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Validation of a Hospital Clinical Pharmacy Workforce Calculator: A methodology for Pharmacy?

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Abstract

Background

The benefits of clinical pharmacy services are established within hospital practice but staff numbers required for service delivery are not well described and staffing levels vary. The need for a consistent, objective method of determining staffing levels was recognised at a UK University Hospital and a Clinical Pharmacy Workforce Calculator (CPWC) was developed.

Objective

To develop the Activity Standard (AS) for pharmaceutical care and establish the reliability of the CPWC across acute hospital settings in UK.

Setting

Acute hospital in-patient clinical pharmacy services on medical and surgical wards

Method

Using the World Health Organisation's Workload Indicators of Staffing Need (WISN) methodology, a two-round Delphi study was undertaken. This developed the Activity Standard for pharmaceutical care and identified the staff-time unavailable for clinical work. Consenting panel members then tested the CPWC, calculating the staff required for three scenarios to determine whether it could be reliably used by different operators.

Results

Thirty-six participants consented to participate. Data was returned from 22 (61%) of whom 20 (56%) supplied analysable data. Consensus was achieved on the tasks required for pharmaceutical care delivery, the mean time each takes, how frequently they should be completed and the time unavailable for clinical work for each grade of staff. The CPWC calculates staffing requirements using this data. Eleven participants (55%) tested the CPWC and analysis of responses demonstrated that 30 of 33 (91%) calculations were accurately completed.

Discussion

This study defined the WISN Activity Standard for UK pharmaceutical care delivery to hospital inpatients and showed content validity for the CPWC in acute medical and surgical hospital settings. Different operators used the CPWC reliably and applied it to local sites.

Conclusion

The CPWC offers hospital pharmacy managers a useful tool to negotiate adequate staffing to deliver pharmaceutical care. Its development methodology could be applied widely in pharmacy practice.

Introduction

The need to determine and manage appropriate staffing resource to be competitive and profitable has long been recognised in industry and commerce, and there is much for healthcare providers to learn from this. With a growing elderly population, increasing reliance on health services and limited resources, healthcare delivery is increasingly driven by cost containment and tight budgetary management. The challenge in terms of effective staff resource calculation to optimise productivity falls to all professions within healthcare and pharmacy is no exception.

The development of Clinical pharmacy services over the past 40 years has been largely based on the seminal paper by Hepler and Strand[1] on pharmacists' responsibility to deliver 'pharmaceutical care'. The objectives of these services have been clearly described as the management and prevention of medicines-related problems to achieve optimum health outcomes for individual patients, and the benefits of clinical pharmacy services have been demonstrated in terms of economic and patient safety outcomes[2-5]. However, much of the published literature on pharmacy staffing focuses on prioritisation of limited resources and productivity, mainly concentrating on dispensary services and supply functions, rather than the clinical aspects of pharmaceutical care[6,7]. An early attempt to quantify pharmacy staffing levels was made by Purkiss[8]. This utilised workload data for identifying staffing in dispensary areas, but acknowledged there was little data available to support the same approach for clinical services, suggesting instead a simple 'one senior pharmacist per speciality' approach, regardless of the number of wards or outpatient activity per specialty. In the UK, NHS Benchmarking data[9] is gathered annually and identifies the range of staffing levels in the UK, but does not give any indication as to the 'right' level – simply the mean or benchmark for the UK. More recent studies have determined hospital clinical pharmacy workforce requirements, based on tasks required for service delivery[10,11]. However, these estimates relied on a fixed number of 24 beds and an inpatient length of stay of 6 days, which limits their practical application to local scenarios with different patient throughput or service models.

In recent years there has been an increased focus on the Pharmacy workforce in the UK, particularly in reducing unwarranted variation[12], and identifying accurate baseline workforce requirements has become a priority. It has been suggested that in order to be accepted into practice any healthcare workforce calculator tool needs to meet the four requirements of being simple to operate, adaptable to changing service delivery models, seen as valid by the healthcare practitioners and the outputs of it should be accepted and understood by non-clinicians[13].

In the absence of an existing tool for calculating clinical pharmacy staffing levels it seemed appropriate to base the development of a new calculator on an established methodological approach. Theories of workforce modelling techniques lie in the domain of mathematics and business management, and complex mathematical algorithms have been developed to calculate manpower requirements[14]. The World Health Organisation's (WHO) accepted methodology for determining healthcare staffing is the Workload Indicators of Staffing Need (WISN)[15] and is equivalent to established staffing algorithms (see Table 1). WISN has been used to identify staffing levels in many healthcare settings internationally and has be applied to a range of healthcare professions[16-18]. However, there is no published data on its application to pharmacy services.

[TABLE ONE HERE]

The Clinical Pharmacy Workforce Calculator (CPWC) utilised the WISN approach and was initially developed from local time and motion studies of the tasks a group of senior pharmacists considered necessary for the delivery of care, the time the tasks routinely took pharmacists and the frequency with which local policy required them to be done. The resulting algorithm was simple to use, since it required only the entry of bed numbers and average length of stay data to calculate the pharmacy staffing requirements of a ward-based service[19]. It was used to determine the pharmacist staffing needs of a series of new local service delivery initiatives and the CPWC output was accepted by senior hospital management. The next step then was for it to be validated by clinical pharmacists by more general application to other hospital pharmacy services, in different settings, which included considering its content validity and the reliability and consistency of its output[20]. The methodology adopted to do so is transferable to other settings and this report outlines a practical approach to addressing the issue of staffing levels for pharmacy practice. As such, this paper critically reports on the validation of the CPWC developed to determine the required staff resource for delivery of clinical pharmacy services for in-patients in acute hospitals.

Aim

The primary aim of the study was to develop consensus on the 'Activity Standard' for pharmaceutical care, as required in the WISN approach. The second aim of the study was to establish the reliability of the tool through a subsequent 'operator evaluation'.

Ethics approval

Institutional Ethical approval was obtained from Keele University.

Method

Study design

The WISN was used as a theoretical framework for this study[15]. Since it has not previously been used in pharmacy, using this approach required defining the 'Activity Standard' (i.e. the tasks and their times and frequencies) for clinical pharmacy service delivery (Table 1).

WISN suggests that this should be a consensus of 'experts in the field', which is why developing this consensus on the 'Activity Standard' for pharmaceutical care formed the primary aim of the study. This also involved establishing the amount of time when pharmacy staff do not undertake clinical activities, which is termed here as 'unavailable' time. A two-round Delphi study (a well-established method of developing consensus)[21-23] was undertaken to confirm the 'Activity Standard' for in-patient clinical pharmacy services and the 'unavailable' time for pharmacy staff. This was distributed and returned by email which facilitated a wide geographical response.

A subsequent 'operator evaluation' to establish the reliability of the tool was undertaken to meet the second aim of the study. This was completed by respondents from the Delphi study, again distributed and returned by email. Participants were provided with a copy of the CPWC, including instructions for use, and asked to use it to answer three hospital pharmacy staffing scenarios (shown in Table 2). Answers generated by participants were compared to identify whether a consistent response was achieved.

[TABLE TWO HERE]

Sampling and recruitment

The target Delphi sample size was based on the literature, which suggests that consensus from participants with homogenous backgrounds can be achieved with samples of 10-15 participants [24]. Where heterogeneity of participants, or complexity of subject is increased, greater numbers are needed but these rarely exceed 50 participants[25]. The sample was anticipated to be relatively homogenous for pharmacy services in each health sector represented in the study, so the target was therefore 10-15 participants from each hospital sector e.g. acute trust, community hospital, mental health unit. Expert Panel participants were hospital pharmacy managers with strategic responsibilities for delivering pharmaceutical care in their setting, with permission from the Chief Pharmacist to share data within a specified timeframe.

Invitations to participate were issued through regional and national professional forums, with a small number of personal invitations issued to individuals identified from professional networks. Where the inclusion criteria described above were met, no exclusion criteria were applied, and so all eligible pharmacy managers who volunteered to participate by email were accepted into the study.

Data collection

For the first part of the study, consensus was electronically (via email) sought on the reference data in the CPWC algorithm. In Round one the Expert Panel was asked to identify from a locally-generated list of suggested ‘clinical pharmacy tasks’ those which they believed to be necessary for individual patient care, who should provide them, how long they perceived each task typically took (this could be provided as existing local data, data collected at the time to answer the question or ‘best guess’) and how often it would be necessary to complete each task for each patient admission. In completing this activity, Panellists indicated in ‘yes/no’ format whether the tasks were necessary in the locally-generated list, which was compiled by a group of senior clinical pharmacists based on their expertise and the literature (e.g. Hepler and Strand[1]). Panellists were given a choice of pharmacist, pharmacy technician or an Assistant Technical Officer (i.e. staff without a professional qualification or registration) for who should undertake the tasks. The time taken (in minutes) and frequency were provided in free-type format (i.e. no scale).

In addition, the Expert Panel was asked to identify for a range of staff groups the time in their employed hours that was typically unavailable for patient care. This included activities such as annual leave, sick leave, training, and travel. Round one responses were collated and anonymised and emailed to each participant together with their own response in Round two for reconsideration in light of the Panel's collated responses. The Panel were asked additional questions in Round two to gain clarity on elements where consensus was not achieved in Round one, or where responses required conversion from narrative into numerical values to allow application in the algorithm. This was achieved by asking participants to respond to exemplar patient scenarios in terms of activities undertaken for patients by day of admission.

The second part of the study, the 'operator evaluation', was emailed to the Delphi Panel participants. They were given instructions and asked to use the CPWC to calculate answers to the three staffing scenarios shown in table 1 and return them for analysis.

Data analysis

The data needed to determine the Activity Standard concerned the tasks required to deliver pharmaceutical care, the times these tasks should take and the frequency that they should be delivered. These data were analysed using descriptive statistics, using the mode value to identify consensus. The extent to which consensus was achieved (i.e. the magnitude of the mode) is depicted using a 'RAG' (i.e. Red, Amber, or Green) colour rating (see Table 3) to give greater clarity on the strength of the consensus for each component, since there is no universal definition of consensus[24,25]. This was particularly necessary where consensus was not reached for tasks to include in the CPWC, which then needed a finite value for the time taken to complete them and the frequency they should be undertaken for the algorithm in the CPWC to function. For times and frequencies associated with these tasks the typical binary approach of consensus/no-consensus was not practical. The RAG rating identified where agreement was widespread (green >70%) and where there were elements of greater variety of opinion (amber >50%). Where consensus (i.e. greater than 50% agreement on a specific figure) could not be achieved for the time a task took, the value for the algorithm was derived from the data provided using a mean value to populate the algorithm.

Similarly, for the frequency of task completion where consensus was not achieved, especially for patient-dependent activities, responses from the exemplar patient questions in Round two were used to calculate an 'average' frequency for the purposes of algorithm development. To complete the WISN algorithm (Table 1), the 'unavailable' staff time was calculated from a mean of reported data.

Results

In Round one 36 participants were recruited and responses were returned by 22 (61%). Of these, one participant indicated that they were unable to provide data because their service delivery was so different the local 'suggested pharmacy tasks' did not apply. Another participant returned a corrupted electronic file and did not respond to requests to resend the data. Therefore analysable data was returned by 20 participants (56%), but not all participants returned data for all questions. In Round 2 and the 'operator evaluation' the participation rate was 50% of the study population (11 participants).

Demographics

Of the 20 participants, eleven represented teaching hospitals, seven represented district general hospitals, one was from an intermediate care facility and one was from a mental health Trust. Participants were drawn from across Great Britain. Consensus sample size was therefore achieved i.e. greater than 10 participants for 'acute Trusts' and it is for this setting only that the validation of the CPWC has been conducted. Consensus sample size for community hospitals and mental health units was not achieved. Staffing levels varied widely across the participant's sites, with teaching hospitals having around a third more staff for the equivalent bed base compared to district general hospitals.

Identifying the activity 'standard' and unavailable time

Over the two Rounds consensus was achieved for the tasks required to deliver pharmaceutical care (i.e. direct patient care activities completed for each patient admission) which are included in the CPWC and for the staff groups who need to complete them (see Table 3). Table 3 also shows that consensus was less certain for the time the tasks take and the frequency with which they should be done. The frequency of tasks for which consensus was not achieved were derived by calculating the mean frequency of activity for a 'typical' patient from the responses participants provided to the management of exemplar patients questions. This pragmatic approach allowed the development of the CPWC and the level of consensus for each element is apparent in the presentation of the tool. Green fill indicates agreement of 70% or greater among the Expert Panel members, amber fill denotes 50-69% agreement and red fill is used where less than 50% of Panel members agreed.

[TABLE 3 HERE]

The proportion of each staff group's employed hours that the Panel identified as being unavailable for clinical/operational duties is shown in Table 4 and forms the 'unavailable time' data for the WISN algorithm.

[TABLE 4 HERE]

Operator evaluation and the transferability of the CPWC

Table 5 shows that 11 of the 20 (55%) participants completed the 'operator evaluation'. Analysis of their responses showed that by using the CPWC, participants consistently identified the same requirement for pharmacy staffing levels, in that the correct completion rates for the scenarios were 8/10, 7/10 and 7/10 respectively (average 73%) and that most of the mistakes still involved correct use of the CPWC.

[TABLE 5 HERE]

Discussion

Consensus was identified for most elements of the CPWC through the Delphi process. Where consensus could not be achieved, data analysis identified a 'national best representative' figure instead. For several activities relating to the delivery of pharmaceutical care the consensus on frequency was that 'it depends on the patient'. This was explored in more detail by participants in round two of the Delphi study and allowed the generation of average frequencies of activities for the purposes of the CPWC being functional. The 'experts in the field' therefore contributed to determining the 'Activity Standard' for the WISN algorithm and in determining the 'unavailable' time for staff groups. The operator evaluation demonstrated the transferability of the CPWC to other operators, producing reliable and repeatable outputs.

Demonstrating the validity of a tool such as the CPWC is not a straightforward process, as there are various forms of validity. One of these forms, content validity, concerns the extent to which any tool addresses the full scope of the phenomenon being measured. This study achieved a national consensus on the tasks that are necessary for the delivery of pharmaceutical care, how long they take, how often they should be performed and by which staff groups, i.e. to establish an 'activity standard' for the delivery of pharmaceutical care. This suggests that content validity of the CPWC has been demonstrated through the consensus study data.

In the case of the CPWC, demonstrating other forms of validity though is more problematic. Criterion validity, for example, requires comparison with an existing 'gold standard, but there are no current 'gold standard' calculations for pharmacy workforce resource, since the 1997 'Purkiss Model'[8] no longer reflects current workforce requirements. Direct comparison of the CPWC with more recent literature (post-2010)[9-11] requires presenting staffing requirements in terms of the number of beds per pharmacist. This comparison (see Table 6) demonstrated that the output of the CPWC matched two of the three reference sources [10,11]. Its advantage over this previous work is that it is a simple to use workforce calculator, which can be applied in practice. The outlier in the comparisons is the figure identified from NHS benchmarking 2015/16[9]. This suggests that many sites are delivering services with far fewer staff than the Activity Standard would suggest. What is unknown is the difference in patient outcomes associated with these different staffing levels and further work is required to determine this.

[TABLE 6 HERE]

Construct validity could be said to have been demonstrated if the values for the various elements of the CPWC can be correlated with values calculated by different methods, provided that such methods have actually measured pharmacists' activities in comparable clinical settings[20]. In this regard, many of the timings that drive the algorithm of the CPWC are similar to values found in the literature[26-30] and this is particularly so for medicines reconciliation (MR), which is the single longest task that needs to be completed for pharmaceutical care[26-28]. MR also has the greatest influence on the value generated by the tool as it is required for all patients and is associated with reduction in patient harm from medicines[5]. However, comparative values could not be found in the literature for all elements of the CPWC e.g. checking of blood results, endorsing of prescription charts.

Demonstrating the reliability of a tool concerns the consistency and reproducibility of the data it generates. The most relevant type of reliability in the context of the CPWC is equivalence and demonstrating this requires it to be able to produce consistent measurements in the hands of two or more investigators. The results of the 'operator evaluation' in this study demonstrated that the majority of the operators achieved essentially the same results in three standardised situations, with nearly all of the differences being accounted for by operators having changed the variables in the CPWC. This suggests that had they used the standard values in the CPWC they would have provided 'correct' answers, which strengths the evidence for equivalence between users of the CPWC.

The results of this study concerned the application of the CPWC in UK acute general hospital in-patients only and this is acknowledged as a limitation of the study. It's applicability to community or mental health in-patient settings has not been demonstrated due to insufficient participant numbers from these settings. Likewise, the CPWC is also not validated for use in specialties, such as critical care. However, this study does demonstrate the value of applying the WISN approach to pharmacy practice and with sector or speciality-specific adaptions to the Activity Standard, the CPWC could be applied to clinical pharmacy services to sectors such as mental health or specialisms such as critical care. Similarly, the CPWC could be applied to clinical pharmacy services in other countries, with adaptation dependent on differences to UK services.

Conclusion

This study findings suggest that the CPWC is at least a content validated and reliable tool for determining clinical pharmacy staffing requirements for medical and surgical inpatients in UK acute hospitals. We would further contend that it has demonstrated the four criteria of an acceptable staffing calculator, namely that it is simple to operate, adaptable to changing service delivery models, seen as valid by experts and its outputs accepted and understood by non-clinicians [13]. The methodology adopted to develop the CPWC is transferable to other settings and is a practical approach to addressing the issue of staffing levels for pharmacy practice.

The process of validating the CPWC has generated a consensus-based description of the full scope of clinical pharmacy activities required to deliver pharmaceutical care to hospital in-patients and, therefore, sets a benchmark for future comparison. The CPWC does not identify ‘safe’ staffing levels, as that was not within the scope of this study. However, there is evidence from the literature that delivery of these tasks is associated with improved patient safety. Whilst not disputing that unwarranted variations exist in the delivery of healthcare within the UK, among other countries, the results of this study suggest the variation in pharmacy service provision is probably not located at what hospital pharmacy managers consider the fundamental principles of pharmaceutical care to be, but rather on how to deliver this care within the actual staff resource available.

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Conflicts of interest

The authors declare that they have no competing interests.

References

1. Hepler C, Strand L. Opportunities and responsibilities in pharmaceutical care. *Am J Hosp Pharm* 1990; 47: 533-543.
2. Bond C, Raehl C, Franke T. Interrelationships among mortality rates, drug costs, total cost of care, and length of stay in United States hospitals: summary and recommendations for clinical pharmacy services and staffing. *Pharmacotherapy* 2001 Feb; 21: 129-141.
3. Gallagher J, Byrne S, Woods N, Lynch D, McCarthy S. Cost-outcome description of clinical pharmacist interventions in a university teaching hospital. *BMC Health Serv Res* 2014; 14: 177.

4. Gammie T, Vogler S, Babar Z. Economic Evaluation of Hospital and Community Pharmacy Services: A Review of the Literature (2010-2015). *Ann Pharmacother* 2017; 51: 54-- 65.
5. Bond C, Raehl C. Clinical pharmacy services, pharmacy staffing, and hospital mortality rates. *Pharmacotherapy* 2007; 27: 481-493.
6. Granko R, Poppe L, Savage S, Daniels R, Smith E, Leese P. Method to determine allocation of clinical pharmacist resources. *Am J Health Syst Pharm* 2012; 69: 1398-1404.
7. Acres S. How many staff members are needed to run a busy hospital dispensary? *Pharm J* 2004; 273: 184.
8. Purkiss R. How to get the staff you need, calculation of pharmacy manpower requirements. *Pharmacy in Practice* 1997; 270: 393-396.
9. NHS Benchmarking Network. National Hospital Pharmacy Benchmarking Programme 2018-19. 2019; Available at https://s3.eu-west-2.amazonaws.com/nhsbn-static/Pharmacy%20&%20Medicines%20Optimisation/2019/Summary%20Report.pdf. Accessed 23/10/2020.
10. O'Leary K, Stuchbery P, Taylor G. Clinical Pharmacist Staffing Levels Needed to Deliver Clinical Services in Australian Hospitals. *J Pharm Prac Res* 2010; 40: 217-221.
11. Onatade R, Miller G, Sanghera I. A quantitative comparison of ward-based clinical pharmacy activities in 7 acute UK hospitals. *Int J Clin Pharm* 2016; 38: 1407-1415.
12. Lord Carter of Coles. *Operational productivity and performance in English NHS acute hospitals: Unwarranted variations. An independent report for the Department of Health.* 2016; Available at: https://www.gov.uk/government/publications/productivity-in-nhs-hospitals. Accessed 23/10/2020.
13. Schoo A, A Boyce R, Ridoutt L, Santos T. Workload capacity measures for estimating allied health staffing requirements. *Aust Health Rev* 2008; 32: 548-558.
14. Kazan H. A Study of Factors Affecting Effective Production and Workforce Planning. The Journal of American Academy of Business 2005;7(1):288—296
15. World Health Organisation. *Workload Indicators of staffing need [WISN] Users Manual.* Geneva: 2015; Available at: http://www.who.int/hrh/resources/wisn_user_manual/en/. Accessed 23/10/2020.
16. McQuide P, Kolehmainen-Aitken R, Forster N. Applying the workload indicators of staffing need [WISN] method in Namibia: challenges and implications for human resources for health policy. *Hum Resour Health* 2013; 11: 64.

17. Hagopian A, Mohanty M, Das A, House P. Applying WHO's 'workforce indicators of staffing need' [WISN] method to calculate the health worker requirements for India's maternal and child health service guarantees in Orissa State. *Health Policy Plan* 2012; 27: 11-18.
18. World Health Organisation. *Applying the WISN Method in Practice: Case studies from Indonesia, Mozambique and Uganda*. 2010 Geneva: WHO Press: Available at http://www.who.int/hrh/resources/wisn_case_studies/en/. Accessed 23/10/2020.
19. Simcock V, Blackshaw C, Bednall R, Hanif I, Freeman S. What is the cost of a modern clinical pharmacy service? Part II - the development of a resource calculator. Conference Handbook UKCPA/GHP Joint Annual Conference. Manchester Abstract 51. 2014; Available at: http://ukclinicalpharmacy.org/community/our-library/. Accessed 23/10/2020
20. Eddy D, Hollingworth W, Caro J, Tsevat J, McDonald K, Wong J. Model transparency and validation: A report of the ISPOR SMDM Modeling Good Research Practices Task Force-7. Value Health 2012; 15: 843-850.
21. Maskrey N, Underhill J. The European Statements of Hospital Pharmacy: achieving consensus using Delphi and World Cafe methodologies. *Eur J Hosp Pharm* 2014; 21: 264-266.
22. Jones J, Hunter D. Consensus methods for medical and health services research. *Br Med J* 1995; 311: 376-380.
23. Clyne W, White S, McLachlan S. Developing consensus-based policy solutions for medicines adherence for Europe: a Delphi study. *BMC Health Serv Res* 2012; 12: 425-6963-12-425.
24. von der Gracht, H. Consensus measurement in Delphi studies: Review and implications for future quality assurance. *Technol Forecast Soc Change* 2012 10; 79: 1525-1536.
25. Hsu CC, Sandford B. The Delphi technique: Making sense of consensus. *Practical Assessment, Research and Evaluation* 2007;12:1-8.
26. Urban R, Armitage G, Morgan J, Marshall K, Blenkinsopp A, Scally A. Custom and practice: a multi-center study of medicines reconciliation following admission in four acute hospitals in the UK. *Res Social Adm Pharm* 2014; 10: 355-368.
27. Lizer M, Brackbill M. Medication history reconciliation by pharmacists in an inpatient behavioral health unit. *Am J Health Syst Pharm* 2007; 64: 1087-1091.
28. Nester T, Hale L. Effectiveness of a pharmacist-acquired medication history in promoting patient safety. *Am J Health Syst Pharm* 2002; 59: 2221-2225.
29. Jenkins A, Eckel S. Analyzing methods for improved management of workflow in an outpatient pharmacy setting. *Am J Health Syst Pharm* 2012; 69: 966-971.

30. Calabrese S, Williams J. Implementation of a web-based medication tracking system in a large academic medical center. *Am J Health Syst Pharm* 2012; 69: 1651-1658.

Tables

Table 1. Comparison of the mathematical algorithms of Kazan[14] to WISN (1998)[15]

Establishment of Need of Real Personnel[14]	WISN[15]	
$RPR = \frac{TT}{AWT}$	$\text{Staff resource} = \frac{\text{Time to perform role for full patient population}}{\text{Available working time}}$	
$TT = \sum_{i=1}^{n} R_i * T_i$	Time to perform role= Activity standard x number of patients	
Where		
TT: Total time needed to finish whole job	Time to perform full role for all patients	
R_i: the number of repeats	Frequency with which task done	Activity standard
T_i: The required time to perform a job at least once	How long it takes to do a task	
i: the individual task	Each task identified	
n: total operation	Total number of tasks required to perform role	
RPR: real personnel requirement	Staff resource	
AWT: average workforce time	Available working time =	Time available for patient care

Table 2. Scenarios given to pharmacy managers

Scenario 1
A new general medical ward is planned to open. This will have 28 beds and an average length of patient stay of 5 days. The average number of items on an in-patient prescription is 8. What is the pharmacy staff whole-time-equivalent required to deliver a standard ward-based service to this new ward?
Scenario 2

An existing 28 bed general medical ward with average length of patient stay of 4 days (average number of items per in-patient prescription is 8) is being converted to a short stay (48 hour) unit. What impact will this have on your pharmacy service and what, if any, additional staff would you request?	
Scenario 3	
You are approached by a directorate manager about to submit a business case for 200 new bariatric surgical patients. No new beds will be opened, but these cases will go through an existing 28 bed surgical ward with a length of patient stay of 3 days. These patients have an average of 6 items on their prescription. What resource implications will this will have for you and what pharmacy resource should he include in the business case?	

Table 3. Consensus on the 'Activity Standard' for clinical pharmacy

Direct patient care activities completed for each patient admission	% Agreement with task necessity n=20	Staff group required to deliver task. Mode response (%) n= 20	Time task takes in minutes. Mode response (%)& range	Frequency which task should be done for each admission. Mode response (%) & range
Medicines Reconciliation (pharmacy confirmed and signed off)	100	P / MMT = 81%	n= 20 10 (29%) & 20 (29%) 6-30 *20	n=20 1(85%) 1-2
Check of Patients Own Drugs (PODs)	95	MMT= 91%	n=17 5 (58%) 4-15	n=20 1(65%) 1-2
Clinical Review of Notes	90	P=81%	n=18 5 (66%) 2-10	n=20 "Depends" (45%) $$0.4
Review of Blood results	90	P=81%	n=17 5 (35%) 1-5 *3	n=19 "Depends" (52%) Depends-3 $$0.4
Initial review of Drug Chart	100	P=81%	n=18 5 (50%) 2-5	n=19 1 (79%) Depends-1
Initial endorsing of Drug Chart	95	P=91%	n=17 5 (40%) 1-10 *4	n=17 1 (82%) Depends-1
Subsequent review of Drug Chart	95	P=90%	n=17 5 (41%) 1-5 *3	n=18 "Depends" (44%) Depends-Daily $$0.7
Subsequent endorsing of Drug Chart	90	P=86%	n=17 2 (30%) 0-5 *2	n=17 "Depends" (41%) Depends-daily $$0.7
Completion of Paperwork (Pharmacy handover/care plans etc)	86	P=61% MMT=52%	n=9 5 (66%) 1-5	n=11 "Depends" (27%) Depends-Daily $$ [illegible]

Ordering of Non Stocks	90	MMT=72%	n=16 5 (44%) 1-5 *3	n=17 “Depends” (47%) Depends-3 $$2
Clinical Check of Discharge prescription	100	P=76%	n=20 5 (38%) 2-17 *10	n=20 1 (100%)
Talking to patient about their medicines	95	P/MMT=81%	n=17 5 (47%) 1-15 *7	n=17 (40%) Depends-2 $$1
Making interventions on patient care	100	P=100%	n=16 5 (56%) 1-10	n=19 “Depends” (57%) Depends-Daily $$1

Key: P = pharmacist. MMT = medicines management technician. PODs=patient’s own drugs. P/MMT = pharmacists or MMTs. “depends” = depends on patient characteristics. $$Frequency for ‘typical’ patient x/day of admission. *No consensus therefore mean value used in calculator. Level of consensus: Strong consensus (≥70% Panel members in agreement) = Moderate consensus (50-69% in agreement) = No consensus (<50% in agreement) =

Table 4. Mean staff time 'unavailable' for clinical/operational duties

	Non-operational activities (mins/week) reported by participant sites									As per NHS policy		
AfC grade	Travel	Mandatory training	Professional training	Meetings	Rest Time	Other	Total Additional time(mins/ week)	Total Additional time(hrs/ week)	Non-operational employment time (WTE)	Annual leave (WTE)	Sickness (WTE)	Total
8a	90.00	14.00	71.95	179.75	5.56	112.36	473.62	7.89	0.21	0.10	0.03	0.34
7	108.33	14.37	86.22	94.17	10.30	47.15	360.54	6.01	0.16	0.10	0.03	0.29
6	103.44	14.99	106.25	64.38	8.43	21.57	319.06	5.32	0.14	0.10	0.03	0.27
5	127.50	16.07	21.39	35.50	0.00	11.11	211.57	3.53	0.09	0.10	0.03	0.22
4	101.75	14.00	19.47	28.42	0.00	11.41	175.05	2.92	0.08	0.10	0.03	0.21
2&3	101.76	16.71	36.18	28.24	0.00	12.13	195.02	3.25	0.09	0.10	0.03	0.22

Table 5. Results from the operator evaluation

	Resource requested ("correct answer" if CPWC used as intended)			Comments
Participant number	Scenario 1 (£77,134)	Scenario 2 (£75,895)	Scenario 3 (£6,488.80)	Shaded boxes identify "wrong answers" the explanation for which were explored and identified below
2	77,134.12	92,674.00	6,488.80	Value incorrect as operator used scenario 1 details for baseline but changed patient length of stay in CPWC, **but CPWC used correctly**
7	78,336.19	53,174.00	12,847.00	Operator changed % prescription type (i.e. standard or controlled drug) for dispensing data and/or number of items dispensed in CPWC, **but CPWC used correctly**
8	77,134.00	75,895.00	6,488.80	
13	77,134.00	76,000.00	6,488.80	Rounded up value calculated, **but CPWC used correctly**
17	77,134.00	169,898.00	6,488.80	Correct post change value calculated but baseline figure not subtracted for difference - **CPWC used correctly though**
18	Narrative	Narrative	Narrative	Instructions for answering question not followed
22	77,134.00	75,895.00	117,014.00	Correct post change value calculated but baseline figure not subtracted for difference - **CPWC used correctly though**
25	77,134.00	75,895.00	6,488.80	
27	77,134.00	75,895.00	6,838.00	Incorrect - reason unclear
34	77,134.00	75,895.00	6,488.80	
35	62,833.00	75,895.00	110,525.00	Scenario 1: Operator changed % prescription type (i.e. standard or

				controlled drug) for dispensing data and/or number of items dispensed in CPWC – **but CPWC used correctly** Scenario 2**:** Incorrect - reason unclear
Mean value	£75,824.00	£75,165.00	£34,455.00	
% Correct	**80%**	**70%**	**70%**	**Average correct completion = 73%**

Table 6. Comparison of workforce requirements from recent literature

Reference source	Beds / WTE pharmacist
O'leary, Stuchberry & Taylor[10] (Average hospital- wide, average LOS 6 days)	19.5
Onatade, Miller & Sanghera[11] (average across 7 London sites)	18.19
NHS Benchmarking[9]	43
RSPWC (24 bed ward, LOS 6 days, 5 day service)	22