

Developing a conceptual framework of patient prioritisation and definition of pharmaceutical acuity

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Executive summary

Limited healthcare resources, a rise in demand for services and the emergence of a global pandemic has meant that hospital pharmacy teams are seeking out ways to work more efficiently to maintain patient safety. One such approach is the use of prioritisation tools that direct the delivery of pharmacy services to patients who need them most.

Indeed, the European Statements of Hospital Pharmacy asserts that ‘Hospital pharmacists should develop, in collaboration with other stakeholders, criteria and measurements to enable the prioritisation of hospital pharmacy activities’. However, although there are many tools or processes in use to support prioritisation, there is ambiguity and variation in terminology when describing this process.

The term ‘patient acuity’ is commonly used within nursing and other areas of healthcare to determine a patient’s requirements for care and several definitions of this term exist. In pharmacy, the word acuity is sometimes used to describe a patient’s need for pharmaceutical care; yet, it has not been defined nor explained. This project aims to develop a conceptual framework of patient prioritisation for pharmacy services and a definition of pharmaceutical acuity. This will provide a shared understanding both within the pharmacy profession and across the wider healthcare team as to the meaning and purpose of acuity in the context of pharmaceutical care as well as inform the future research agenda in this area.

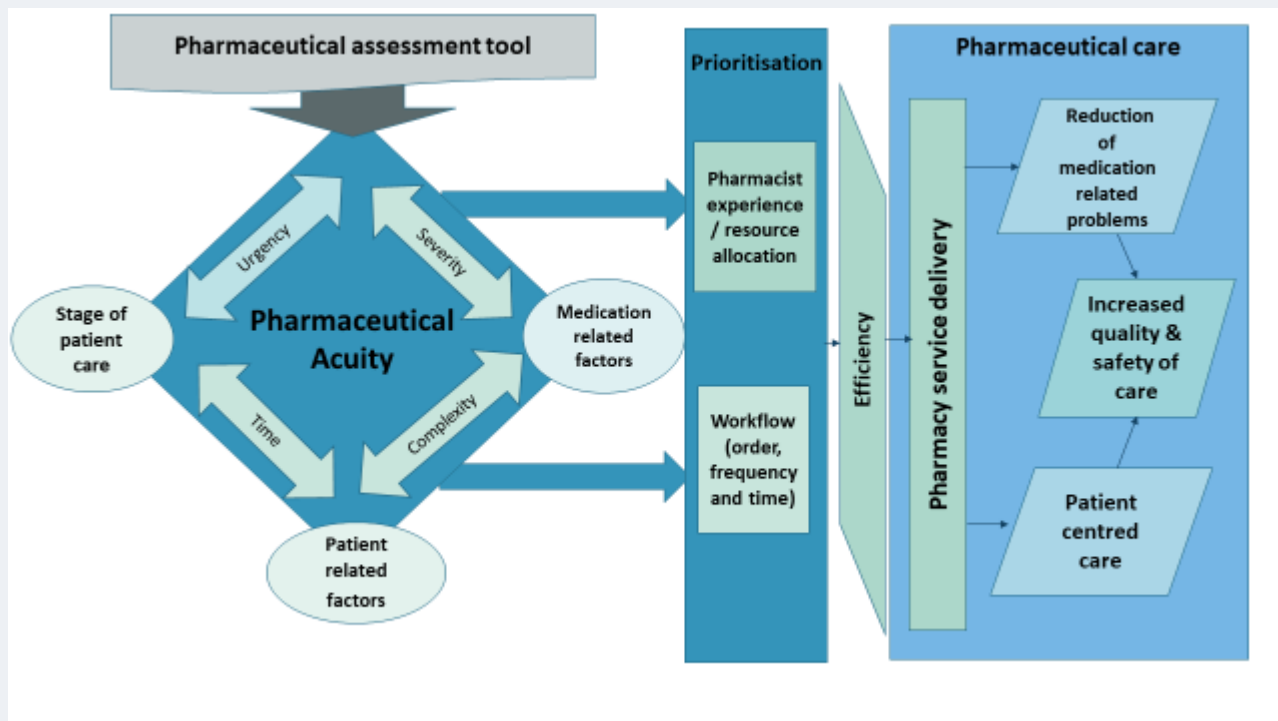
To develop a conceptual framework of patient prioritisation for pharmacy services and a definition of pharmaceutical acuity, multiple steps were taken:

- A literature review and content analysis of existing pharmaceutical assessment/prioritisation tools
- A literature review of definitions and concepts of acuity in pharmacy and wider healthcare contexts
- Two consensus building workshops with experts from 12 countries
- Patient and public involvement workshop

The review and content analysis of existing pharmaceutical tools elucidated the key processes and outcomes associated with patient prioritisation for pharmacy services, generating the basis for a conceptual framework. The review also generated a rich understanding of the meaning of acuity and related terms within a pharmacy context.

The review of definitions and concepts of acuity in pharmacy and wider healthcare contexts confirmed our belief that there is no existing definition of pharmaceutical acuity or acuity within a pharmacy context. Definitions of acuity from nursing and other settings were extracted from the literature and compared to our initial conceptual framework, enabling adaptation of existing definitions.

A group of 15 international experts were provided with a summary of the review findings and invited to take part in two consensus building workshops and online survey. The conceptual framework was refined, and agreement reached on a definition of pharmaceutical acuity from a selection of adapted definitions and original definition developed by the team. A patient and public involvement group provided their views on the conceptual framework and definition. The resulting conceptual framework and definition of pharmaceutical acuity are provided below:



A conceptual framework of patient prioritisation for pharmacy services

The agreed definition was:

“Pharmaceutical acuity is an attribute of a patient, determined by an assessment of the likely requirement for pharmacy services, and used to direct and prioritise pharmacy workflow and workforce to ensure the right patient is seen by the right pharmacy professional at the right time - an approach that seeks to reduce medication-related problems and ensure person-centred care.”

The establishment of an agreed framework of patient prioritisation for pharmacy services and definition of pharmaceutical acuity provides the basis for a universal understanding of acuity within a pharmacy context. This may influence hospital pharmacy practice and research, supporting the implementation of approaches for prioritising pharmacy services and ultimately ensuring the right patient is seen by the right pharmacists at the right time.

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The European Association of Hospital Pharmacists represents more than 25.000 hospital pharmacists in 35 European countries and is the only association of national organisations representing hospital pharmacists at European and international levels. EAHP represents and develops the hospital pharmacy profession within Europe in order to ensure the continuous improvement of care and outcomes for patients in the hospital setting. This is achieved through science, research, education, practice, as well as sharing best-practice and responsibility with other healthcare professionals

Introduction

There is increasing interest in the topic of patient prioritisation for hospital pharmacy services¹. Pressures within healthcare systems around the world have driven the need for prioritisation processes or tools in pharmacy. Such pressures have arisen from multiple factors including an increasingly aging population with multiple co-morbidities, reduced healthcare funding, and problems with staffing recruitment and retention.

The pressure on hospital pharmacy services was intensified by the Covid-19 pandemic, which dramatically reduced hospital workforce capacity. In response to these pressures, there has been a drive towards the implementation of prioritisation tools that aim to direct pharmacists and their teams to patients most likely to benefit from their services.

Published studies of these tools often focus on determining the factors that make a patient a priority for pharmacy services (e.g., age, polypharmacy, renal/hepatic impairment, and the prescription of high-risk medicines). However, there is a lack of consistency in the way that the pharmacy profession describes prioritisation and acuity within a pharmacy context and an absence of definitions.

Acuity is a term commonly used within the nursing profession and in clinical specialties such as intensive care, however, what definitions exist within these disciplines are not necessarily transferable to a pharmacy context. Having a clear and consistent definition of what is meant by acuity from a pharmacy perspective would be helpful, encouraging a shared understanding both within the pharmacy profession and across the wider healthcare team.

Collaboration with EAHP

Dr Penny Lewis from the University of Manchester approached the European Association of Hospital Pharmacists to collaborate on developing a definition for pharmaceutical acuity.

Given the importance of this topic and the absence of an existing definition of acuity from the pharmacy perspective, the EAHP team decided to provide the support, in particular in the set up and coordination of the workshops.

This project lies within the aim of EAHP to move towards the implementation of the European Statements of Hospital Pharmacy². The Statements represent what we believe every European health system should aim to achieve in the delivery of hospital pharmacy services (<https://statements.eahp.eu/statements/european-statements-hospital-pharmacy>).

The project proposed Dr Lewis relates directly to the European Statement of Hospital Pharmacy 1.3:

'Health systems have limited resources, and these should be used responsibly to optimise outcomes for patients. Hospital pharmacists should develop, in collaboration with other stakeholders, criteria and measurements to enable the prioritisation of hospital pharmacy activities'.²

Aims

This project aims to develop a conceptual framework of patient prioritisation for pharmacy services and a definition of pharmaceutical acuity.

The objectives are to:

- explore the use of language describing acuity and related terms in published pharmaceutical assessment/prioritisation tools
- describe and summarise the key concepts (processes and outcomes) of pharmaceutical assessment/prioritisation tools
- identify and compare existing definitions of acuity in pharmacy and wider healthcare contexts
- synthesize the above to generate a conceptual framework of patient prioritisation and pharmaceutical acuity
- Develop, via expert consensus a definition of pharmaceutical acuity

Methods

Definition development

The first step in creating a definition is to research the term, as this may reveal an existing definition and preclude the need for development of a new definition. An extensive and systematic literature search for a definition of pharmaceutical acuity or acuity in a pharmacy context did not find any existing definitions. The next stage was to develop an understanding of how the term acuity is currently used and associated meanings. A search for acuity in the wider healthcare literature provided an understanding of acuity definitions across different healthcare contexts. However, it is important to determine how this term is used within a pharmacy context.

Therefore, the next step in this process was to describe and summarise key concepts (processes and outcomes) of tools that seek to prioritise patients for pharmacy services and an extensive review of the literature was undertaken. This

enabled an exploration of the language describing acuity and related terms and led to the creation of a draft conceptual framework of patient prioritisation for pharmacy services, in which the term pharmaceutical acuity is nested.

A conceptual framework provides a ‘network of interlinked concepts that together provide a comprehensive understanding of a phenomenon’.³ Once there is a comprehensive, agreed and therefore shared understanding of concepts related to acuity it is possible to develop a definition. There are different types of definitions: our definition is an ‘intensional definition’ as it specifies the necessary features or properties of pharmaceutical acuity without an exhaustive list of referents. An extensional definition would typically name every object that belongs to the concept, however, to list every factor implicated in determining pharmaceutical acuity would be unachievable.

Literature reviews

Two separate literature reviews were conducted. The first was a review and content analysis of existing pharmaceutical assessment/prioritisation tools, the second was a literature search and content analysis of definitions and concepts of acuity in pharmacy and wider healthcare contexts

Literature review 1: A review and content analysis of existing pharmaceutical assessment/prioritisation tools

Literature search

To prevent duplication, existing reviews of hospital pharmacy prioritisation tools by Alshakrah et al¹ and Botelho et al⁽⁴⁾ were used to identify relevant studies from 1990 -2020. An updated search of the literature was performed using the same search strategy as Alshakrah et al to find relevant papers published between May 2020 and December 2021 within Embase, International Pharmaceutical Abstracts, Ovid Medline, Scopus and Web of Science. PubMed was also searched for pharmaceutical assessment tools published from 1976 to December 2021 to ensure all relevant papers were identified. Search terms can be found in appendix 1. Papers were screened according to the inclusion and exclusion criteria found in appendix 2.

Data extraction

Information such as tool name (if specified), country, tool functions and intended purpose were extracted from included papers. This permitted an analysis of the processes and outcomes related to determining acuity. The concepts of acuity, i.e., the meanings conveyed using the term acuity, were extracted through a search of acuity and other related terms. Initial reading of a sample of papers along with discussion between JL and PL identified key terms related to acuity and the notion of pharmaceutical prioritisation. These related key terms were complexity, priority, severity, urgency, workload

and workflow. Definitions, concepts, and context of use of the term acuity and related terms were documented. Where explicit definitions or explanations of the concept were made, the original quotation was directly extracted. Where concepts were implied, these were interpreted, summarised, and categorised. The number of times each term was used in each paper were recorded, excluding references to the terms in titles, tables, figures, figure legends, tool names and keywords.

Data analysis

Tables containing the extracted data were compiled to facilitate interpretation of findings. An analysis of the processes and intended outcomes of pharmaceutical prioritisation tools adopted a conventional approach to content analysis with the aid of a colour coding system.⁵ A summative content analysis approach was taken for analysis of the use and meaning of acuity in the included studies. A summative approach to content analysis involves the identification and quantification of terms of interest, with the focus to understand the contextual use of the terms. The differences in usage of acuity and related terms were summarised to describe the range of use.

Literature review 1: A review of definitions and concepts of acuity in pharmacy and wider healthcare contexts

Literature search

Searches for definitions of acuity in a pharmacy context and within the wider healthcare context were conducted within Embase, International Pharmaceutical Abstracts and Ovid Medline between 1970, 1974, and 1946 and 15th December 2021 respectively. As the concept patient acuity is predominantly used in nursing, a further literature search for definitions of acuity in nursing was performed between 1986 and 15th December 2021 in the CINAHL Plus database. The search strategy can be found in appendix 3. A search of the grey literature for definitions of patient acuity was also conducted in Google. All types of publications were included, i.e., journal articles, books, web pages, and reports.

Data extraction

Definitions of acuity and related concepts were extracted from the source literature. The term “acuity” was searched for using the “search for text” function on Chrome webpage or Adobe Acrobat Reader. All sentences including the term “acuity” were screened and interpreted. Where definitions of acuity were adapted from different sources, the original sources were screened.

Data analysis

Concepts of acuity, i.e., the meanings conveyed using the term acuity, in pharmacy literature and definitions of acuity in the wider healthcare context were presented in tables to facilitate content analysis. A conventional approach to content analysis was adopted to achieve systematic description and interpretation of concepts and definitions of acuity.

Expert consensus building workshops

The team initially considered undertaking a Delphi study to gain consensus on the framework and definition. However, a workshop approach was felt to be more appropriate in achieving the aims of the study as the interactivity and opportunities for reflection would permit a richer understanding of the topic as members are able to ask questions to clarify ideas and perceptions; a Delphi would rely on experts reading and understanding a large amount of information in isolation.

Furthermore, we sought agreement on two areas, a model and definition rather than a series of statements, and therefore a workshop approach would be more efficient and less time consuming than multiple Delphi rounds. However, in order to ensure all experts had the opportunity to contribute their thoughts anonymously, an online survey was included as part of our methodological approach.

Selection of experts

A call for expression of interests in joining an expert panel was sent to all EAHP members. Experts were selected if:

- 1) they had experience in managing clinical pharmacy services;
- 2) they currently worked in a hospital pharmacy where general medical and surgical inpatients are visited (or remotely assessed using electronic patient records and electronic prescribing / administration systems) by pharmacists to undertake pharmaceutical care;
- 3) they had good spoken and written English with sufficient time to commit themselves to undertaking workshop. Experts were selected to reflect a range of European countries.

Workshops

Experts were invited to attend two consensus building workshops to discuss pharmaceutical acuity in order to agree upon a conceptual framework of patient prioritisation for pharmacy services and derive a definition for pharmaceutical acuity.

The aim of workshop 1 was to agree on a draft conceptual framework of patient prioritisation for pharmacy services. All members of the expert group were provided with a report containing both literature reviews and a draft conceptual framework to read prior to attending. This approach ensured that the discussions were focused on what is already known on the topic. During this workshop the usefulness of defining pharmaceutical acuity, how acuity is different or similar in a pharmacy context versus nursing and other healthcare contexts and thoughts on a draft conceptual model of patient prioritisation for pharmacy services were discussed. All attendees were asked for their thoughts and ideas on modifications, additions, deletions, changes to structure to the model. After this workshop, the model was refined.

Prior to a second workshop, expert members were emailed a list of nine draft candidate definitions via a Qualtrics® online survey for pharmaceutical acuity. These were generated from adaptation of existing acuity definitions from nursing found in the literature or generated based on the conceptual framework of patient prioritisation for pharmacy services and the existing pharmacy literature. Experts were asked to rate their preference for each of the definitions (1=lowest, 10=highest) and add any comments or suggestions for modifications. Experts were given the opportunity to add their own definitions. The three with the highest scores were taken forward for discussion at workshop 2. Experts were also provided with a modified version of the conceptual framework of patient prioritisation for pharmacy services for comment.

The aim of workshop 2 was to agree on a definition of pharmaceutical acuity and the latest version of the conceptual framework of patient prioritisation for pharmacy services. Modified versions of the top three definitions based on expert comments in the survey were presented and each was discussed in detail. A vote, via an anonymous online polling platform, enabled selection of the preferred definition. This was then discussed and agreement from all experts was sought.

Patient and public involvement workshop

A patient and public involvement (PPI) group with five members of the UK public with experience of pharmacy services was convened. An outline of the project aims, methods and resultant framework and definition were presented with opportunities for discussion and questioning throughout. The PPI group members provided their thoughts on the definition and suggested edits.

Results

Literature review 1: A review and content analysis of existing pharmaceutical assessment/prioritisation tools

In total, 30 publications describing 25 pharmaceutical prioritisation tools were identified and included for analysis (see appendix 4 for flow diagram of screening process).

Definitions and meaning of acuity in pharmacy

No explicit definitions of acuity were found in any of the studies and only five studies directly referenced the term. However, one study attempted to clarify the meaning of acuity with reference to a nursing definition, which is “the ability to predict patient requirements for care”.⁶ Table 1 provides a summary of concepts of acuity and context of use within pharmacy tool studies. Most frequently, patient acuity was considered a metric, i.e. a system or standard of measurement. In one study, “pharmaceutical acuity” was a metric evaluated for the purposes of clinical prioritisation.⁷ Patient acuity was one of the factors considered when determining optimal pharmacist: patient ratio and was one of the metrics evaluated for prioritisation tool development.⁸ It was not a term used explicitly in relation to pharmaceutical acuity but rather one of multiple factors considered for determining the prioritisation of services. One study describing an obstetrics triage tool interpreted the concept of acuity in a slightly different context, in terms of bed acuity. Higher acuity beds “require a greater share of service time”.⁹

Concepts of acuity	Meaning of acuity in context	Associated pharmaceutical assessment tools
Reference to nursing definition	When discussing assessment of “patient acuity”, the nursing definition was referred to: “the ability to predict patient requirements for care”.	Pharmaceutical Assessment Screening Tool ⁶
Metric for clinical prioritisation	Assigning patients a “pharmaceutical acuity” permits clinical prioritisation based on patients’ needs and benefits.	Medicines Optimisation Assessment Tool (MOAT) ⁷
Metric for determining pharmacist allocation	Patient acuity is one of the factors considered when determining optimal pharmacist: patient ratio, a key factor in determining pharmacist allocation and justification. The combination of illness acuity and medication regimen complexity can facilitate justification of pharmacist allocation.	Medication Regimen Complexity ICU Scoring Tool ¹⁰
Metric for inclusion in pharmacy tool development	“Patient acuity” was referred to as one of the metrics evaluated for the development of HOPAT.	Hem/onc Pharmacist Allocation Tool (HOPAT) ⁸
Metric for representing specialty’s need for services	“Overall acuity” of inpatient service was insufficient...There is a requirement for additional metrics to better illustrate these hem/onc specialty needs.	Hem/onc Pharmacist Allocation Tool (HOPAT) ⁸
Bed acuity	Neonatal beds are generally “higher acuity”, which “require a greater share of service time.”	Obstetrics Triage Tool ⁹

Table 1. Meaning of acuity, context of use, and associated pharmaceutical assessment tools

Quantification of acuity in pharmacy

Fourteen studies (see table 2) included a description or explanation of quantifications of acuity, out of which nine studies described quantification of acuity explicitly using the term acuity, and five studies described quantification of acuity using related terms of acuity. The measures of acuity are termed as “patient acuity score”, “acuity score”, “acuity level”, “patient acuity level”, “patient’s level of acuity”, “complexity level”, “complexity score”, “risk level” and “risk score”. It was highlighted in one study that the measure of acuity relates to associated level of pharmacy attention.¹¹ It was implied that patients of higher acuity are likely to require a greater level of attention from pharmacists including clinical pharmacist review and intervention. Patient acuity was also described in one paper as a variable construct and that patients responding to treatment can “became low acuity during their hospital stay.”¹²

Among the studies using related terms to quantify acuity, one study¹³ used “risk level” as a measure to determine the types of pharmaceutical care actions required for each level. Care actions included pharmacotherapy monitoring, training or education to patient/parent/caregiver, or coordination activities with the care team. Only one study defined the acuity measure, specifically in relation to preventable adverse drug events.¹⁴ It was defined that complexity score is “predicted probability to experience at least one pADE after a given risk day.”¹⁴

Conclusively, the quantification of acuity has implications for determining pharmaceutical needs and prioritisation of pharmacy services, as well as presenting as an attribute of the patient at a point in time.

Quantification of acuity	Description of measure	Pharmaceutical assessment tool
Quantification of the term acuity		
Patient acuity score	“Patient acuity score” is the quantification of acuity through calculation of the “patient acuity score” based on clinically significant attributes to identify patients’ greatest clinical pharmacy needs.	Electronic Clinical Scoring System ¹⁵
Patient acuity scores	The Acute Physiology Assessment and Chronic Health Evaluation (APACHE) score is one measure of patient acuity, referred to in the study as “patient acuity scores”.	Medication Regimen Complexity ICU Scoring Tool ¹⁰
Patient’s acuity score	Patient’s acuity was used to stratify patients into three risk categories (low, medium, and high), which determines patient’s acuity score. High acuity patients have more frequent, more in-depth reviews with higher seniority of pharmacist input. Low acuity patients benefit less from a pharmacist’s review. Patient acuity is variable, patient responding to treatment can “became low acuity during their hospital stay.”	Clinical Prioritisation Tool ¹⁰

Acuity score	The calculation of an “acuity score” was stated as per diagnosis-related groups (DRG). “Acuity score per DRG = (DRG frequency x assigned weight) / sum of DRGs for service”.	Hem/onc Pharmacist Allocation Tool (HOPAT) ⁸
Acuity level	Assigning “acuity level” to patients.	Assessment of Risk tool ¹⁶
Acuity level	The classification of levels of acuity is: Level 1: Early Warning Score (EWS) 0–2 AND no significant medication history; Level 2: EWS 2–4 OR significant medication history; level 3: EWS >4.	Assessment tool ¹⁷
Patient acuity level (PAL)	“A PAL is a pharmaceutical assessment of a patient (lowest=1 to highest=3), higher PALs highlight the requirement for a more intensive pharmaceutical input to reduce potential harm.”	Pharmaceutical Assessment Screening Tool (PAST) ^{6,18}
Patient's level of acuity	Patient's levels of acuity are classified into high (red), moderate (orange), or low (yellow). The level directs the attention of the clinical pharmacist to patients with the highest acuity first. Patients of higher acuity are likely to require a greater level of attention and clinical pharmacist review and intervention.	Electronic Pharmacy Acuity System active surveillance program ¹¹
Quantification of acuity using related terms		
Complexity level	Classification of patients through assigning a “complexity level” allows the assessment or identification of patient complexity and prioritisation of pharmaceutical services. The (pharmaceutical) complexity levels (red, amber, green) assigned to patients after medicines reconciliation determines the levels of pharmaceutical care required by patients.	Adult Complexity Tool for Pharmaceutical Care (ACTPC) ¹⁹
Complexity score	“Complexity score” estimates patients’ risk for preventable adverse drug events (pADEs). “Complexity score” is defined as the “predicted probability to experience at least one pADE after a given risk day.”	Complexity Score ^{14,20}
Risk level	“Risk levels” were assigned to patients through the evaluation of relevant clinical metrics. Risk level defines the types of care actions: pharmacotherapy monitoring, training/education to patient/parent/caregiver, and coordination activities with the care team.	Risk Stratification Tool ¹³
Risk score	“Risk score” incorporates existing scores that define levels of attention, factors associated with adverse effects and drug interactions. Risk score classifies the patients as low, moderate and high risk groups.	Risk Score ²¹

Table 2 Quantification of acuity and description of measure within pharmaceutical assessment tools

Concepts related to acuity

Studies were explored for related concepts to acuity, these are described below. Appendix 5 provides a table listing the concepts attached to each term in different contexts and any established definitions of each term.

1) Complexity

Complexity was used in one paper⁶ as a metric for patient acuity quantification in terms of “pharmaceutical complexity”. However, more commonly, complexity was referenced in five studies as a clinical characteristic of patients, with an implication for determining pharmaceutical needs. More specifically, one study stated that patient complexity is a clinical contributory factor to drug related problems.²²

2) Priority

Priority was described as a factor assigned to patients where patients of higher priority would receive earlier and more frequent pharmaceutical interventions, improving service delivery. One study described how priority is determined by the predicted probability of medication error.²³

3) Severity

Severity was referenced in one study¹⁹ as a clinical characteristic with implications for service delivery. Furthermore, severity was considered as a metric for the development of a risk-predictive algorithm.²⁴

4) Urgency

One study directly referenced urgency.⁹ This concept related to the urgency of obstetrics admissions which resulted in difficulties in “predicting service needs and coverage” and prompted the need for developing pharmaceutical assessment tools to facilitate service delivery.

5) Workload

Workload was extensively referenced in studies describing pharmaceutical assessment tools. It was typically referenced as a service delivery measure, in the context of workload capacity, allocation and prioritisation of workload. Workload was referenced as an outcome measure where the developed tool achieves optimisation of workload.²⁵ Workload pressures were one of the metrics to determine decision thresholds for patient classification in one study.²⁶

6) Workflow

Comparably, workflow was referenced as a service delivery measure in five studies. When workload was specifically referenced as an outcome measure of pharmaceutical assessment tools, perceived tool benefits were improving workflow,²⁷ maintaining consistent workflow,¹¹ and prioritising workflow.⁶

7) Frailty

Frailty was a concept relating to acuity that was only mentioned in one study, where frailty was interpreted as a clinical status.²⁸

Review of existing pharmaceutical prioritisation tools: intended outcomes and processes

Two overarching themes were identified in the analysis of the included papers; these were **service delivery related** and **patient related**. Within each of these overarching themes, the perceived processes and outcomes were grouped into categories to aid the understanding and interpretation of these concepts (see table 4).

Pharmacy service delivery

Within the overarching theme of pharmacy service delivery, four studies made the general statement that their tools were developed to improve the delivery of pharmacy services, other perceived outcomes of pharmaceutical assessment tools included increasing efficiency and improving workflow, improving pharmacist resource management and allocation and workforce planning. In terms of processes, nine studies stated that the designed tool aimed to prioritise patients for pharmacy services. The use of the tool to allow matching of pharmacy resources to patients with greatest needs or with maximum predicted benefits was highlighted in eight studies. Another four studies described prioritising the frequency of, and the seniority of, pharmacists performing patient reviews. Two studies suggested tools utilised pharmacy expertise through facilitating senior pharmacists' involvement in other clinical activities. Clinical decision support was stated in one conference presentation that described how the Electronic Prescribing Web Portal “provides a form of clinical decision support” to pharmacists through the range of alerts and features, mainly to facilitate new patient prioritisation.²⁹

Patient related

Within the patient related theme, patient outcomes and processes were grouped. One study had the general statement that use of the tool could “improve patient safety”¹⁹ or reduce medication related harm.³⁰ Multiple studies provided more detailed descriptions of patient care outcomes and patient safety related aims of the tools, which included optimising patient outcomes, optimising patient-centred care and providing medication related benefits.

In the category of patient related processes, the most common theme was to identify or predict patients at high risk of medication related problems (MRPs), as described in eight studies. The Medication Regimen Complexity (MRC) ICU scoring tool¹⁰ was designed to determine the association between medication regimen complexity and patient acuity. This is the only tool incorporating the concept of acuity in the perceived tool benefits. The MRC scoring tool supports the investigation of “the association between MRC and both patient acuity and patient outcomes.”¹⁰

Table 3. Studies describing the processes and intended outcomes of pharmaceutical assessment/prioritisation tools

Intended outcomes and processes related to use of pharmaceutical assessment/prioritisation tools	Study
Service delivery related	
1. Service delivery outcomes	
1.1. Improving delivery of pharmacy services	Alshakrah et al. ¹⁹ Herring ¹² Munday and Forest ³¹ Spencer et al. ³²
1.2 Increasing efficiency	Carlson and Phelps ¹⁵ Covey et al. ⁹ Kaufmann et al. ²² Patel et al. ¹¹ Mott et al. ¹⁷
1.3 Improving pharmacist resource management/allocation and workforce planning	Alshakrah et al. ¹⁹ Falconer et al. ²⁷ Martinbiancho et al. ²¹ Smith et al. ⁸ Gwynn et al. ¹⁰ Stump et al. ³³
1.3 Optimising workload	Roten et al. ²⁵
1.4. Improving workflow	Falconer et al. ²⁷ Hickson et al. ⁶ Munday and Forest ³¹ Patel et al. ¹¹
2. Service delivery processes	
2.1 Forecasting workload	Stump et al. ³³
2.2 Prioritisation of pharmaceutical interventions to ensure effectiveness of service and avoid duplication or oversight	Gonzalez-Torres et al. ³⁴
2.3 Providing clinical decision support	Mullan and Jennings ²⁹
2.4 Patient prioritisation for pharmacy services	Covey et al. ⁹ El Hajji et al. ²⁴ Fernández-Llamazares et al. ¹³ Geeson et al. ²⁶ Jeon et al. ²⁰

	Mullan and Jennings ²⁹ Munday and Forest ³¹ Patel et al. ¹¹ Roten et al. ²⁵
2.5 Matching pharmacy resource to patients with greatest needs/ maximum predicted benefits	Alshakrah et al. ¹⁹ Carlson and Phelps ¹⁵ Cottrell et al. ³⁰ Fernández-Llamazares et al. ¹³ Geeson et al. ²⁶ Mott et al. ¹⁷ Winterstein et al. ¹⁴ Spencer et al. ³²
2.6 Facilitating staffing decisions	Mullan and Jennings ²⁹
2.7 Prioritising the frequency of, and the seniority of, pharmacists performing patient reviews	Alshakrah et al. ¹⁹ Herring ¹² Hickson et al. ⁶ Saxby et al. ¹⁸
2.7. Allowing pharmacy technicians and rotational pharmacists to lead medication therapy management, facilitating senior pharmacists' involvement in other clinical opportunities	Gonzalez -Torres et al. ³⁴ Patel et al. ¹¹
Patient outcome related	
3. Patient outcomes	
3.1 Improving patient safety	Alshakrah et al. ¹⁹
3.2 Reducing medication related harm	Cottrell et al. ³⁰
3.3 Optimising patient outcomes	El Hajji et al. ²⁴ Falconer et al. ²⁷ Patel et al. ¹¹
3.4 Optimising patient-centred care	Gonzalez-Torres et al. ³⁴
4. Patient processes	
4.1 Identifying patients at high risk of medication related problems	Cottrell et al. ³⁰ Geeson et al. ²⁶ Kaufmann et al. ²² Martinbiancho et al. ²¹ Nguyen et al. ²³ Onder et al. ²⁸ Roten et al. ²⁵ Winterstein et al. ¹⁴

4.2 Determining the association between medication regimen complexity and patient acuity	Gwynn et al. ¹⁰
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Literature review 2: Existing definitions and concepts of acuity in pharmacy and wider healthcare contexts

Definitions and concepts of acuity in pharmacy literature

The previous section explored acuity and related terms from papers describing pharmaceutical prioritisation tools. To ensure that definitions from the wider literature were not overlooked a search of the literature for acuity within a pharmacy context was conducted. This search did not identify any established definitions of acuity in a pharmacy context. However, three pharmacy papers were identified that included a discussion about the concept of patient acuity.³⁵⁻³⁷ See table 5 below for examples of use.

Table 4 Meaning of acuity in wider pharmacy literature, and the concepts in context

Meaning	Example	Author
1. Components of acuity	Patient acuity is “based on the complexity of their condition and medication use”.	Abuzour et al. ³⁷
2. Clinical characteristic with an implication for service delivery	Patient acuity is one of the criteria influencing the determination of pharmacist workflow. “A novel tool to guide the application of pharmacy human resources incorporates the objective criteria of patient census, patient acuity, teaching involvement, drug expenditures, and use of high-risk medications. The tool can be used to determine the appropriate allocation and placement of clinical pharmacist resources in a service-based coverage model.”	Granko et al. ³⁵
	“The index of patient acuity of illness and the number of standard hours of nursing care are good predictors of pharmacy workload of the same and the following days; the potential exists to use these nursing workload indicators in determining pharmacy staffing requirements.”	Lundgren and Daniels. ³⁶

Definitions of acuity in the wider healthcare context

Thirty-two sources of definitions of acuity from the wider healthcare setting were found. A table of the definitions can be found in appendix 6. Patient acuity is a concept that has been clearly defined in nursing. One comprehensive definition of patient acuity was generated from a concept analysis by Brennan and Daly^{38,39} who described acuity as “a measure of the severity of illness and nursing intensity, or the nursing care needs, complexity, and workload required to provide care to a patient or group of patients.”

Definitions of acuity in a range of different healthcare contexts were identified, such as in emergency care⁴⁰ and intensive care.⁴¹ Acuity is an established concept in the emergency department, with two papers^{42,43} referring to a definition of emergency department acuity. Additionally, acuity was defined in the context of case management⁴⁴, healthcare management⁴⁵, and in relation to bed acuity⁴⁶. Lastly, an organisational concept of acuity was identified in tertiary care context, based on length of stay, hospital throughput and hospital charges.⁴⁷

A wide range of attributes to the definition of acuity were identified from the literature, including severity of illness or patient, complexity of patient, care requirement, i.e. patient's care needs, time required to provide care, intensity of care, complexity of care, workload, urgency, level of expertise and number of nurses required to provide care.

Understanding of patient acuity had implications for service provision and delivery, commonly including improving efficiency, facilitating staffing decisions, balancing workload, improving patient safety, reducing costs, permitting patient classification, and supporting resource management.

Expert consensus building workshops

Overall, 16 experts were involved with one or both workshops. Experts were from 12 different European countries (see appendix 7).

Development of a conceptual framework of patient prioritisation for pharmacy services

The first workshop focused upon agreeing whether or not there was a need for a definition of pharmaceutical acuity and the development of a conceptual framework of patient prioritisation for pharmacy services. There was unanimous agreement that there is a need for a universally adopted definition of pharmaceutical acuity as current acuity definitions did not refer to medicines and that clinical acuity was different to pharmaceutical acuity. A draft framework based on the literature was presented to the workshop attendees and experts provided their views of the framework with suggested additions and edits including the need to simplify and rearrange the structure. This process facilitated understanding of the key concepts relating to pharmaceutical acuity in preparation for development of the definition.

A conceptual definition of pharmaceutical acuity

Experts were provided, via a qualtrics® survey, nine candidate and original definitions of pharmaceutical acuity and, based on their ratings, three were modified based on feedback and taken forward for discussion in workshop 2. None of the experts provided their own definition. Agreement was reached on the below definition by the end of workshop 2:

“Pharmaceutical acuity is an attribute of a patient, determined by an assessment of the likely requirement for pharmacy services and intervention. Knowledge of pharmaceutical acuity is used to direct and prioritise pharmacy workflow and workforce to ensure the right patient is seen by the right pharmacy professional at the right time. This approach seeks to reduce medication related problems and ensure patient centred care”

Other definitions were ruled out as they were paternalistic, centered on less relevant concepts or were too brief whereas the selected definition described acuity in a positive light i.e. ‘the right patient, right pharmacist, right time’ and was felt more complete than the other definitions.

Feedback regarding the framework resulted in removal of unnecessary framework components and edits to improve the presentation of components.

Patient and public involvement workshop

Key issues discussed by the PPI group during the workshop were the positive implications for continuity of care when implementing any patient prioritisation systems, the need for future work exploring patient acuity and prioritisation from a patient perspective and the need for hospitals to develop patient information regarding pharmaceutical prioritisation especially in light of access to patient records. The definition was shortened for ease of reading.

Final conceptual framework and definition

A final opportunity to comment on and review of the definition and framework was undertaken via email by all workshop members. The final framework is provided below:

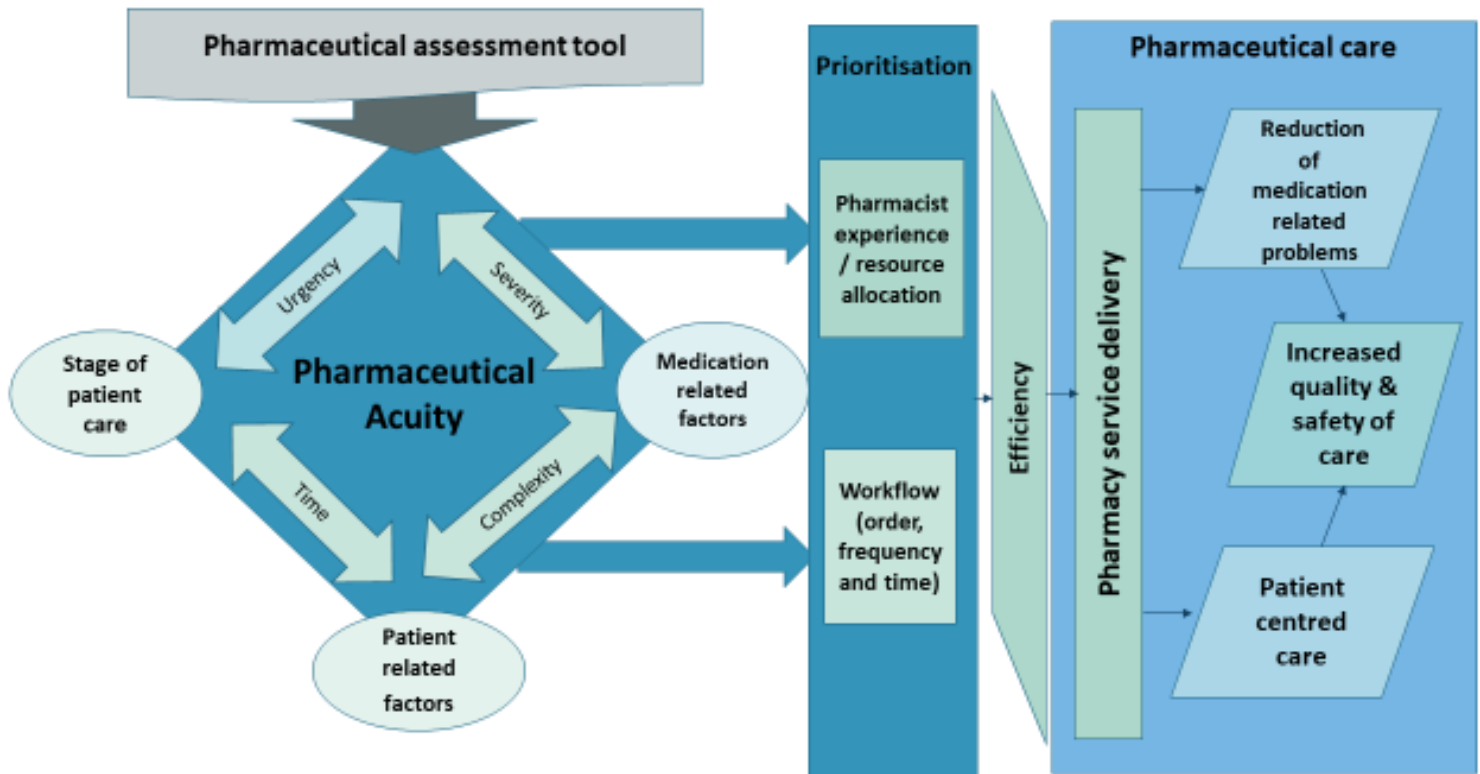


Figure 1: A conceptual framework of patient prioritisation for pharmacy services

The framework highlights how pharmaceutical assessment tools or prioritisation tools as they are often referred to, can be used to determine pharmaceutical acuity based on patient related factors (e.g. co-morbidities, frailty), medication related factors (e.g. high risk medicines) and the stage of patient care (e.g. admission to hospital, discharge). Such factors are usually simple to identify and pharmaceutical assessment tools will often provide a checklist for the presence or absence of specific factors and stage of patient care.

However, there are other, often more nuanced factors, such as the severity of the patient condition (patient acuity in the nursing sense), urgency (does the patient require services promptly), the time involved in providing a pharmacy service (e.g. counselling) to the patient and also the complexity of the patient (a combination of both patient related and medication related factors) that can be used to make a judgment regarding a patients' pharmaceutical acuity. This information regarding a patient's pharmaceutical acuity is used to prioritise pharmacy services and to make decisions regarding the flow of pharmacy work, such as the order in which patients should be seen, how often and even for how long. For some organisations, knowledge of patient acuity can facilitate the allocation of pharmacy professionals based on their knowledge and experience, ensuring the right patient is seen by the right pharmacy professional.

This overall approach seeks to improve the provision of limited pharmacy services, reducing the risks of medication related problems and providing greater opportunities for person centred care, ultimately improving the quality and safety of patient care in relation to the use of medicines.

The resulting definition of pharmaceutical acuity is as follows:

“Pharmaceutical acuity is an attribute of a patient, determined by an assessment of the likely requirement for pharmacy services, and used to direct and prioritise pharmacy workflow and workforce to ensure the right patient is seen by the right pharmacy professional at the right time - an approach that seeks to reduce medication-related problems and ensure person-centred care.”

Discussion

There is no existing definition, or indeed clear explanation, of acuity within a pharmacy context. Therefore, our study has systemically generated a conceptual framework of patient prioritisation for pharmacy services enabling the development of a definition of pharmaceutical acuity, rooted in the current context of hospital pharmacy practice. It is hoped by conducting this work, there will be a universally clear and shared understanding of terms that can inform the research agenda in this area and facilitate the development and uptake of pharmaceutical assessment tools in practice.

Our definition was developed based upon an extensive review of current prioritisation tools used in hospitals and therefore the initial model may not have captured concepts relevant to other pharmacy settings e.g. primary/ambulatory care. The prioritisation of patients for pharmacy services within other settings is less prevalent, nevertheless, pharmacy professionals will be under similar pressures and prioritisation is likely to be useful beyond the hospital setting. Our definition, as deemed by our expert panel, resonates across all pharmacy settings yet future work may seek to validate its use within other areas of practice.

Based on the themes identified in our literature review, a framework of the processes and outcomes relating to the use of pharmacy prioritisation tools was produced and agreed upon in conjunction with an international group of experts. Within this diagram, pharmaceutical acuity is positioned, highlighting the relationship of acuity with other processes and outcomes. However, omitted from this model are the structures (facilities e.g. electronic patient medication records, systems, staffing) and context (patient mix, specialties etc.). Such factors are important to the success of implementing a

pharmaceutical prioritisation tool and in practice, will require consideration. However, this is beyond the scope of this current work.

Overwhelmingly, the pharmacy literature indicates that the term acuity is a metric concept, often represented as quantitative score or level. This metric can be used to influence decisions regarding workflow and staffing requirements. There is mostly reference to 'patient acuity', a concept that is established within the nursing discipline and other areas of hospital practice (e.g. emergency care). Only one study explicitly used the term 'pharmaceutical acuity'²⁶. However, patient acuity and pharmaceutical acuity are related yet different concepts.

The former often used to determine nursing care, and not pharmacy services, and its key attributes are severity and acuteness of the patient condition. Although patient acuity, as defined in the nursing literature, might be a factor that influences a patients' need for pharmacy services, it is certainly not the only factor determining a patient's requirement for pharmacy input. Pharmaceutical acuity is qualitatively different, containing concepts such as complexity- a state that in itself is not necessarily acute, but rather a latent risk that if clinical decisions (e.g. prescribing) are made or patient factors (e.g. renal function) were to change, could quickly become a medication related problem or adverse drug event. Complexity was found to be the only term where the literature explicitly suggested its direct contribution to the quantification of patient acuity⁶. Complexity, priority and severity were all described as clinical characteristics of patients with implications for pharmacy workload and workflow, however, the use of these terms varied across studies.

This study has helped bring these terms together, arranged within a framework, demonstrating their relationship to pharmaceutical acuity and to each other. Understanding these related concepts in a pharmacy context was an important step in defining pharmaceutical acuity.

In our definition, we propose that pharmaceutical acuity is an attribute of a person, a composite of multiple factors referred to in our conceptual framework. Although we identified the key areas that could determine a patient's pharmaceutical acuity, we did not attempt to provide specific details. The specific patient or medication related factors important in determining acuity will vary dependent on context, although some clear patterns of commonly used indicators have been reported¹.

Prioritisation is an action generated from possessing knowledge of this attribute and that can direct pharmacy workload and workflow with the ambition to effectively reduce medication related problems and provide person centered care. Presently, the use of pharmaceutical assessment tools is often a response to a serious medication related incident,(48) and in practice, it is the prevention of medication related harm that may be the priority for pharmacy managers.

As discussed previously, the concept of pharmaceutical acuity was strongly associated with its implications for practice, such as facilitating pharmacy service delivery and improving patient outcomes. Well established definitions of patient acuity in the nursing literature all incorporate similar implications for practice as those found in the pharmacy literature, for example, determining workload, improving efficiency, facilitating staffing decisions, supporting resource management, and improving patient safety. Our conceptual definition of pharmaceutical acuity also sets out the implications that attributing acuity to patients may have on the delivery of pharmacy services and, similarly, improving the safety of medicines use as well as improving the quality of care provided to patients. Although the pharmacy discipline is some way behind the nursing profession in terms of applying acuity measurements to calculate workforce requirements, there is potential scope for this going forward.

Our patient group raised important points that require future investigation, including the need to develop patient information regarding patient prioritisation for pharmacy services. By establishing a common understanding of this process within the pharmacy profession we should now consider, in conjunction with patients, how best to explain this to those that receive pharmacy services.

Conclusion

Pharmaceutical acuity, when used to direct pharmacy service processes is perceived to be beneficial for improving the delivery of pharmaceutical care and improving patient safety³⁷. The establishment of an agreed conceptual definition of pharmaceutical acuity provides an explicit understanding of acuity within a pharmacy context. Both our conceptual model of patient prioritisation for pharmacy services and resulting definition can help underpin the continuing development and use of pharmaceutical assessment tools in hospital pharmacy practice across Europe and beyond.

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Appendices

Appendix 1

Search terms

Keywords Search terms

1. Priority priorit*, triage*, acuity, complex*

2. Tool tool*, scor*, screen*, criteria, scale, classif*, assess*, clinical assess* tool*, instrument*, measure*, stratif*, software

3. Hospital hospital*, secondary care

4. Pharmaceutical care pharmacy, pharmacist*, pharmaceutical, pharmac* service*, hospital pharmac*, clinical pharmac*, clinical pharmac* service*

5. 1 AND 2 AND 3 AND 4

Appendix 2

Inclusion and exclusion criteria

Inclusion criteria:

- Tools used within inpatient settings.
- Tools designed for all patient groups, i.e., age and conditions, (paediatrics, elderly, ICU, HIV, obstetric, oncology).
- Tools of all formats (electronic, algorithm, web portal, surveillance program).
- Papers published from 1990 to December 2021.
- Studies based in all geographical locations.
- Papers published in English language (ensuring the accurate interpretation and extraction of concepts of acuity and relevant terms).
- Papers describing the development, evaluation or validation of assessment tools were all included, as the differences in concepts of acuity referenced in different types of paper is relevant to the interest of this study.

Exclusion criteria:

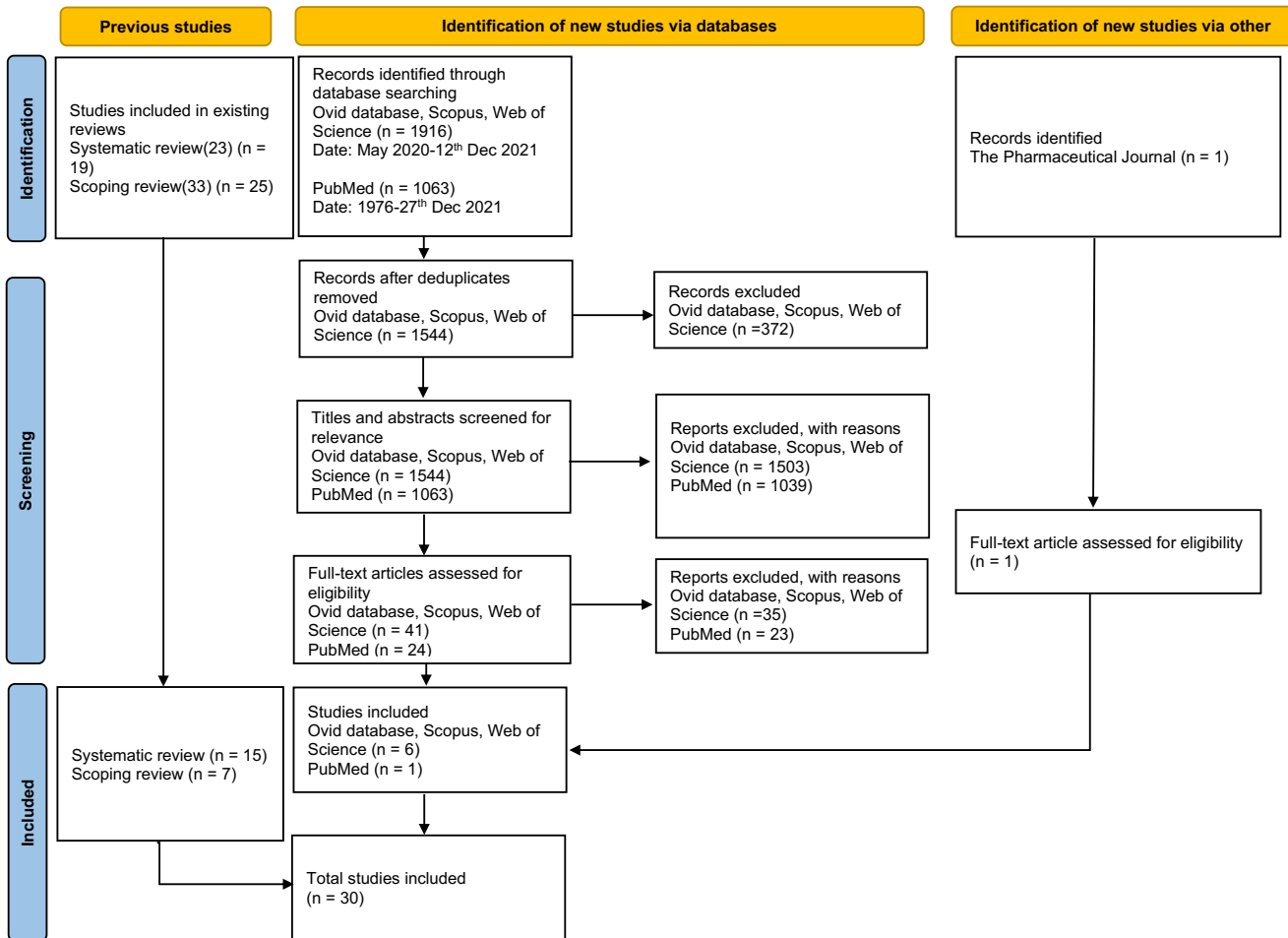
- Tools designed for outpatient or community settings.
- Papers describing pharmaceutical assessment tools without any direct implications for assisting pharmaceutical service delivery (i.e., prioritisation, workflow, allocation)
- Papers describing a tool that was not intended to impact upon pharmacy service delivery. For example, risk stratification tools designed with the sole aim of determining the risks of a patients experiencing an ADRs without any implication or involvement of pharmacy services.

Appendix 3

Search terms

Keywords	Search terms
1. Acuity	Pharmac* acuity, pharmac* ADJ2 acuity, patient acuity
2. Definition	Defin* OR concept*
Combinations of 1 AND 2 based on number of papers generated	

Appendix 4



Appendix 5

Category of concepts of related terms to acuity, contexts of references and the relevant pharmaceutical assessment tools

Category of concepts	Definitions or concepts in context	Relevant pharmaceutical assessment tools
1. Complexity		
1.1. Metric for patient acuity quantification	Complexity was referred to 3 times in terms of “pharmaceutical complexity” or “patient’s pharmaceutical complexity”. There are other tools developed to measure patient acuity based on pharmaceutical complexity.	Pharmaceutical Assessment Screening Tool(6)
1.2. Clinical characteristic	Complexity was referred to 1 time. It was stated that complexity of admitted older adult patients have increased.	GerontoNet ADR Risk Score(28)
	Complexity was referred to 1 time. It was stated that “integration of skills from different healthcare professionals are needed to address medical complexity of older adults.”	GerontoNet ADR Risk Score(28)
	Complexity was referred to 17 times in the following contexts. Patients with different levels of pharmaceutical needs vary in complexity.	Adult Complexity Tool for Pharmaceutical Care (ACTPC)(19)
1.2.1. Clinical contributory factor to DRPs	Complexity was referred to 1 time, where patient complexity is a clinical contributory factor to development of DRPs.	Drug-Associated Risk Tool (DART)(22)
1.2.2. Subjective nature	Complexity was referred to 3 times, where complexity can be subjective depending on the experiences and qualifications of clinical pharmacists. The perceptions of complexity by a pharmacist may not reflect that of other pharmacists on a universal level.	Medication Regimen Complexity ICU Scoring Tool(10)
2. Priority		
2.1. Clinical characteristic	Priority was referred to 1 time, in terms of “the priority assigned by pharmacy team to a patient”.	Pharmacy Risk Screening Tool(30)
	Priority was referred to 1 time, in terms of “patient priority”, which is determined by the predicted probability of medication.	A model predicting in-hospital significant medication errors(23)
2.1.1. Implication for improving service delivery	Priority was referred to 2 times, where patients were given “patient priority” for pharmaceutical services. Patient queued “in order of priority for intervention”.	Assessment of Risk Tool(27)
	Priority was referred to 12 times, in relation to the amount of pharmacy service input. The implementation of the tool involves identifying “priority patient”. “Patients in critical care areas including haematology/oncology, paediatric and neonatal intensive care units were all considered to be high priority, requiring a daily pharmacist review.”	Patient Prioritization Tool(32)
3. Severity		

3.1. Clinical characteristic with an implication for service delivery	Severity was referred to 1 time. "... Patient complexity and the severity of patient needs are not taken into consideration in the traditional model of clinical pharmacy service delivery."	Adult Complexity Tool for Pharmaceutical Care (ACTPC)(19)
3.2. Metric for tool development	Severity was referred to 4 times, in terms of "patient severity of illness", which is a clinical measure input for a medical algorithm PARR (patients at risk of re-hospitalization).	Risk-predictive Algorithms(24)
4. Urgency		
4.1. Admission urgency with an implication for service delivery	Urgency was referred to 1 time, in terms of the "urgency associated with obstetrics admissions" which results in difficulties in "predicting service needs and coverage" and the need for developing a "triage protocol for pharmacists" to aid patient care and improve service planning".	Obstetrics Triage Tool(9)
5. Workload		
5.1. Service delivery measure	Workload was referred to 1 time, where it was stated that problems with pharmacy workloads and patient prioritisation occurred in other hospital pharmacy departments in New Zealand.	Assessment of Risk Tool(27)
	"The creation of risk groups permits pharmacists to take account of workload capacity when prioritising patients."	Medicines Optimisation Assessment Tool (MOAT)(26)
	Workload was referred to 1 time, where "by using the new scoring system, pharmacists could provide high-quality clinical monitoring services while absorbing these increases in workload due to the efficiencies achieved through the new workflow."	Electronic Clinical Scoring System(15)
	Workload was referred to 1 time, where pharmacy prioritisation tools result in "time savings in service workload".	Obstetrics Triage Tool(9)
	Workload was referred to 5 times in the following contexts. The developed tool potentially permits "prioritisation of patients and appropriate allocation of workload among team members based on skills and expertise".	Medicines Optimisation Assessment Tool (MOAT)(26)
	Workload was referred to 3 times, where structuring of pharmacists' workload through patient prioritisation maintains efficiency with finite resources. This tool was developed "in order not to increase the workload of either clinical pharmacists or other healthcare professionals."	Drug-Associated Risk Tool (DART)(49)
	Workload was referred to 1 time, where the designed tool facilitates prioritisation of workload.	Medicines Optimisation Intervention Track Tool(34)
5.1.1. Outcome measure of tools	Workload was referred to 3 times in the concept that the screening tool developed optimises clinical pharmacists' workload.	Screening Tool(25)

5.2. Metric for patient classification	Decision threshold separating different risks patients was informed by workload pressures.	Medicines Optimisation Assessment Tool (MOAT)(26)
6. Workflow		
6.1. Service delivery measure	Workflow was referred to 2 times, where “by using the new scoring system, pharmacists could provide high-quality clinical monitoring services while absorbing these increases in workload due to the efficiencies achieved through the new workflow.”	Electronic Clinical Scoring System(15)
	Workflow was referred to 5 times, where a clinical pharmacy triage system allows the pharmacy team to integrate current workflow into a usable and real time updated format. This tool incorporates features to aid workflow.	Clinical Pharmacy Triage and Referral System(31)
6.1.1. Outcome measure of tools	Workflow was referred to 1 time, where the use of an electronic prioritisation tool can improve pharmacist workflow and potentially patient outcomes.	Assessment of Risk tool(27)
	Workflow was referred to 1 time, where the aim of the pharmaceutical assessment tool was to “prioritise departmental workflow for clinical pharmacists.”	Pharmaceutical Assessment Screening Tool(6)
	Workflow was referred to 3 times, where the information provided by the tool “assists the clinical pharmacist in maintaining a consistent workflow by allowing for easier identification of patients who still require an assessment.”	Electronic Pharmacy Acuity System active surveillance program(11)
7. Frailty		
7.1. Clinical status	This paper provided a description of frail hospitalised patients, who are usually older adults, presenting with acute diseases, with increased susceptibility to ADRs and increased severity of drug-related illnesses.	The GerontoNet ADR Risk Score(28)

Appendix 6

Definitions of acuity in wider healthcare literature - **references need importing on a separate document**

Themes of definitions	Healthcare domain	Definitions	Authors
Nursing definitions of patient acuity incorporating severity of illness, care requirement, time required to provide care, intensity of care, complexity of care, workload, level of expertise and number of nurses required to provide care, with implications for service provision and delivery			
Patient acuity	Nursing	<p>“The concept of acuity can be considered a structure of care, in that it is a characteristic of the patient that, when measured, can be applied to nurse staffing decisions and thus be considered a process of care.”</p> <p>“Nurse staffing decisions based on patient acuity have the potential to balance the nursing workload among</p>	Brennan and Daly(38)

		available nurses, thus improving patient safety and quality, and potentially reducing costs, which are outcomes of care.”	
Patient acuity	Nursing	Patient acuity is the patient’s requirements for nursing care. “As acuity rises, more nursing resources are needed to provide safe care.” Patient acuity could be used to manage nursing personnel resources, costs, and quality.” “Acuity was a significant predictor of various self-care measures such as symptom management.”	Jennings(50)
Patient acuity	Nursing	“Patient acuity is defined as a measure of the severity of illness and nursing intensity, or the nursing care needs, complexity, and workload required to provide care to a patient or group of patients.”	Brennan and Daly(39)
Patient acuity	Nursing	“The Inpatient Complexity Assessment and Monitoring to Ensure Optimal Outcomes (CAMEO©) acuity tool measures patient acuity in terms of nursing cognitive workload complexity.”	Atkinson et al.(51)
Patient acuity	Nursing	“The amount of ‘nursing time’ that is spent to perform all nursing care is known as ‘patient acuity’.”	Alghamdi(52)
Patient acuity	Nursing	“Acuity, defined as the individual patient need for nursing care, can inform level of care, nurse staffing, and the nurse-to-patient assignment.”	Garcia(53)
Patient acuity	Nursing	A change in patient acuity indicates the need for modifications in staffing.	Simpson(54)
Patient acuity	Nursing	“Patient acuity is a measure of the number of nurse equivalents required to care safely for each patient.” Patient acuity is variable.	Dexter et al.(55)
Patient acuity	Nursing	“Patient acuity systems are workload measurement systems that measure the amount of care required by individual patients.” “Patient acuity systems measure the amount of time required to care for patients during a given time frame.” Acuity measurement usually correlates with severity of illness. However, the two concepts are not identical.	Piper(56)
Patient acuity	Nursing	Patient acuity includes the severity of illness and the caring intensity.	Cologna et al.(57)
Patient acuity	Nursing	“Patient acuity is defined as the severity of illness of the patient, in terms of the physical and psychological status of the patient, and the nursing intensity of the patient's status, in terms of the nursing care needs and corresponding workload and complexity of care required by a patient.”	MacGregor et al.(58)
Patient acuity	Nursing	“Patient acuity means the measure of a patient’s severity of illness or medical conditions including, but not limited to, the stability of physiological and psychological parameters and the dependency needs of the patient and the patient’s family. Higher patient acuity requires more intensive nursing time and advanced nursing skills for continuous surveillance.” “‘Patient acuity’ means the complexity of patient care	Law insider dictionary(59)

		needs requiring the skill and care of nursing staff.”	
Patient acuity classification in nursing			
Patient acuity classification	Nursing	“Patient acuity (ie, classification of patients by needs) had become a tool used in nursing to forecast staffing and manage costs appropriately.”	Lau simmons and Vaughan(60)
Patient acuity classification	Nursing	“Patient acuity systems, also known as patient classification systems, categorize patients according to the need for nursing care.”	Kim et al.(61)
Patient acuity classification	Nursing	“Acuity, or a patient classification system, is an important component of safe staffing.” “An acuity number is assigned to represent how sick the patient is or how much nursing care is needed.”	Garcia(53)
Patient acuity classification	Nursing	“Patient acuity can be defined as the intensity of care provided to a patient by a registered nurse.” Patient acuity can be defined as “the use of patient classification systems that can forecast patient care requirements for nursing care to manage nursing personnel.”	Fesler and Toms(62)
Patient acuity categorisation	Nursing	Patient acuity is “the categorization of patients as measured by the intensity of registered nurse (RN) care necessary to meet their safety needs, in terms of required RN hours per patient day (rNHPPD).” Patient acuity “is a critical factor in achieving balanced distribution of workload.”	Juvé-Udina et al.(63)
Patient acuity categorisation	Nursing	“Patient acuity can be defined as the categorization of patients according to an assessment of their nursing care requirements.”	Harper and McCully(64)
Similar definitions of patient acuity in other healthcare contexts, based on the attributes to the concept of acuity in nursing			
Patient acuity	Oncology	“The amount of time spent caring for a patient”	Strusowski et al.(65)
Patient acuity	Oncology	“A measure of the severity of illness of the patient and the intensity of nursing care that patient requires.” (Adapted from Brennan and Daly 2009)	Strusowski et al.(65)
Patient acuity	Breastfeeding and lactation	Patient acuity is the “driver of patient outcomes” “Patient-related acuity attributes include onset, time sensitivity, and severity of the illness or physiologic state.” “Provider-related acuity attributes include the intensity or level of difficulty of care required.” “System-related acuity aligns efficiency and effectiveness with the resources needed to provide optimal care, and it can be used to predict staffing needs.”	Mannel(66)
Unusual definitions of patient acuity in nursing and other healthcare contexts			
Patient acuity	Tertiary care (burn care)	“Represents patient complexity in comorbid conditions or injury characteristics.”	Williams et al.(47)
Acuity	Nursing	“Within a health-care context, complexity refers to the intensity and resources required to care for a patient. This is not to be confused with acuity, which describes the severity of a patient's illness; acuity does not	Rogers et al.(67)

		necessarily equate to or have bearing on complexity.”	
Definitions of acuity within different levels			
High acuity	Emergency care	“High acuity was defined as where a patient died on-scene or was transported by ambulance on priority one (lights & sirens) from the scene to hospital.” Patient acuity was considered as an outcome variable in emergency care.	Ceklic et al.(68)
High acuity	Breastfeeding and lactation	“Higher-acuity breastfeeding patients require higher skill and knowledge levels of the practitioner, indicating referral to an International Board Certified Lactation Consultant (IBCLC) or a Registered Lactation Consultant (RLC).”	Mannel(66)
Low acuity	Neonatal nursing	“Neonatal intensive care units are difficult to staff appropriately due to fluctuations in patient volume and acuity.” “Neonates with lower acuity need nurses with knowledge and training in caring for newborns and their families, whereas neonates in need of intensive care need nurses with an additional high level of knowledge and training in intensive care.”	Ohnstad and Solberg(69)
Contrasting definitions of acuity in different healthcare contexts			
Patient acuity	Paramedics	“Patient acuity (call urgency) is a determinant of paramedics' physical demands.”	Morales et al.(70)
Patient acuity	Emergency care	Patient acuity is defined by triage designation, and hour of arrival.	White et al.(40)
Emergency department acuity	Emergency department	This study stated that acuity can be differentiated into perceived medical acuity and valid acuity. “Ambulance transport may be acting as an information mechanism, conveying perceived ‘medical acuity’ instead of ‘valid acuity’.”	Déziel(42)
Emergency department acuity	Emergency department	“Emergency department (ED) acuity may be defined as the general level of patient illness, urgency for clinical intervention, and the intensity of resource use within an ED’s clinical care environment.” “In this context it is a characteristic encompassing the intensity of medical need and services delivered.”	Yiadom et al.(43)
ICU acuity	ICU	ICU acuity is defined as the mean Acute Physiology and Chronic Health Evaluation IVa score of all admitted patients in a calendar year, stratified into quartiles. ICUs with admission of higher average patient severity is defined as high-acuity ICUs, ICUs with lower average patient severity is defined as low-acuity ICUs, which have outcomes of patients at low risk of dying.	Vranas(71)
Bed acuity	Medical decisions making	“Bed acuity is graded in order of level of care required: increasing from Observation Unit, General Care Unit, Step-Down Unit, to ICU.”	Shenoy et al.(46)
Acuity	Case management	Acuity is defined as “severity of illness or client condition that indicates the need for the intensity of the subsequent CM intervention, acuity links duration, quality, quantity, and volume to constitute pivotal	Huber and Craig(44)

		aspects of the service delivery platforms of healthcare providers, especially CMS."CM: case management; CMS: case management system	
Acuity	Healthcare management	Acuity is patients' care needs. Predicting acuity would "provide a powerful tool for health-care managers to allocate resources."	Kontio et al.(45)
Acuity in organisational concept	Tertiary care (burn care)	A surrogate for acuity was based on "lengths of stay, hospital throughput and hospital charges, with inefficient throughput, higher lengths of stay and higher charges representing higher acuity.	Williams et al.(47)

Appendix 7

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