity • Occupation • Physical illness • Qualifications
Hayward (2010) [30]	Cohort	Postal survey of a general practice population	GP attendees	2662	51.3 (*SD*= 17.18)	55	16	• GP contacts • Medication usage	• Insomnia symptoms • Comorbid anxiety or depression	• No insomnia symptoms • No comorbidity
Keene (2007) [31]	Cross-sectional	Databases: health authority, mental health population, and A&E population.	Health and mental health service users	625964	16+ (*M* not stated)	52	16	• A&E attendances	• Four typologies: (1) Young, male frequent attendees with self-harm and other injuries; (2) Young females with self-harm; (3) Older patients with multiple medical conditions; (4) Very old patients with cardiac conditions and fractures	-

Knapp (2002) [32]	Cross-sectional	Maudsley (NHS) psychiatric hospital data; patient interviews	Former Maudsley child and adolescent psychiatric patients	149	Not stated	61	11	• Client Services Receipt Inventory [21]	• Comorbidity of childhood depression and conduct disorder	• No childhood comorbidity
Mohan (2006) [33]	Cohort	PRISM psychosis study set in Maudsley & Bethlem NHS trust area	White (group 1) and African Caribbean (group 2) patients with psychosis	140	40.55 (*SD*= 14.9)	49	18	• Client Services Receipt Inventory [21]	• Receiving intensive community treatment (for African Caribbean patients only)	• Ethnicity • Receiving intensive community treatment (for White patients only)
Patel (2006) [34]	Cross-sectional data from a RCT	RCT data set in South London /Maudsley NHS trust area	Schizophrenia patients	85	26 (SD not stated)	26	13	• 'Other' • A&E attendances • CMHT contacts • Community psychiatric nurse contacts • Day care attendances • General medical ward attendances • GP contacts • Group PCT attendances • Home carer visits • Inpatient admissions • Inpatient days • Non-psychiatric outpatient attendances • Nurse contacts • Occupational therapist contacts • Psychiatric outpatient attendances • Psychiatrist contacts • Psychologist contacts • Sheltered workshop attendances • Specialist education	• Cognitive deficits	• Anti-social behaviour • Depression symptoms • No cognitive deficits • Positive symptoms • Social withdrawal

								• attendances • Total inpatient service use		
Torres (2007) [35]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents with OCD	114	16-74 (*M* not stated)	65	13	• Any community service attendance • Counselling attendance • GP contact for psychological problems • Home carer visits • Medication usage • PCT attendance • Psychiatric inpatient admission • Community psychiatric nurse contacts • Psychiatric outpatient attendances • Psychiatrist contact • Psychologist contact • Support group attendances • Total HSU ('any kind of treatment')	• OCD diagnosis • OCD with co-morbid anxiety or depression	• No OCD diagnosis
Ulrich (2009) [36]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents with ASPD	245	16-74 (*M* not stated)	22	16	• Community psychiatric nurse contacts • GP contacts • Other nursing service contacts • Outreach worker contacts • Psychiatric inpatient admission • Psychiatrist contacts • Psychologist contacts • Support group attendances • Total HSU	• Comorbid Axis 1 mental disorders	• Comorbid personality disorders
Walters (2011) [37]	Cohort	Seven NHS general practices.	Primary care patients with mild-to-moderate distress	250	46 (*SD* not stated)	71	20	• GP contacts	• ICD-10 disorders (apart from mixed anxiety and depression)	• Mixed anxiety and depression

Wright (2000) [38]	Cross-sectional	NHS mental health services	Patients with functional psychosis and co-morbid substance abuse.	61	43.1 (*SD* not stated)	56	15	• Inpatient admissions • Inpatient days	-	• Dual diagnosis

Note: A&E= Accident and Emergency; ADLs= Activities of Daily Living restrictions; Age= mean age (if not stated, where possible, age range is stated); ASPD= Anti-social personality disorder; BPD= Borderline Personality Disorder; CMHT= Community Mental Health Team; CMP= common mental health problem; DBT= Dialectical Behaviour Therapy; f=female; GAD= Generalised Anxiety Disorder; GP= General Practitioner; HSU= health service utilisation; *M*= mean; NHS= National Health Service; NS= not stated; OCD= obsessive compulsive disorder; ST= STROBE statement (score range 0-22; 0 represents lowest quality and 22 represents highest quality) [14]; RCT= Randomised Controlled Trial; PCT= psychotherapy; PD= personality disorder. Q= Quality assessment

Table 2. Intervention studies of HSU (*n*=11)

Study	Design	Data Source	Participants				Quality		HSU outcomes	Intervention	Control	Reduced HSU? ($p<.05$)
			Composition	*N*	Age	%f	ST	NC				
Amner (2012) [39]	Cohort	NHS service data	BPD patients availing of DBT	21	36.2 (*SD*= 10.87)	81	13	-	• Day care attendances • DBT attendances • Inpatient days • Nurse contacts • Outpatient attendances • PCT attendances • Total HSU	DBT	-	NO
Ballard (2002) [40]	Quasi-experi-mental	Care facilities	Dementia patients	224	82.5 (*SD*= 7.1)	75	12	-	• GP contacts • Inpatient days	Psychiatric liaison	Usual care	YES
Bateman (2008) [41]	RCT	NHS PD PCT unit	BPD patients	41	31.8 (*SD*= 6.23)	58	-	2	• A&E attendances • Outreach worker contacts • Inpatient days • Medication usage • PCT attendances • Psychiatric treatment days	Mentalisation-based treatment by partial hospitalisation	Usual care	YES
Comman-der (2005) [42]	Cohort	Assertive outreach service data	Outreach patients with schizophrenia, bipolar disorder or 'other' disorder	250	18-64 (*M* not stated)	26	12	-	• Compulsory admissions • Inpatient admissions • Inpatient days	Community outreach service use	-	YES
de Lusignan (2012) [43]	Cohort	NHS (IAPT and hospital service) data	IAPT attendees	1118	35.3 (SD=21.4)	50	15	-	• A&E attendances • Inpatient admissions • Inpatient days • Medication usage • Outpatient attendances • Sick notes issued	IAPT service	-	YES

de Lusignan (2013) [44]	Case control	NHS (IAPT and hospital service) data	IAPT attendees with long term health conditions	1341	52.8 (SD= 11.15)	65	19	-	• A&E attendances • Inpatient admissions • Inpatient days • Medication usage • Outpatient attendances • Sick notes issued	IAPT service	-	YES
Hayhurst (2002) [45]	Cohort	NHS University Hospitals service data	Patients receiving antipsychotic medication	126	42.55 (SD= 12.29)	35	16	-	• Inpatient admissions • Inpatient days	Clozapine	-	YES
Lam (2005) [46]	RCT	Maudsley & Bethlem NHS trust area	Patients with bipolar disorder	87	43.95 (*SD*= 11.45)	33	-	4	• Any community services attendance • Medication usage • Non-psychiatric inpatient days • Psychiatric inpatient days • Total HSU	Cognitive therapy (added to usual care)	Usual care	NO
Shi (2012) [47]	Cohort	NHS primary care database	Depressed adults initiating duloxetine	909	49.6 (*SD*= 16.5)	67	17	-	• A&E attendances • Inpatient admissions • Medication usage • Referrals to specialists • GP phone calls • GP visits • Inpatient admissions • Medication usage • Referrals to other specialist • Referrals to psychiatrist • Total HSU	Duloxetine	-	YES
Wade (2010) [48]	Cohort	NHS primary care database	Depressed adults using escitalopram, venlafaxine, or generic SSRI	2485	43.1 (*SD*= 14.7)	60	18	-		Escitalopram	Generic SSRIs; venla-faxine	YES
Woods (2012) [49]	RCT	Community-based RCT	Patients of NHS Memory Clinics and CMHTs	488	77.1 (*SD*= 7.3)	50	-	4	• A&E attendances • Care attendant contacts • Care manager contacts • Chiropodist contacts • CMHT contacts • Community psychiatrist contacts • Continuing care/respite contacts • Counsellor contacts • Day hospital contacts • Dietician contacts	Reminiscence group	Usual care	NO

- Family support worker contacts
- GP contacts
- Health visitor contacts
- Home carer visits
- Informal/ voluntary care contacts
- Inpatient rehabilitation contacts
- General medical ward attendances
- NHS contacts
- Occupational therapist contacts
- Other inpatient ward contacts
- Outpatient attendances
- Physiotherapist contacts
- Nurse contacts
- Psychologist contacts
- Sitting scheme worker contacts

Note: A&E= Accident and Emergency; Age= mean age (if not stated, where possible, age range is stated); BPD= Borderline Personality Disorder; CMHT= community mental health team; DBT= Dialectical Behaviour Therapy; f=female; GP = General Practitioner; HSU= health service utilisation; IAPT= *Improving Access to Psychological Therapies* initiative; NC= NICE checklist for RCTs (score range = 0-4; 0 indicates bias and 4 indicates no bias) (NICE, 2009); NHS= National Health Service; ST= STROBE statement (score range 0-22; 0 represents lowest quality and 22 represents highest quality) [14]; PCT= psychotherapy; PD= personality disorder

Table 3. Frequency of HSU outcomes used across included studies (*n*=28).

Primary care HSU	***n***
Mental health	
GP contact(s) for psychological problems	6
Referrals to psychiatrist	1
Support group attendances	2
Total	9
*General health**	
GP contacts	7
GP phone calls	2
GP visits	2
Referrals to specialists	2
Sick notes issued	2
Total	15

Specialist HSU	***n***
Mental health	
Medication usage**	12
Psychotherapy attendance(s)	6
Community psychiatric nurse contacts	5
Psychiatrist contact(s)	5
Psychologist contact(s)	5
Outpatient attendances	4
Counsellor contacts	3
Day care attendances	2
CMHT contacts	2
DBT attendances	1
Psychiatric outpatient attendances	1
Psychologist / psychiatrist contacts	1
Total	47

*General health**	
Nurse contacts	4
Home carer visits	3
Any community service attendance	2
General medical ward attendances	2
Occupational therapist contacts	2
Outreach worker contacts	2
Care attendant contacts	1
Care manager contacts	1
Chiropodist contacts	1
Continuing care / respite contacts	1
Counselling attendance	1
Day hospital contacts	1
Dietician contacts	1
Family support worker contacts	1
Health visitor contacts	1
Informal/voluntary care contacts	1
Inpatient rehabilitation contacts	1
NHS contacts	1
Non-psychiatric outpatient attendances	1
Other inpatient ward contacts	1
Other nursing service contacts	1
Other specialist contacts	1
Physiotherapist contacts	1
Total	32

Inpatient HSU	***n***
Mental health	
Psychiatric inpatient admission(s)	5
Psychiatric inpatient days	1
Psychiatric outpatient attendances	1
Compulsory admissions	1
Psychiatric treatment days	1
Total	9
*General health**	
Inpatient days	9
A&E attendances	8
Inpatient admissions	8
Non-psychiatric inpatient days	2
Sheltered workshop attendances	1
Sitting scheme worker contacts	1
Specialist education attendances	1
Total inpatient service use	1
Total	31

Total and other HSU	***n***
Total HSU	8
'Other' HSU	1
Any service use for psychological problem	1
Client Services Receipt Inventory	2
Total	12

Summary totals	***n***
Primary Care HSU	24
Specialist HSU	79
Inpatient HSU	40
Total and other HSU	12
Mental health HSU	65
General health HSU	78
Types of outcome variables	60
Times outcomes assessed	155

Note: * General health refers to HSU that was not specified as being directly linked to mental ill health. **Type of medication varied widely. A&E= Accident and Emergency; CMHT= community mental health team; Client Services Receipt Inventory [21]; DBT= Dialectical Behaviour Therapy; HSU= health service utilisation. NHS= National Health Service.

Table 4. Summary of the evidence for examined predictors of HSU.

Predictor variables	*n* variable assessed	Assessments in which variable predicted HSU												Assessments in which variable did not predict HSU											
		n	HSU outcomes predicted (*n*)*											*n*	HSU outcomes not predicted (*n*)*										
			Prim. Care			Specialist			Inpatient			Total HSU			Prim. Care			Specialist			Inpatient			Total HSU	
			n	Quality		*n*	Quality		*n*	Quality		*n*	Quality		*n*	Quality		*n*	Quality		*n*	Quality		*n*	Quality	
				+	-		+	-		+	-		+	-		+	-		+	-		+	-		+	-
Demographic [24-33 35 36 38]																									
Comorbidity**	15	14	*4*	**3**	1	*3*	**2**	1	*3*	**2**	1	*4*	**2**	2	1	*0*			*0*			*1*	**0**	1	*0*		
Age***	7	7	*2*	**2**	0	*2*	**2**	0	*2*	**1**	1	*1*	**1**	0	0												
Female gender	7	5	*2*	**2**	0	*2*	**2**	0	*1*	**1**	0	*0*			2	*0*			*0*			*1*	**0**	1	*1*	**1**	0
Male gender	7	2	*0*			*0*			*1*	**1**	0	*1*	**1**	0	5	*2*	**2**	0	*2*	**2**	0	*1*	**0**	1	*0*		
NW ethnicity	6	4	*2*	**2**	0	*2*	**2**	0	*0*			*0*			2	*0*			*0*			*0*			*2*	**1**	1
White ethnicity	6	1	*0*			*0*			*0*			*1*	**0**	1	5	*2*	**2**	0	*2*	**2**	0	*0*			*1*	**1**	0
Marital status****	5	4	*2*	**2**	0	*2*	**2**	0	*0*			*0*			1	*0*			*0*			*0*			*1*	**0**	1
Non-home owner	5	2	*1*	**1**	0	*1*	**1**	0	*0*			*0*			3	*1*	**1**	0	*1*	**1**	0	*0*			*1*	**0**	1
Qualifications	3	0	*0*			*0*			*0*			*0*			3	*1*	**1**	0	*1*	**1**	0	*0*			*1*	**0**	1
High prev. HSU	2	2	*0*			*0*			*0*			*2*	**2**	0	0	*0*			*0*			*0*			*0*		
Family situation	1	0	*0*			*0*			*0*			*0*			1	*0*			*0*			*1*	**0**	1	*0*		
Occupation	1	0	*0*			*0*			*0*			*0*			1	*0*			*0*			*1*	**0**	1	*0*		
Total	65	41	*13*	**12**	1	*12*	**11**	1	*7*	**5**	2	*9*	**6**	3	24	*6*	**6**	0	*6*	**6**	0	*5*	**0**	5	*7*	**3**	4
Intervention ***** [39-49]																											
IAPT service	4	4	*1*	**1**	0	*1*	**1**	0	*2*	**1**	1	*0*			0	*0*			*0*			*0*			*0*		
Psychotherapy	4	1	*1*	**1**	0	*0*			*0*			*0*			3	*0*			*1*	**1**	0	*1*	**1**	0	*1*	**1**	0
Reminiscence grp.	4	0	*0*			*0*			*0*			*0*			4	*1*	**1**	0	*1*	**1**	0	*1*	**1**	0	*1*	**1**	0
Medication	3	3	*1*	**1**	0	*0*			*2*	**2**	0	*0*			0	*0*			*0*			*0*			*0*		
Comm. outreach	1	1	*0*			*0*			*1*	**1**	0	*0*			0	*0*			*0*			*0*			*0*		
Psychiatric liaison	1	1	*1*	**0**	1	*0*			*0*			*0*			0	*0*			*0*			*0*			*0*		
Total	17	10	*4*	**3**	1	*1*	**1**	0	*5*	**4**	1	*0*			7	*1*	**1**	0	*2*	**2**	0	*2*	**2**	0	*2*	**2**	0
Diagnostic [22 25 26 35 37]																											
PD	8	8	*2*	**2**	0	*2*	**2**	0	*2*	**2**	0	*2*	**2**	0	0	*0*			*0*			*0*			*0*		
OCD	4	4	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1	0	*0*			*0*			*0*			*0*		

Unspec. ICD-10	1	1	*1*	**1**	0	*0*			*0*			*0*			0	*0*			*0*			*0*			*0*		
Eating disorder	1	0	*0*			*0*			*0*			*0*			1	*0*			*0*			*0*			*1*	**0**	1
MADD	1	0	*0*			*0*			*0*			*0*			1	*1*	**1**	0	*0*			*0*			*0*		
Total	15	13	*4*	**3**	1	*3*	**2**	1	*3*	**2**	1	*3*	**2**	1	2	*1*	**1**	0	*0*			*0*			*1*	**0**	1
Symptoms [27-30 34]																											
Neurotic	6	6	*3*	**2**	1	*2*	**2**	0	*0*			*1*	**0**	1	0	*0*			*0*			*0*			*0*		
Depression	4	0	*0*			*0*			*0*			*0*			4	*1*	0	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1
Positive******	4	0	*0*			*0*			*0*			*0*			4	*1*	0	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1
Insomnia	1	1	*1*	**1**	0	*0*			*0*			*0*			0	*0*			*0*			*0*			*0*		
Total	15	7	*4*	**3**	1	*2*	**2**	0	*0*			*1*	**0**	1	8	*2*	0	2	*2*	**0**	2	*2*	**0**	2	*2*	**0**	2
Functioning [27 34]																											
Social withdrawal	4	0	*0*			*0*			*0*			*0*			4	*1*	0	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1
Cognitive deficits	3	3	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1	*0*			0	*0*			*0*			*0*			*0*		
ADLs	2	2	*1*	**1**	0	*1*	**1**	0	*0*			*0*			0	*0*			*0*			*0*			*0*		
Total	9	5	*2*	**1**	1	*2*	**1**	1	*1*	**0**	1	*0*			4	*1*	0	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1
Behavioural [31]																											
Self-harm	1	1	*0*			*0*			*1*	**1**	0	*0*			0	*0*			*0*			*0*			*0*		

Note: *Most studies examined more than one health service utilisation outcome measure. **Both mental and physical comorbidity. ***Various heterogeneous age ranges predicted increased HSU in individual studies: 16-34; 31-49; 45-54; 50-64; >35; 35-54; 75+. **** Only divorced/ separated/ widowed marital statuses were predictive of increased HSU. *****If an intervention reduced HSU, it was counted as predicting HSU, and vice versa. ******Positive = positive symptoms associated with schizophrenia. ADLs= Activities of Daily Living ; Comm.= community; grp= group; HSU= health service utilisation; IAPT= *Improving Access to Psychological Therapies* initiative; ICD-10= International Classification of Diseases-10; MADD= mixed anxiety and depressive disorder; NW= non-white; PD=Personality Disorder; prev.= previous; Prim.= Primary; Unspec.= Unspecified; $^{+}$ = A score of $\geq$16 on STROBE statement,[14] or $\geq$3 on NICE checklist for RCTs;[15] - = A score of $\leq$15 on STROBE checklist, or $\leq$2 on NICE RCT checklist).

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3/4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3/4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	n/a
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5

Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	5
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	n/a
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	n/a

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A systematic review of the predictors of health service utilisation by adults with mental disorders in the UK

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Author Contributions

CT, AC and DSB conceived the paper. CT and AC designed the paper and undertook analysis and interpretation of data. CT drafted the paper. MH and DSB inputted into the literature search process. All authors critically reviewed the paper and suggested revisions. All authors gave final approval for the paper for submission

Abstract

Objectives
To identify variables which predict health service utilisation (HSU) by adults with mental disorders in the UK, and to determine the evidence level for these predictors.

Design
A narrative synthesis of peer-reviewed studies published after the year 2000. The search was conducted using four databases (i.e. *PsycINFO, CINAHL Plus with full text, MEDLINE,* and *EMBASE*) and completed on March 25th, 2014.

Setting
The majority of included studies were set in health services across primary, secondary, specialist, and inpatient care. Some studies used data from household and postal surveys.

Participants
Included were UK-based studies that predicted HSU by adults with mental disorders, Participants had a range of mental disorders including psychotic disorders, personality disorders, depression, anxiety disorders, eating disorders, and dementia.

Primary outcome
A wide range of HSU outcomes were examined, including GP contacts, medication usage, psychiatrist contacts, psychotherapy attendances, inpatient days, accident and emergency admissions, and 'total HSU'

Results
Taking into account study quality, 28 studies identified a range of variables with good preliminary evidence supporting their ability to predict HSU. Of these variables, comorbidity, personality disorder, age (heterogeneous age ranges), neurotic symptoms, female gender, a marital status of divorced, separated or widowed, non-white ethnicity, medication, high previous HSU, and activities of daily living were associated with increased HSU. Moreover, good preliminary evidence was found for associations of accessing a primary care psychological treatment service and medication use with decreased HSU.

Conclusions
The findings can inform decisions about which variables might be used to derive mental health clusters in 'payment by results' systems in the UK. The findings also support the need to investigate whether combining broad diagnoses with care pathways is an effective method for mental health clustering, and the need for research to further examine the association between mental health clusters and HSU.

Declaration of interest
None.

Strengths and limitations of the study

- The review was limited to UK studies only, meaning the list of identified variables is not exhaustive and the findings may not be applicable to services in other countries.
- There was wide heterogeneity in the operationalisation of HSU by included studies, which limits the validity of comparisons across studies. Addressing this issue, the operationalisation of HSU in included studies was documented in considerable detail (Table 3).
- The study benefits from its use of structured checklists for assessments of study quality.
- The majority of literature searching was undertaken by one study author. However, in order to minimise bias and error, 20% of abstracts were independently screened by another author.

Introduction

Many stakeholders with differing needs are involved in the delivery of public health services. Patients seek the best obtainable care, providers aim to deliver optimal care but also strive for self-regulation and autonomy, and policy-makers need to balance meeting high public demand with controlling health service expenditure.[1] To meet these differing needs, fair and efficient health service payment systems are required. Contemporary, 'activity-based' payment systems aim to achieve this fairness and efficiency by financially incentivising competing providers to treat more patients, cut costs, and reduce waiting list times.[2]

In typical activity-based payment systems, resources are allocated towards distinct patient 'clusters' (or groups). These clusters are comprised of patients with similar clinical characteristics and expected health service utilisation (HSU) patterns.[3] Each patient treated by a health service provider is assigned to a specific cluster based on collected information about a range of 'case-mix' variables (e.g. diagnosis, comorbidity, age) which are associated with HSU.[4] Thereafter, health service providers receive a fixed payment based on the cluster each patient is allocated to, with clusters with higher expected HSU generating higher payments than those with lower expected HSU.[5] Paying providers fixed payments based on 'clustering' of treated patients allows policy-makers to distribute resources in a systematic and equitable manner.[3]

In recent years, there have been ongoing efforts by the National Health Service (NHS) in England to develop (a potential UK-wide) activity-based payment system for its mental health services, in what is referred to as *Mental Health Payment by Results*. Initially, the system will cover secondary care services with various service types excluded (e.g. those relating to primary care psychotherapy, acquired brain injury, and autism).[6] A subject of much debate in this development surrounds how to define 'mental health clusters' for use in this system. In contrast to typical activity-based payment systems, diagnostic information has so far not been used to define these clusters. Instead, clusters have been defined using the newly-developed *Mental Health Clustering Tool* (MHCT). The MHCT assesses the domains of behaviour, symptoms, impairment, social functioning, and risk factors, and is used to assign patients to one of 21 clusters, falling under one of three broad 'super-classes' (non-psychotic, psychotic and organic).[7]

One of the main reasons for not using diagnostic information for clustering in *Mental Health Payment by Results* was that mental disorder diagnosis was shown to be a poor predictor of HSU in studies involving national and multi-site trial datasets.[8-11] On the other hand, it has been argued that although mental disorder diagnosis alone is not sufficient for clustering purposes, information about broad diagnoses and care pathways can be combined, in a simple and practical manner, to form reliable clusters with homogenous resource patterns.[12] Moreover, the MHCT has also been criticised because its development did not take HSU and costs into account,[13] and there currently exists very little evidence for the ability of the MHCT to predict HSU in patient populations.

In the context of the ongoing development of *Mental Health Payment by Results*, and the debate surrounding the use of diagnostic information and the MHCT, it is important to provide evidence that can inform decisions about which variables might be used to derive mental health clusters. To date, no UK-based systematic reviews informing this process have been undertaken. A review of relevant studies set in the UK would address UK-specific HSU patterns, increasing the applicability of findings to the *Mental Health Payment by Results*

system. Therefore, the general objective of this systematic review is to identify variables with sufficient evidence supporting their ability to predict HSU. The review has two specific aims. First, to identify the variables examined in relation to the prediction of HSU by adults with mental disorders in the UK. Second, to determine the level of evidence that exists for identified predictors of this HSU.

Method

Inclusion and exclusion criteria

Only the following types of studies were included in the review: (1) observational and intervention studies that predicted HSU by adults with mental disorders. (For the purposes of this review, mental disorders included adults experiencing elevated symptoms of mental disorders, or adults formally diagnosed with a mental disorder. Studies with participants with intellectual disability were excluded due to the specific additional needs of this population which have to be met beyond the healthcare system (e.g. in the education or labour systems); (2) studies based in the UK, with UK participants; (3) peer-reviewed studies published in scientific journals, in the year 2000 or after. (This cut-off point was chosen so that included studies were approximately in line with the overall *Payment by Results* scheme introduced in 2003. Intervention costing studies which did not predict HSU were excluded).

Literature search

Based on these criteria, the first author searched four databases: *PsycINFO, CINAHL Plus with full text, MEDLINE,* and *EMBASE.* The final search was conducted on March 25th, 2014. Additional records were identified from hand-searching reference lists of included studies. Search terms and database subject headings related to HSU (i.e. health care utilisation [subject heading] OR health care utili* OR health service utili* OR health care use OR health service use) were combined with those terms for mental disorders (i.e. Mental disorders [subject heading] OR psychiatric) and the UK location (i.e. UK [subject heading] OR NHS). Due to the differing search procedures deployed by the four databases, slightly altered versions of this search strategy were used in each database. Independent screening of 20% of abstracts was undertaken by the third author. When the first author and third author disagreed regarding the screening outcome of an abstract, the abstract was included in screening at 'full-text' level (by the first author).

Data extraction

Data from included studies were extracted using an Excel spreadsheet. Extracted data pertained to basic study description, study design, records source, data collection times, participants, mental disorder investigated, operationalization of HSU outcomes, the prediction of HSU, and statistics. In addition, each study was assessed for quality using the STROBE statement[14] (for observational studies) and the National Institute for Health and Clinical Excellence (NICE) checklist for Randomized Controlled Trials (RCTs).[15] The former is a checklist of 22 items related to the reporting of title (one item), introduction (two items), methods (nine items), results (five items), discussion (four items), and funding information (one item).[14] The latter assesses bias in RCTs in four sections- selection bias, performance bias, attrition bias, and detection bias.[15]

Data analysis

Due to the heterogeneity in study designs, samples and mental disorders investigated, a meta-analysis was not possible. Narrative synthesis was deemed the most appropriate method of data analysis.

RESULTS

Literature search flow

The literature search flow is displayed in Figure 1. In total, 1,364 records were identified. Database-searching yielded 1,347 records and hand-searching yielded 17 additional records. After duplicates were removed, 928 studies were screened at 'abstract' level. For screening of abstracts, there was a 94.1% agreement rate between the first author and the third author. After abstract screening, 133 studies were assessed for eligibility at 'full-text' level. 28 studies were included in the final review.

INSERT FIGURE 1 HERE

Overview of included studies

To provide an overview of included studies, extracted data were summarised in two tables (Tables 1 and 2). Table 1 summarises observational studies of HSU, and Table 2 summarises studies of interventions (of both observational and experimental design) aiming to reduce HSU. As can be seen in both tables, the data source of included studies varied. Most frequently it included routine NHS service data or databases (n = 14), different versions of the *Adult National Psychiatric Morbidity Survey* (n = 6) and other household and postal surveys (n = 3). The sample composition also varied and included adults with a psychotic disorder (n = 7), personality disorder (n = 5), depression (n = 3), an anxiety disorder (n = 2), an eating disorder (n = 1), 'common mental health problems' (n = 2) and dementia (n = 1). It also included health service users (n = 6) and former adolescent psychiatric patients (n = 1). The quality of included studies was mixed. STROBE statement[14] scores for observational studies (n = 25) ranged from 9-20 (mean *[M]* = 15.5; standard deviation *[SD]* = 3.05), out of a possible maximum score of 22. Of the three RCTs assessed using the NICE checklist,[15] two indicated the absence of bias, and one indicated the possible presence of bias. As can be seen in Tables 1 and 2, both the operationalisation of HSU outcomes and the identified predictors of HSU in individual studies varied widely.

INSERT TABLES 1 AND 2 HERE

Operationalisation of HSU outcomes

To determine the level of evidence for identified predictors of HSU, it was beneficial to first summarise the operationalisation of HSU outcomes across included studies. This summary is provided in Table 3. Across the 28 studies, 60 different HSU outcome variables were assessed 155 times in total: 24 of these related to primary care HSU, 79 to specialist HSU, 40 to inpatient HSU, and 12 to 'total and other' HSU. Across all categories apart from the 'total and other' HSU category, 65 outcomes related to mental health HSU and 78 related to general health HSU.

HSU outcomes used in three or more studies were: medication usage (n = 12); inpatient days (n = 9); accident and emergency (A & E) admissions (n = 8); inpatient admissions (n = 8); total HSU (n = 8); GP contacts (n = 7); GP contacts for psychological problems (n = 6); psychotherapy attendances (n = 6); community psychiatric nurse contacts (n = 5); psychiatrist contacts (n = 5); psychiatric inpatient admissions (n = 5); psychologist contacts (n = 5); nurse

contacts (n = 4); outpatient attendances (n = 4); counsellor contacts (n = 3); and home carer visits (n = 3). Remaining HSU outcomes are shown in Table 3.

Summary of evidence for identified predictors of HSU

INSERT TABLE 4 HERE

Table 4 provides a summary of the evidence for identified predictors of HSU. The table is structured as follows. First, identified predictors are categorised by 'demographics', 'diagnosis', 'interventions', 'symptoms', 'functioning', and 'behaviour'. Second, the table displays the number of times each identified predictor variable was assessed in relation to HSU, and the number of times each identified variable significantly predicted HSU (and vice versa). Third, using the broad categories of 'primary care HSU', 'specialist HSU', 'inpatient HSU', and 'total HSU', the table documents the operationalisation of HSU outcomes in relation to the prediction of HSU. Fourth, study quality information is provided to aid evaluation of the evidence. For simplicity, a study was arbitrarily deemed to be of 'satisfactory' quality if it scored ≥16 on the STROBE statement, [14] or if bias was not present on three out of four domains on the NICE checklist for RCTs.[15]

As an overview, the review identified 31 predictor variables that were examined in relation to the prediction of HSU. By category, these were: twelve demographic variables, six intervention variables, five diagnostic variables, four symptom variables, three functioning variables and one behavioural variable.

The 12 demographic variables significantly predicted increased HSU 41 of 65 times assessed (63.1%). Six demographic variables predicted increased HSU in two or more assessments and in over 50% of assessments made. These variables, in order of frequency of increased HSU prediction, were: comorbidity (both mental and physical), age (heterogeneous age ranges), female gender, a marital status of divorced, separated or widowed, non-white ethnicity, and high previous HSU. Regarding the age variable, several heterogeneous age ranges (e.g. 35-54, 31-49, 35+, 50-64) were associated with increased HSU, thus it was not possible to draw conclusions relating to specific age ranges. Specific age ranges associated with increased HSU in individual studies are viewable in Table 1. As study quality was satisfactory in the vast majority of these assessments, it can be concluded that there exists good preliminary evidence for these six demographic variables in relation to the prediction of increased HSU.

The six intervention variables significantly predicted decreased HSU 10 of 17 times assessed (58.8%). Two intervention variables predicted decreased HSU in two or more assessments and in over 50% of assessments made. These variables, in order of frequency of decreased HSU prediction, were: accessing an *Improving Access to Psychological Therapies* (IAPT) service, and medication. As study quality was satisfactory in all but one these assessments (an assessment of IAPT), it can be concluded that there exists good preliminary evidence for both IAPT and medication in relation to the prediction of decreased HSU.

The five diagnostic variables significantly predicted increased HSU 13 of 15 times assessed (86.6%). Two diagnostic variables predicted increased HSU in two or more assessments and in over 50% of assessments made. These variables, in order of frequency of increased HSU prediction, were: personality disorder, and obsessive compulsive disorder. Whereas all (eight) assessments of personality disorder came from studies of satisfactory quality, none of the

(four) assessments of obsessive compulsive disorder came from studies of satisfactory quality. Therefore, it can only be concluded that there exists good preliminary evidence for personality disorder in relation to the prediction of increased HSU.

The four symptom variables significantly predicted increased HSU 7 of 15 times assessed (46.6%). One symptom variable - neurotic symptoms- predicted increased HSU in six of six assessments made. Although two assessments came from studies of unsatisfactory quality, it can be concluded that there exists good preliminary evidence for neurotic symptoms in relation to the prediction of increased HSU.

The three functioning variables significantly predicted increased HSU 5 of 9 times assessed (55.6%). Two functioning variables predicted increased HSU in two or more assessments and in over 50% of assessments made. These variables, in order of frequency of increased HSU prediction, are: cognitive deficits and activities of daily living (ADLs). Whereas all (two) assessments of ADLs came from studies of satisfactory quality, none of the (three) assessments of cognitive deficits came from studies of satisfactory quality. Therefore, it can only be concluded that there exists good preliminary evidence for ADLs in relation to the prediction of increased HSU.

In the final variable category, a behavioural variable- self-harm- significantly predicted increased HSU one of one time assessed. This assessment came from a study of satisfactory quality. However, as just one assessment was undertaken, it cannot be concluded that there exists good preliminary evidence for self-harm in relation to the prediction of increased HSU.

In summary, taking into account frequency of prediction and study quality, several predictor variables have good preliminary evidence supporting their ability to predict HSU by adults with mental disorders in the UK. Of these variables (in order of frequency of prediction), comorbidity, personality disorder, age (heterogeneous age ranges), neurotic symptoms, female gender, a marital status of divorced, separated or widowed, non-white ethnicity, medication, high previous HSU, and activities of daily living were associated with increased HSU. Moreover, good preliminary evidence was found for associations of accessing a primary care psychological treatment service and medication use with decreased HSU. Figure 2 illustrates the relative frequencies of predictors of HSU, by category.

INSERT FIGURE 2 HERE

DISCUSSION

Summary of main findings

Taking into account study quality, 28 studies identified a range of variables with good preliminary evidence supporting their ability to predict HSU. Of these variables, comorbidity, personality disorder, age (heterogeneous age ranges), neurotic symptoms, female gender, a marital status of divorced, separated or widowed, non-white ethnicity, medication, high previous HSU, and activities of daily living were associated with increased HSU. Moreover, good preliminary evidence was found for associations of accessing a primary care psychological treatment service and medication use with decreased HSU.

Comparison of main findings with other reviews

Few existing reviews of the predictors of HSU in mental health populations were available for comparison of results. Nevertheless, comorbidity- the most evidenced predictor of increased HSU in the present review- was also shown in a review of 72 studies to predict increased psychiatric service utilisation by 'heavy users' of psychiatric services.[16] This previous review found that several variables not examined by studies in our review (i.e. substance abuse, psychotic illness, isolation, homelessness, and social support) were predictive of increased psychiatric service utilisation. In line with the present review, another review of eight studies found that high previous utilisation predicted increased psychiatric service utilisation.[17] On the other hand, this review found that the variables of living alone and psychosis diagnosis- not examined by studies in the present review- were predictive of increased psychiatric service utilisation.

Overall, the findings from previous reviews add robustness to our finding of good preliminary evidence for the variables of comorbidity and high previous HSU in relation to the prediction of increased HSU by adults with mental disorders in the UK. In addition, despite the sole focus of the previous reviews on psychiatric services which limits their comparability, it is possible that several additional variables- in particular, a psychosis diagnosis- may also predict increased HSU by adults with mental disorders in the UK.

Comparison of main findings with international studies of HSU

As the review was limited to UK studies only, it is informative to compare the findings with those from international studies of HSU by adults with mental disorders. Three recent international studies were chosen for comparative purposes because of their large samples comprising adults with a range of mental health problems.[18-20]

The first was set in Canada, and had a sample of 243 adults diagnosed with various mental disorders.[18] In line with our review, it found that increased social withdrawal, female gender, and (mental disorder) comorbidity were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were emotional problems, income, major depression diagnosis and alcohol dependence.

The second study was set in Australia and had a sample of 822 adults who had previously participated in a school-based epidemiological study in their youth.[19] In line with our review, it found that age (treated as continuous variable), comorbidity, and a marital status of divorced, were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were psychological distress, affective disorder diagnosis, exposure to childhood trauma, while rural living predicted reduced HSU.

The third study[20] used data from a cross-national health survey and involved 8,688 adults from the USA and Canada. It found that comorbidity (various health comorbidities), female gender, and non-white ethnicity were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were emotional problems, income, having a regular doctor, and having insurance.

The findings from these international studies add robustness to our finding of good preliminary evidence for the variables of comorbidity, female gender, and a marital status of divorced in relation to the prediction of HSU by adults with mental disorders in the UK. In addition, it is possible that several additional variables identified in international studies- in particular, emotional problems- may also predict HSU by adults with mental disorders in the UK.

Implications of findings for Mental Health Payment by Results

Our findings can inform the debate surrounding the use of diagnostic information and the MHCT for clustering purposes. The findings also highlight several additional variables that are worthy of consideration in the clustering process.

Regarding the use of diagnostic information, in contrast to previous large-scale studies which showed mental disorder diagnosis to be a poor predictor of increased HSU,[9-11] the review yielded good preliminary evidence for personality disorder diagnosis in relation to the prediction of increased HSU. In addition, it is noted that diagnoses of psychosis, major depression and affective disorder were identified as predictors in previous reviews and international studies.[16-19] Although methodological differences (e.g. in the operationalisation of HSU) in these reviews and studies mean that firm conclusions cannot be drawn, a possible explanation for the discrepancy in findings is that some but not other mental disorder diagnoses may be significantly associated with increased HSU. The uncertainty regarding the ability of mental disorder diagnoses to predict increased HSU means that this review neither refutes nor supports the argument that reliable mental health clusters can be formed by combining broad diagnoses with care pathways, in a simple and practical manner.[12]

Findings relating to the domains of the MHCT (i.e. behaviour, symptoms, impairment, social functioning, and risk factors) can aid assessments of its suitability for clustering purposes. Although some variables relating to these domains were examined, good preliminary evidence for the prediction of increased HSU was found for just two relevant variables- neurotic symptoms and ADLs. Therefore, this review does not provide sufficient evidence to settle the debate regarding the use of the MHCT. However, it highlights the need for further

investigation of the link between the MHCT and increased HSU, especially since this link was not taken into account in the initial development of the MHCT.[13]

Regarding additional variables worth considering in the clustering process, various demographic (i.e. comorbidity, age, female gender, marital status, non-white ethnicity, high previous HSU) and intervention (i.e. IAPT, medication) variables with good preliminary evidence relating to their ability to predict HSU were identified. Future research could investigate if adding these variables into the 'case mix' of the MHCT adds to the economic validity and reliability of mental health clusters. However, it is worth noting that variables that are predictive of HSU are not always suitable for clustering and resource allocation purposes. For example, concerning demographic variables, it could be argued that it would be unfair to distribute resources on the basis of increased HSU by females (relative to males). Similar arguments could be made regarding other population groupings with contrasting HSU levels (e.g. certain ethnic groups). Moreover, the benefit of using intervention variables for clustering purposes may be somewhat limited because it is relatively easy for providers to use these variables to 'game' the system (i.e. when patients are inappropriately and deliberately allocated to clusters that attract higher fixed payments) in order to generate additional revenue. [7]

Methodological considerations

There is relevant research relating to HSU by people with mental disorders not included in this review. This was for various methodological reasons, for example, differing conceptualisations of HSU in investigations by Killapsy and Zi [21] and Trieman and Leff. [22] These studies focused on the stability of HSU over time and were excluded because they do not address our study question which concerns identifying predictive variables contributing to an increase or decrease in HSU. In addition, various methodological factors should be taken into account when interpreting our findings. First, the quality of included studies was mixed. Specifically, using arbitrarily cut-off points on the STROBE statement[14] and the NICE checklist for RCTs,[15] 18 of the 28 studies (64.2%) were deemed to be of 'satisfactory' quality. This mixed quality limits the strength of conclusions that can be drawn. Second, there was wide heterogeneity in the operationalisation of HSU by included studies, which limits the validity of comparisons across studies. A possible reason for this heterogeneity is that 23 out of 28 (82%) of studies collected secondary data from NHS service databases or household surveys, and thus their operationalisation of HSU was constrained. Addressing this issue, the operationalisation of HSU in included studies was documented in considerable detail (Table 3). Third, the review was limited to UK studies only, meaning the list of identified variables is not exhaustive, and the findings may not be applicable to services in other countries. Indeed, this applicability is particularly limited given that only a few other countries (e.g. Australia, New Zealand, Canada, the Netherlands, Norway, USA) have made progress implementing mental health payment systems, using heterogeneous clustering and resource distribution methodologies. [23] Fourth, the majority of literature searching was undertaken by one study author. However, in order to minimise bias and error, 20% of abstracts were independently screened by another author. Fifth, the age variable was reported with heterogeneous age ranges across studies. Thus, conclusions in relation to specific age ranges could not be made. Finally, the study benefits from its thorough reporting process and use of structured checklists for assessments of study quality.

Additional future research directions

Five future research directions not already discussed in relation to *Mental Health Payment by Results* are provided. First, as the operationalisation of HSU in included studies was largely constrained by the use of secondary data from service databases, future HSU studies may benefit from the administration of measures such as the *Client Services Receipt Inventory*,[24] alongside secondary data. Second, an international systematic review of the predictors of HSU by mental health populations could provide a more comprehensive list of predictor variables. Third, the HSU of people with intellectual disabilities were not examined in this review due to the specific additional needs of this population which have to be met beyond the healthcare system. However, it is an important area of research since UK-based studies have highlighted the widespread failure of health services to make required additional accommodations (e.g. extended appointment hours) for this patient group, with no additional funding currently allocated for these purposes to NHS acute trusts.[25] Determining how the inadequate provision of additional accommodations impacts upon the HSU of people with intellectual disabilities could inform future decisions surrounding allocation of resources. Fourth, the review identified a number of variables (i.e. attending a community outreach service, attending a psychiatric liaison service, unspecified ICD-10 diagnosis, insomnia symptoms, self-harming behaviour) examined in relation to HSU in just one study yet predictive of HSU. Therefore, the associations of these variables with HSU could be explored in future research. Finally, further large-scale case register studies (including participants from shared service catchment areas) would address the study heterogeneity found in this review and provide more robust evidence on the predictors of HSU by people with mental disorders in the UK.

Conclusions

This review provides evidence that can inform decisions about which variables might be used to derive mental health clusters in the *Mental Health Payment by Results* system. Several variables- in particular comorbidity, female gender, age (heterogeneous age ranges) high previous HSU, and a marital status of divorced- have good preliminary evidence supporting their ability to predict HSU by adults with mental disorders in the UK, and thus are relevant for clustering purposes. The findings support the need to determine the association of the MHCT (and its domains of behaviour, symptoms, impairment, social functioning and risk factors) with HSU, the need to investigate whether combining broad diagnoses with care pathways is an effective alternative method for mental health clustering, and the need for research to further examine the association between existing mental health clusters and HSU. Overall, this review has highlighted important unresolved issues related to the *Mental Health Payment by Results* system. Addressing these issues could improve how health service resources are distributed, helping to ensure that people experiencing mental health problems can access the most appropriate services at their time of need.

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Statement

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Competing interests.

All authors have completed the ICMJE uniform disclosure form and declare no support from any organisation for submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

Transparency

I, Conal Twomey (lead author and guarantor), affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained .

Ethical approval

None sought for this review of secondary published data that did not involve participants or any identifiable participant information.

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Corresponding author statement

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Table 1. Observational studies of HSU (*n*=17)

Study	Design	Data Source	Participants				Q	HSU outcomes	Predictors of increased HSU	Not predictive of increased HSU
			Composition	*N*	Age	%f	ST			
Button (2005) [26]	Cohort	NHS eating disorders clinic	Eating disorder patients	147	26.3 (*SD* not stated)	96	9	• Total HSU	-	• Type of eating disorder diagnosis
Byford (2010) [27]	Cohort	NHS primary care database	Depressed patients	88935	44.4 (*SD*= 16.75)	68	18	• A&E attendances • GP phone calls • GP visits • Inpatient days • Medication usage • Other specialist contacts • Psychiatrist contacts • Psychologist contacts	• Non-remission (after antidepressant treatment)	• Remission (after antidepressant treatment)
Chollet (2013) [28]	Cohort	NHS primary care database	GAD patients	29131	48.5 (*SD*= 17.5)	67	18	• Total HSU	• Aged 31-49 • Aged 50-64 • High previous HSU • High previous medication use • Male • Two comorbidities	• Aged 18-30 • Aged >65 • Lower previous HSU • Lower previous medication use • FemaleNo, one, or three comorbidities
Coid (2009) [29]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents (some with BPD)	8397	16-74 (*M* not stated)	53	18	• Community psychiatric nurse contacts • Counsellor contacts • GP contacts for psychological problems • Psychiatric inpatient admission • Psychiatrist contacts • Total HSU	• Diagnosis of BPD	• No diagnosis of BPD
Coid (2006)	Cross-sectional	Adult Psychiatric	UK residents with a PD	626	16-74 (*M* not	56	17	• Community psychiatric nurse contacts	• Cluster A, B, and C PD diagnoses	• No comorbidity

[30]		Morbidity Survey			stated)			• Counsellor contacts • GP contacts for psychological problems • Medication usage • Psychiatric inpatient admission • Psychiatrist contacts	• Comorbid mental disorder and substance abuse	
Cooper (2010) [31]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents (some with CMPs)	7461	16+ (*M* not stated)	51	18	• PCT attendance • GP contact for psychological problems • Medication usage	• Aged >35 • ADLs • Widowed / divorced/ separated • Elevated neurotic symptoms • Female • Non-white ethnicity •	• Aged <35 • No ADLs • Marital status other than widowed / divorced/ separated • Non-elevated neurotic symptoms • Male • White ethnicity • Any home ownership status • Number of qualifications
Cooper (2013) [32]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents (some with CMPs)	22196	16+ (*M* not stated)	52	19	• PCT attendance • GP contact for psychological problems • Medication usage	• Aged 35-54 • Aged 75+ • Divorced/ separated/ widowed • Elevated neurotic symptoms • Female • Non-home owner • Non-white ethnicity •	• Aged 16-34 • Aged 55-74 • Marital status other than widowed / divorced/ separated • Male • Non-elevated neurotic symptoms • Home owner • White ethnicity

Foster (2003) [33]	Cross-sectional	Government surveys: adults in private households; adults with psychosis in households and adults in mental institutions	Adults with psychosis	470	16-64 (*M* not stated)	NS	10	• GP contact for psychological problems • Psychiatric inpatient admission • Any service use for a psychological problem	• Aged 16-34 • Aged 45-54 • Elevated neurotic symptoms • White ethnicity	• Aged 35-44 • Aged 55-64 • Family circumstances • Gender • Household type • Living arrangements • Marital status • Non-elevated neurotic mental health symptoms • Non-white ethnicity • Occupation • Physical illness • Qualifications
Hayward (2010) [34]	Cohort	Postal survey of a general practice population	GP attendees	2662	51.3 (*SD*= 17.18)	55	16	• GP contacts • Medication usage	• Insomnia symptoms • Comorbid anxiety or depression	• No insomnia symptoms • No comorbidity
Keene (2007) [35]	Cross-sectional	Databases: health authority, mental health population, and A&E population.	Health and mental health service users	625964	16+ (*M* not stated)	52	16	• A&E attendances	• Four typologies: (1) Young, male frequent attendees with self-harm and other injuries; (2) Young females with self-harm; (3) Older patients with multiple medical conditions; (4) Very old patients with cardiac conditions and fractures	-

Knapp (2002) [36]	Cross-sectional	Maudsley (NHS) psychiatric hospital data; patient interviews	Former Maudsley child and adolescent psychiatric patients	149	Not stated	61	11	• Client Services Receipt Inventory [24]	• Comorbidity of childhood depression and conduct disorder	• No childhood comorbidity
Mohan (2006) [37]	Cohort	PRISM psychosis study set in Maudsley & Bethlem NHS trust area	White (group 1) and African Caribbean (group 2) patients with psychosis	140	40.55 (*SD*= 14.9)	49	18	• Client Services Receipt Inventory [24]	• Receiving intensive community treatment (for African Caribbean patients only)	• Ethnicity • Receiving intensive community treatment (for White patients only)
Patel (2006) [38]	Cross-sectional data from a RCT	RCT data set in South London /Maudsley NHS trust area	Schizophrenia patients	85	26 (SD not stated)	26	13	• 'Other' • A&E attendances • CMHT contacts • Community psychiatric nurse contacts • Day care attendances • General medical ward attendances • GP contacts • Group PCT attendances • Home carer visits • Inpatient admissions • Inpatient days • Non-psychiatric outpatient attendances • Nurse contacts • Occupational therapist contacts • Psychiatric outpatient attendances • Psychiatrist contacts • Psychologist contacts • Sheltered workshop attendances • Specialist education	• Cognitive deficits	• Anti-social behaviour • Depression symptoms • No cognitive deficits • Positive symptoms • Social withdrawal

								• attendances • Total inpatient service use		
Torres (2007) [39]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents with OCD	114	16-74 (*M* not stated)	65	13	• Any community service attendance • Counselling attendance • GP contact for psychological problems • Home carer visits • Medication usage • PCT attendance • Psychiatric inpatient admission • Community psychiatric nurse contacts • Psychiatric outpatient attendances • Psychiatrist contact • Psychologist contact • Support group attendances • Total HSU ('any kind of treatment')	• OCD diagnosis • OCD with co-morbid anxiety or depression	• No OCD diagnosis
Ulrich (2009) [40]	Cross-sectional	Adult Psychiatric Morbidity Survey	UK residents with ASPD	245	16-74 (*M* not stated)	22	16	• Community psychiatric nurse contacts • GP contacts • Other nursing service contacts • Outreach worker contacts • Psychiatric inpatient admission • Psychiatrist contacts • Psychologist contacts • Support group attendances • Total HSU	• Comorbid Axis 1 mental disorders	• Comorbid personality disorders
Walters (2011) [41]	Cohort	Seven NHS general practices.	Primary care patients with mild-to-moderate distress	250	46 (*SD* not stated)	71	20	• GP contacts	• ICD-10 disorders (apart from mixed anxiety and depression)	• Mixed anxiety and depression

Wright (2000) [42]	Cross-sectional	NHS mental health services	Patients with functional psychosis and co-morbid substance abuse.	61	43.1 (*SD* not stated)	56	15	• Inpatient admissions • Inpatient days	-	• Dual diagnosis

Note: A&E= Accident and Emergency; ADLs= Activities of Daily Living restrictions; Age= mean age (if not stated, where possible, age range is stated); ASPD= Anti-social personality disorder; BPD= Borderline Personality Disorder; CMHT= Community Mental Health Team; CMP= common mental health problem; DBT= Dialectical Behaviour Therapy; f=female; GAD= Generalised Anxiety Disorder; GP= General Practitioner; HSU= health service utilisation; *M*= mean; NHS= National Health Service; NS= not stated; OCD= obsessive compulsive disorder; ST= STROBE statement (score range 0-22; 0 represents lowest quality and 22 represents highest quality) [14]; RCT= Randomised Controlled Trial; PCT= psychotherapy; PD= personality disorder. Q= Quality assessment

Table 2. Intervention studies of HSU (*n*=11)

Study	Design	Data Source	Participants				Quality		HSU outcomes	Intervention	Control	Reduced HSU? ($p<.05$)
			Composition	*N*	Age	%f	ST	NC				
Amner (2012) [43]	Cohort	NHS service data	BPD patients availing of DBT	21	36.2 (*SD*= 10.87)	81	13	-	• Day care attendances • DBT attendances • Inpatient days • Nurse contacts • Outpatient attendances • PCT attendances • Total HSU	DBT	-	NO
Ballard (2002) [44]	Quasi-experi-mental	Care facilities	Dementia patients	224	82.5 (*SD*= 7.1)	75	12	-	• GP contacts • Inpatient days	Psychiatric liaison	Usual care	YES
Bateman (2008) [45]	RCT	NHS PD PCT unit	BPD patients	41	31.8 (*SD*= 6.23)	58	-	2	• A&E attendances • Outreach worker contacts • Inpatient days • Medication usage • PCT attendances • Psychiatric treatment days	Mentalisation-based treatment by partial hospitalisation	Usual care	YES
Comman-der (2005) [46]	Cohort	Assertive outreach service data	Outreach patients with schizophrenia, bipolar disorder or 'other' disorder	250	18-64 (*M* not stated)	26	12	-	• Compulsory admissions • Inpatient admissions • Inpatient days	Community outreach service use	-	YES
de Lusignan (2012) [47]	Cohort	NHS (IAPT and hospital service) data	IAPT attendees	1118	35.3 (SD=2 1.4)	50	15	-	• A&E attendances • Inpatient admissions • Inpatient days • Medication usage • Outpatient attendances • Sick notes issued	IAPT service	-	YES

de Lusignan (2013) [48]	Case control	NHS (IAPT and hospital service) data	IAPT attendees with long term health conditions	1341	52.8 (SD= 11.15)	65	19	-	• A&E attendances • Inpatient admissions • Inpatient days • Medication usage • Outpatient attendances • Sick notes issued	IAPT service	-	YES
Hayhurst (2002) [49]	Cohort	NHS University Hospitals service data	Patients receiving antipsychotic medication	126	42.55 (SD= 12.29)	35	16	-	• Inpatient admissions • Inpatient days	Clozapine	-	YES
Lam (2005) [50]	RCT	Maudsley & Bethlem NHS trust area	Patients with bipolar disorder	87	43.95 (*SD*= 11.45)	33	-	4	• Any community services attendance • Medication usage • Non-psychiatric inpatient days • Psychiatric inpatient days • Total HSU	Cognitive therapy (added to usual care)	Usual care	NO
Shi (2012) [51]	Cohort	NHS primary care database	Depressed adults initiating duloxetine	909	49.6 (*SD*= 16.5)	67	17	-	• A&E attendances • Inpatient admissions • Medication usage • Referrals to specialists • GP phone calls • GP visits • Inpatient admissions • Medication usage • Referrals to other specialist • Referrals to psychiatrist • Total HSU	Duloxetine	-	YES
Wade (2010) [52]	Cohort	NHS primary care database	Depressed adults using escitalopram, venlafaxine, or generic SSRI	2485	43.1 (*SD*= 14.7)	60	18	-		Escitalopram	Generic SSRIs; venla-faxine	YES
Woods (2012) [53]	RCT	Community-based RCT	Patients of NHS Memory Clinics and CMHTs	488	77.1 (*SD*= 7.3)	50	-	4	• A&E attendances • Care attendant contacts • Care manager contacts • Chiropodist contacts • CMHT contacts • Community psychiatrist contacts • Continuing care/respite contacts • Counsellor contacts • Day hospital contacts • Dietician contacts	Reminiscence group	Usual care	NO

- Family support worker contacts
- GP contacts
- Health visitor contacts
- Home carer visits
- Informal/ voluntary care contacts
- Inpatient rehabilitation contacts
- General medical ward attendances
- NHS contacts
- Occupational therapist contacts
- Other inpatient ward contacts
- Outpatient attendances
- Physiotherapist contacts
- Nurse contacts
- Psychologist contacts
- Sitting scheme worker contacts

Note: A&E= Accident and Emergency; Age= mean age (if not stated, where possible, age range is stated); BPD= Borderline Personality Disorder; CMHT= community mental health team; DBT= Dialectical Behaviour Therapy; f=female; GP = General Practitioner; HSU= health service utilisation; IAPT= *Improving Access to Psychological Therapies* initiative; NC= NICE checklist for RCTs (score range = 0-4; 0 indicates bias and 4 indicates no bias) (NICE, 2009); NHS= National Health Service; ST= STROBE statement (score range 0-22; 0 represents lowest quality and 22 represents highest quality) [14]; PCT= psychotherapy; PD= personality disorder

Table 3. Frequency of HSU outcomes used across included studies (*n*=28).

Primary care HSU	***n***
Mental health	
GP contact(s) for psychological problems	6
Referrals to psychiatrist	1
Support group attendances	2
Total	9
*General health**	
GP contacts	7
GP phone calls	2
GP visits	2
Referrals to specialists	2
Sick notes issued	2
Total	15

Specialist HSU	***n***
Mental health	
Medication usage**	12
Psychotherapy attendance(s)	6
Community psychiatric nurse contacts	5
Psychiatrist contact(s)	5
Psychologist contact(s)	5
Outpatient attendances	4
Counsellor contacts	3
Day care attendances	2
CMHT contacts	2
DBT attendances	1
Psychiatric outpatient attendances	1
Psychologist / psychiatrist contacts	1
Total	47

*General health**	
Nurse contacts	4
Home carer visits	3
Any community service attendance	2
General medical ward attendances	2
Occupational therapist contacts	2
Outreach worker contacts	2
Care attendant contacts	1
Care manager contacts	1
Chiropodist contacts	1
Continuing care / respite contacts	1
Counselling attendance	1
Day hospital contacts	1
Dietician contacts	1
Family support worker contacts	1
Health visitor contacts	1
Informal/voluntary care contacts	1
Inpatient rehabilitation contacts	1
NHS contacts	1
Non-psychiatric outpatient attendances	1
Other inpatient ward contacts	1
Other nursing service contacts	1
Other specialist contacts	1
Physiotherapist contacts	1
Total	32

Inpatient HSU	***n***
Mental health	
Psychiatric inpatient admission(s)	5
Psychiatric inpatient days	1
Psychiatric outpatient attendances	1
Compulsory admissions	1
Psychiatric treatment days	1
Total	9
*General health**	
Inpatient days	9
A&E attendances	8
Inpatient admissions	8
Non-psychiatric inpatient days	2
Sheltered workshop attendances	1
Sitting scheme worker contacts	1
Specialist education attendances	1
Total inpatient service use	1
Total	31

Total and other HSU	***n***
Total HSU	8
'Other' HSU	1
Any service use for psychological problem	1
Client Services Receipt Inventory	2
Total	12

Summary totals	***n***
Primary Care HSU	24
Specialist HSU	79
Inpatient HSU	40
Total and other HSU	12
Mental health HSU	65
General health HSU	78
Types of outcome variables	60
Times outcomes assessed	155

Note: * General health refers to HSU that was not specified as being directly linked to mental ill health. **Type of medication varied widely. A&E= Accident and Emergency; CMHT= community mental health team; Client Services Receipt Inventory [24]; DBT= Dialectical Behaviour Therapy; HSU= health service utilisation. NHS= National Health Service.

Table 4. Summary of the evidence for examined predictors of HSU.

Predictor variables	*n* variable assessed	Assessments in which variable predicted HSU												Assessments in which variable did not predict HSU											
		n	HSU outcomes predicted (*n*)*											*n*	HSU outcomes not predicted (*n*)*										
			Prim. Care			Specialist			Inpatient			Total HSU			Prim. Care			Specialist			Inpatient			Total HSU	
			n	Quality		*n*	Quality		*n*	Quality		*n*	Quality		*n*	Quality		*n*	Quality		*n*	Quality		*n*	Quality	
				+	-		+	-		+	-		+	-			+	-		+	-			+	-		+	-
Demographic [28-37 39 40 42]																											
Comorbidity**	15	14	*4*	**3**	1	*3*	**2**	1	*3*	**2**	1	*4*	**2**	2	1	*0*			*0*			*1*	**0**	1	*0*		
Age***	7	7	*2*	**2**	0	*2*	**2**	0	*2*	**1**	1	*1*	**1**	0	0												
Female gender	7	5	*2*	**2**	0	*2*	**2**	0	*1*	**1**	0	*0*			2	*0*			*0*			*1*	**0**	1	*1*	**1**	0
Male gender	7	2	*0*			*0*			*1*	**1**	0	*1*	**1**	0	5	*2*	**2**	0	*2*	**2**	0	*1*	**0**	1	*0*		
NW ethnicity	6	4	*2*	**2**	0	*2*	**2**	0	*0*			*0*			2	*0*			*0*			*0*			*2*	**1**	1
White ethnicity	6	1	*0*			*0*			*0*			*1*	**0**	1	5	*2*	**2**	0	*2*	**2**	0	*0*			*1*	**1**	0
Marital status****	5	4	*2*	**2**	0	*2*	**2**	0	*0*			*0*			1	*0*			*0*			*0*			*1*	**0**	1
Non-home owner	5	2	*1*	**1**	0	*1*	**1**	0	*0*			*0*			3	*1*	**1**	0	*1*	**1**	0	*0*			*1*	**0**	1
Qualifications	3	0	*0*			*0*			*0*			*0*			3	*1*	**1**	0	*1*	**1**	0	*0*			*1*	**0**	1
High prev. HSU	2	2	*0*			*0*			*0*			*2*	**2**	0	0	*0*			*0*			*0*			*0*		
Family situation	1	0	*0*			*0*			*0*			*0*			1	*0*			*0*			*1*	**0**	1	*0*		
Occupation	1	0	*0*			*0*			*0*			*0*			1	*0*			*0*			*1*	**0**	1	*0*		
Total	65	41	*13*	**12**	1	*12*	**11**	1	*7*	**5**	2	*9*	**6**	3	24	*6*	**6**	0	*6*	**6**	0	*5*	**0**	5	*7*	**3**	4
Intervention ***** [43-53]																											
IAPT service	4	4	*1*	**1**	0	*1*	**1**	0	*2*	**1**	1	*0*			0	*0*			*0*			*0*			*0*		
Psychotherapy	4	1	*1*	**1**	0	*0*			*0*			*0*			3	*0*			*1*	**1**	0	*1*	**1**	0	*1*	**1**	0
Reminiscence grp.	4	0	*0*			*0*			*0*			*0*			4	*1*	**1**	0	*1*	**1**	0	*1*	**1**	0	*1*	**1**	0
Medication	3	3	*1*	**1**	0	*0*			*2*	**2**	0	*0*			0	*0*			*0*			*0*			*0*		
Comm. outreach	1	1	*0*			*0*			*1*	**1**	0	*0*			0	*0*			*0*			*0*			*0*		
Psychiatric liaison	1	1	*1*	**0**	1	*0*			*0*			*0*			0	*0*			*0*			*0*			*0*		
Total	17	10	*4*	**3**	1	*1*	**1**	0	*5*	**4**	1	*0*			7	*1*	**1**	0	*2*	**2**	0	*2*	**2**	0	*2*	**2**	0
Diagnostic [26 29 30 39 41]																											
PD	8	8	*2*	**2**	0	*2*	**2**	0	*2*	**2**	0	*2*	**2**	0	0	*0*			*0*			*0*			*0*		
OCD	4	4	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1	0	*0*			*0*			*0*			*0*		

Unspec. ICD-10	1	1	*1*	**1**	0	*0*			*0*			*0*			0	*0*			*0*			*0*			*0*		
Eating disorder	1	0	*0*			*0*			*0*			*0*			1	*0*			*0*			*0*			*1*	**0**	1
MADD	1	0	*0*			*0*			*0*			*0*			1	*1*	**1**	0	*0*			*0*			*0*		
Total	15	13	*4*	**3**	1	*3*	**2**	1	*3*	**2**	1	*3*	**2**	1	2	*1*	**1**	0	*0*			*0*			*1*	**0**	1
Symptoms [31-34 38]																											
Neurotic	6	6	*3*	**2**	1	*2*	**2**	0	*0*			*1*	**0**	1	0	*0*			*0*			*0*			*0*		
Depression	4	0	*0*			*0*			*0*			*0*			4	*1*	0	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1
Positive******	4	0	*0*			*0*			*0*			*0*			4	*1*	0	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1
Insomnia	1	1	*1*	**1**	0	*0*			*0*			*0*			0	*0*			*0*			*0*			*0*		
Total	15	7	*4*	**3**	1	*2*	**2**	0	*0*			*1*	**0**	1	8	*2*	0	2	*2*	**0**	2	*2*	**0**	2	*2*	**0**	2
Functioning [31 38]																											
Social withdrawal	4	0	*0*			*0*			*0*			*0*			4	*1*	0	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1
Cognitive deficits	3	3	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1	*0*			0	*0*			*0*			*0*			*0*		
ADLs	2	2	*1*	**1**	0	*1*	**1**	0	*0*			*0*			0	*0*			*0*			*0*			*0*		
Total	9	5	*2*	**1**	1	*2*	**1**	1	*1*	**0**	1	*0*			4	*1*	0	1	*1*	**0**	1	*1*	**0**	1	*1*	**0**	1
Behavioural [35]																											
Self-harm	1	1	*0*			*0*			*1*	**1**	0	*0*			0	*0*			*0*			*0*			*0*		

Note: *Most studies examined more than one health service utilisation outcome measure. **Both mental and physical comorbidity. ***Various heterogeneous age ranges predicted increased HSU in individual studies: 16-34; 31-49; 45-54; 50-64; >35; 35-54; 75+. **** Only divorced/ separated/ widowed marital statuses were predictive of increased HSU. *****If an intervention reduced HSU, it was counted as predicting HSU, and vice versa. ******Positive = positive symptoms associated with schizophrenia. ADLs= Activities of Daily Living ; Comm.= community; grp= group; HSU= health service utilisation; IAPT= *Improving Access to Psychological Therapies* initiative; ICD-10= International Classification of Diseases-10; MADD= mixed anxiety and depressive disorder; NW= non-white; PD=Personality Disorder; prev.= previous; Prim.= Primary; Unspec.= Unspecified; $^{+}$ = A score of $\geq$16 on STROBE statement,[14] or $\geq$3 on NICE checklist for RCTs;[15] $^{-}$ = A score of $\leq$15 on STROBE checklist, or $\leq$2 on NICE RCT checklist).

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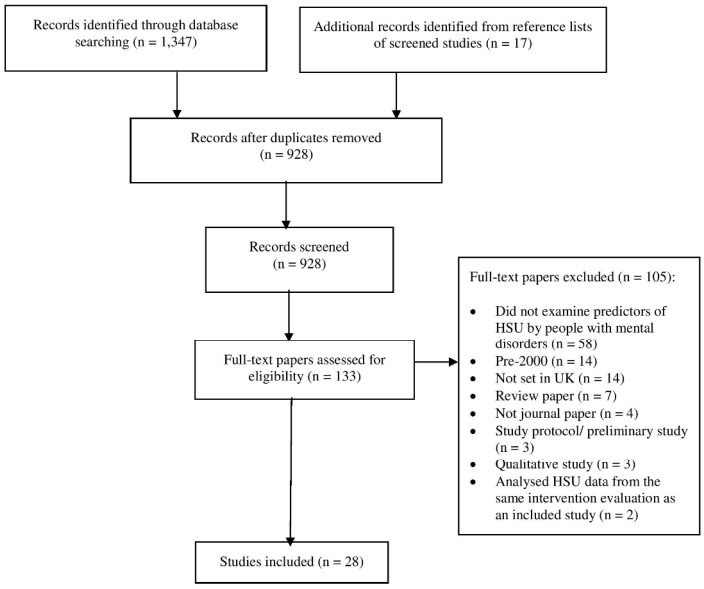

Figure 1: Literature search flow

210x297mm (300 x 300 DPI)

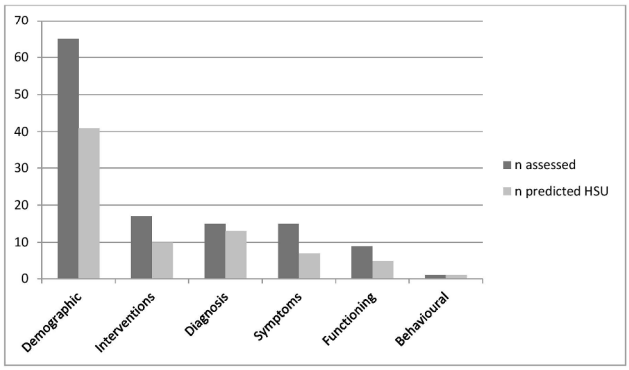

Figure 2: Frequency of HSU prediction by variable category.

Note: HSU= health service utilisation; frequencies were obtained by counting some studies various times for one variable category; for interventions, the count concerned the prediction of decreased HSU

210x297mm (300 x 300 DPI)

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both. **A systematic review of the predictors of health service utilisation by adults with mental disorders in the UK**	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. **Abstract** **Objectives** To identify variables which predict health service utilisation (HSU) by adults with mental disorders in the UK, and to determine the evidence level for these predictors. **Design** A narrative synthesis of peer-reviewed studies published after the year 2000. The search was conducted using four databases (i.e. *PsycINFO, CINAHL Plus with full text, MEDLINE,* and *EMBASE*) and completed on March 25th, 2014. **Setting** The majority of included studies were set in health services across primary, secondary, specialist, and inpatient care. Some studies used data from household and postal surveys. **Participants** Included were UK-based studies that predicted HSU by adults with mental disorders, Participants had a range of mental disorders including psychotic disorders, personality disorders, depression, anxiety disorders, eating disorders, and dementia. **Primary outcome**	2

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		A wide range of HSU outcomes were examined, including GP contacts, medication usage, psychiatrist contacts, psychotherapy attendances, inpatient days, accident and emergency admissions, and 'total HSU' **Results** Taking into account study quality, 28 studies identified a range of variables with good preliminary evidence supporting their ability to predict HSU. Of these variables, comorbidity, personality disorder, age (heterogeneous age ranges), neurotic symptoms, female gender, a marital status of divorced, separated or widowed, non-white ethnicity, medication, high previous HSU, and activities of daily living were associated with increased HSU. Moreover, good preliminary evidence was found for associations of accessing a primary care psychological treatment service and medication use with decreased HSU. **Conclusions** The findings can inform decisions about which variables might be used to derive mental health clusters in 'payment by results' systems in the UK. The findings also support the need to investigate whether combining broad diagnoses with care pathways is an effective method for mental health clustering, and the need for research to further examine the association between mental health clusters and HSU. **Declaration of interest** None.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. In the context of the ongoing development of *Mental Health Payment by Results*, and the debate surrounding the use of diagnostic information and the MHCT, it is important to provide evidence that can inform decisions about which variables might be used to derive mental health clusters. To date, no UK-based systematic reviews informing this process have been undertaken. A review of relevant studies set in the UK would address UK-specific HSU patterns, increasing the applicability of findings to the *Mental Health Payment by Results* system.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). Therefore, the general objective of this systematic review is to identify variables with sufficient evidence	4

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		supporting their ability to predict HSU. The review has two specific aims. First, to identify the variables examined in relation to the prediction of HSU by adults with mental disorders in the UK. Second, to determine the level of evidence that exists for identified predictors of this HSU.	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. A review protocol exists but it is not available to the public.	n/a
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. *Inclusion and exclusion criteria* Only the following types of studies were included in the review: (1) observational and intervention studies that predicted HSU by adults with mental disorders. (For the purposes of this review, mental disorders included adults experiencing elevated symptoms of mental disorders, or adults formally diagnosed with a mental disorder. Studies with participants with intellectual disability were excluded due to the specific needs of this population which have to be met beyond the healthcare system (e.g. in the education or labour systems); (2) studies based in the UK, with UK participants; (3) peer-reviewed studies published in scientific journals, in the year 2000 or after. (This cut-off point was chosen so that included studies were approximately in line with the overall *Payment by Results* scheme introduced in 2003. Intervention costing studies which did not predict HSU were excluded).	6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. *Literature search* Based on these criteria, the first author searched four databases: *PsycINFO, CINAHL Plus with full text, MEDLINE,* and *EMBASE.* The final search was conducted on March 25th, 2014. Additional records were identified from hand-searching reference lists of included studies.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6

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		Search terms and database subject headings related to HSU (i.e. health care utilisation [subject heading] OR health care utili* OR health service utili* OR health care use OR health service use) were combined with those terms for mental disorders (i.e. Mental disorders [subject heading] OR psychiatric) and the UK location (i.e. UK [subject heading] OR NHS). Due to the differing search procedures deployed by the four databases, slightly altered versions of this search strategy were used in each database.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). *Inclusion and exclusion criteria* Only the following types of studies were included in the review: (1) observational and intervention studies that predicted HSU by adults with mental disorders. (For the purposes of this review, mental disorders included adults experiencing elevated symptoms of mental disorders, or adults formally diagnosed with a mental disorder. Studies with participants with intellectual disability were excluded due to the specific needs of this population which have to be met beyond the healthcare system (e.g. in the education or labour systems); (2) studies based in the UK, with UK participants; (3) peer-reviewed studies published in scientific journals, in the year 2000 or after. (This cut-off point was chosen so that included studies were approximately in line with the overall *Payment by Results* scheme introduced in 2003. Intervention costing studies which did not predict HSU were excluded).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. Independent screening of 20% of abstracts was undertaken by the third author. When the first author and third author disagreed regarding the screening outcome of an abstract, the abstract was included in screening at 'full-text' level (by the first author). *Data extraction* Data from included studies were extracted using an Excel spreadsheet. Extracted data pertained to basic study description, study design, records source, data collection times, participants, mental disorder	6

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		investigated, operationalization of HSU outcomes, the prediction of HSU, and statistics. In addition, each study was assessed for quality using the STROBE statement[14] (for observational studies) and the National Institute for Health and Clinical Excellence (NICE) checklist for Randomized Controlled Trials (RCTs).[15] The former is a checklist of 22 items related to the reporting of title (one item), introduction (two items), methods (nine items), results (five items), discussion (four items), and funding information (one item).[14] The latter assesses bias in RCTs in four sections- selection bias, performance bias, attrition bias, and detection bias.[15]	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. Only the following types of studies were included in the review: (1) observational and intervention studies that predicted HSU by adults with mental disorders. (For the purposes of this review, mental disorders included adults experiencing elevated symptoms of mental disorders, or adults formally diagnosed with a mental disorder. Studies with participants with intellectual disability were excluded due to the specific needs of this population which have to be met beyond the healthcare system (e.g. in the education or labour systems).	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. In addition, each study was assessed for quality using the STROBE statement[14] (for observational studies) and the National Institute for Health and Clinical Excellence (NICE) checklist for Randomized Controlled Trials (RCTs).[15] The former is a checklist of 22 items related to the reporting of title (one item), introduction (two items), methods (nine items), results (five items), discussion (four items), and funding information (one item).[14] The latter assesses bias in RCTs in four sections- selection bias, performance bias, attrition bias, and detection bias.[15]	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means). It was a narrative synthesis so no summary measures were used. *Data analysis*	6

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		Due to the heterogeneity in study deigns, samples and mental disorders investigated, a meta-analysis was not possible. Narrative synthesis was deemed the most appropriate method of data analysis.	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis. *Data analysis* Due to the heterogeneity in study deigns, samples and mental disorders investigated, a meta-analysis was not possible. Narrative synthesis was deemed the most appropriate method of data analysis.	6

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). In addition, each study was assessed for quality using the STROBE statement[14] (for observational studies) and the National Institute for Health and Clinical Excellence (NICE) checklist for Randomized Controlled Trials (RCTs).[15] The former is a checklist of 22 items related to the reporting of title (one item), introduction (two items), methods (nine items), results (five items), discussion (four items), and funding information (one item).[14] The latter assesses bias in RCTs in four sections- selection bias, performance bias, attrition bias, and detection bias.[15]	6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. *Literature search flow* The literature search flow is displayed in Figure 1. In total, 1,364 records were identified. Database-searching yielded 1,347 records and hand-searching yielded 17 additional records. After duplicates were removed, 928 studies were screened at 'abstract' level. For screening of abstracts, there was a 94.1% agreement rate between the first author and the third author. After abstract screening, 133 studies were	8

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		assessed for eligibility at 'full-text' level. 28 studies were included in the final review.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. This is viewable in Tables 1 and 2, and referred to, as below: *Overview of included studies* To provide an overview of included studies, extracted data were summarised in two tables (Tables 1 and 2). Table 1 summarises observational studies of HSU, and Table 2 summarises studies of interventions (of both observational and experimental design) aiming to reduce HSU. As can be seen in both tables, the data source of included studies varied. Most frequently it included routine NHS service data or databases (n = 14), different versions of the *Adult National Psychiatric Morbidity Survey* (n = 6) and other household and postal surveys (n = 3). The sample composition also varied and included adults with a psychotic disorder (n = 7), personality disorder (n = 5), depression (n = 3), an anxiety disorder (n = 2), an eating disorder (n = 1), 'common mental health problems' (n = 2) and dementia (n = 1). It also included health service users (n = 6) and former adolescent psychiatric patients (n = 1).	8
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). See Tables 1 and 2 for bias reported for individual studies.:	19/25
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. See Tables 1 and 2	19/25
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency. See Tables 3 and 4	28/29
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	8

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		The quality of included studies was mixed. STROBE statement[14] scores for observational studies (n = 25) ranged from 9-20 (mean *[M]* = 15.5; standard deviation *[SD]* = 3.05), out of a possible maximum score of 22. Of the three RCTs assessed using the NICE checklist,[15] two indicated the absence of bias, and one indicated the possible presence of bias. As can be seen in Tables 1 and 2, both the operationalisation of HSU outcomes and the identified predictors of HSU in individual studies varied widely.	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). *Summary of main findings* Taking into account study quality, 28 studies identified a range of variables with good preliminary evidence supporting their ability to predict HSU. Of these variables, comorbidity, personality disorder, age (heterogeneous age ranges), neurotic symptoms, female gender, a marital status of divorced, separated or widowed, non-white ethnicity, medication, high previous HSU, and activities of daily living were associated with increased HSU. Moreover, good preliminary evidence was found for associations of accessing a primary care psychological treatment service and medication use with decreased HSU. *Comparison of main findings with other reviews* Few existing reviews of the predictors of HSU in mental health populations were available for comparison of results. Nevertheless, comorbidity- the most evidenced predictor of increased HSU in the present review- was also shown in a review of 72 studies to predict increased psychiatric service utilisation by 'heavy users' of psychiatric services.[16] This previous review found that several variables not examined by studies in our review (i.e. substance abuse, psychotic illness, isolation, homelessness, and social support) were predictive of increased psychiatric service utilisation. In line with the present review, another review of eight studies found that high previous utilisation predicted increased psychiatric service utilisation.[17] On the other hand, this review found that the variables of living alone and psychosis diagnosis- not examined by studies in the present review- were predictive of increased psychiatric service utilisation. Overall, the findings from previous reviews add robustness to our finding of good preliminary evidence for the variables of comorbidity and high previous HSU in relation to the prediction of increased HSU by	11-13

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adults with mental disorders in the UK. In addition, despite the sole focus of the previous reviews on psychiatric services which limits their comparability, it is possible that several additional variables- in particular, a psychosis diagnosis- may also predict increased HSU by adults with mental disorders in the UK.

Comparison of main findings with international studies of HSU

As the review was limited to UK studies only, it is informative to compare the findings with those from international studies of HSU by adults with mental disorders. Three recent international studies were chosen for comparative purposes because of their large samples comprising adults with a range of mental health problems.[18-20]

The first was set in Canada, and had a sample of 243 adults diagnosed with various mental disorders.[18] In line with our review, it found that increased social withdrawal, female gender, and (mental disorder) comorbidity were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were emotional problems, income, major depression diagnosis and alcohol dependence.

The second study was set in Australia and had a sample of 822 adults who had previously participated in a school-based epidemiological study in their youth.[19] In line with our review, it found that age (treated as continuous variable), comorbidity, and a marital status of divorced, were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were psychological distress, affective disorder diagnosis, exposure to childhood trauma, while rural living predicted reduced HSU.

The third study[20] used data from a cross-national health survey and involved 8,688 adults from the USA and Canada. It found that comorbidity (various health comorbidities), female gender, and non-white ethnicity were associated with increased HSU. Additional predictors of increased HSU not identified by studies in our review were emotional problems, income, having a regular doctor, and having insurance.

The findings from these international studies add robustness to our finding of good preliminary evidence for the variables of comorbidity, female gender, and a marital status of divorced in relation to the prediction of HSU by adults with mental disorders in the UK. In addition, it is possible that several additional variables identified in international studies- in particular, emotional problems- may also predict HSU by adults with mental disorders in the UK.

Implications of findings for Mental Health Payment by Results

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Our findings can inform the debate surrounding the use of diagnostic information and the MHCT for clustering purposes. The findings also highlight several additional variables that are worthy of consideration in the clustering process.

Regarding the use of diagnostic information, in contrast to previous large-scale studies which showed mental disorder diagnosis to be a poor predictor of increased HSU,[9-11] the review yielded good preliminary evidence for personality disorder diagnosis in relation to the prediction of increased HSU. In addition, it is noted that diagnoses of psychosis, major depression and affective disorder were identified as predictors in previous reviews and international studies.[16-19] Although methodological differences (e.g. in the operationalisation of HSU) in these reviews and studies mean that firm conclusions cannot be drawn, a possible explanation for the discrepancy in findings is that some but not other mental disorder diagnoses may be significantly associated with increased HSU. The uncertainty regarding the ability of mental disorder diagnoses to predict increased HSU means that this review neither refutes nor supports the argument that reliable mental health clusters can be formed by combining broad diagnoses with care pathways, in a simple and practical manner.[12]

Findings relating to the domains of the MHCT (i.e. behaviour, symptoms, impairment, social functioning, and risk factors) can aid assessments of its suitability for clustering purposes. Although some variables relating to these domains were examined, good preliminary evidence for the prediction of increased HSU was found for just two relevant variables- neurotic symptoms and ADLs. Therefore, this review does not provide sufficient evidence to settle the debate regarding the use of the MHCT. However, it highlights the need for further investigation of the link between the MHCT and increased HSU, especially since this link was not taken into account in the initial development of the MHCT.[13]

Regarding additional variables worth considering in the clustering process, various demographic (i.e. comorbidity, age, female gender, marital status, non-white ethnicity, high previous HSU) and intervention (i.e. IAPT, medication) variables with good preliminary evidence relating to their ability to predict HSU were identified. Future research could investigate if adding these variables into the 'case mix' of the MHCT adds to the economic validity and reliability of mental health clusters. However, it is worth noting that variables that are predictive of HSU are not always suitable for clustering and resource allocation purposes. For example, concerning demographic variables, it could be argued that it would be unfair to distribute resources on the basis of increased HSU by females (relative to males). Similar arguments could be made regarding other population groupings with contrasting HSU levels (e.g. ethnic groups). Moreover, the benefit of using intervention variables for clustering purposes may be somewhat limited because it is relatively easy for providers to use these variables to 'game' the system (i.e. when patients are

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		inappropriately and deliberately allocated to clusters that attract higher fixed payments) in order to generate additional revenue. [7]	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). *Methodological considerations* There is relevant research relating to HSU by people with mental disorders that was not included in this review. This was for various methodological reasons, for example, differing conceptualisations of HSU in investigations by Killapsy and Zi [22] and Trieman and Leff. [23] These studies focused on the stability of HSU over time and were excluded because they do not address our study question which concerns identifying predictive variables contributing to an increase or decrease in HSU. In addition, various methodological factors should be taken into account when interpreting our findings. First, the quality of included studies was mixed. Specifically, using arbitrarily cut-off points on the STROBE statement[14] and the NICE checklist for RCTs,[15] 18 of the 28 studies (64.2%) were deemed to be of 'satisfactory' quality. This mixed quality limits the strength of conclusions that can be drawn. Second, there was wide heterogeneity in the operationalisation of HSU by included studies, which limits the validity of comparisons across studies. A possible reason for this heterogeneity is that 23 out of 28 (82%) of studies collected secondary data from NHS service databases or household surveys, and thus their operationalisation of HSU was constrained. Addressing this issue, the operationalisation of HSU in included studies was documented in considerable detail (Table 3). Third, the review was limited to UK studies only, meaning the list of identified variables is not exhaustive, and the findings may not be applicable to services in other countries. Indeed, this applicability is particularly limited given that only a few other countries (e.g. Australia, New Zealand, Canada, the Netherlands, Norway, USA) have made progress implementing mental health payment systems, using heterogeneous clustering and resource distribution methodologies. [24] Fourth, the majority of literature searching was undertaken by one study author. However, in order to minimise bias and error, 20% of abstracts were independently screened by another author. Fifth, the age variable was reported with heterogeneous age ranges across studies. Thus, conclusions in relation to specific age ranges could not be made. Finally, the study benefits from its thorough reporting process and use of structured checklists for assessments of study quality.	13-14
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12-14

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		benefit of using intervention variables for clustering purposes may be somewhat limited because it is relatively easy for providers to use these variables to 'game' the system (i.e. when patients are inappropriately and deliberately allocated to clusters that attract higher fixed payments) in order to generate additional revenue. [7] *Conclusions* This review provides evidence that can inform decisions about which variables might be used to derive mental health clusters in the *Mental Health Payment by Results* system. Several variables- in particular comorbidity, female gender, age (heterogeneous age ranges) high previous HSU, and a marital status of divorced- have good preliminary evidence supporting their ability to predict HSU by adults with mental disorders in the UK, and thus are relevant for clustering purposes. The findings support the need to determine the association of the MHCT (and its domains of behaviour, symptoms, impairment, social functioning and risk factors) with HSU, the need to investigate whether combining broad diagnoses with care pathways is an effective alternative method for mental health clustering, and the need for research to further examine the association between existing mental health clusters and HSU. Overall, this review has highlighted important unresolved issues related to the *Mental Health Payment by Results* system. Addressing these issues could improve how health service resources are distributed, helping to ensure that people experiencing mental health problems can access the most appropriate services at their time of need.	
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Competing interests.

All authors have completed the ICMJE uniform disclosure form and declare no support from any organisation for submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

Transparency

I, Conal Twomey (lead author and guarantor), affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained .

Ethical approval

None sought for this review of secondary published data that did not involve participants or any identifiable participant information.

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No additional data available.

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