Selecting and Applying Methods for Estimating the Size and Mix of Nursing Teams

A systematic review of the literature commissioned by the Department of Health

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Summary: systematic review of the literature commissioned by the Department of Health, April 2002.

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INTRODUCTION

Nurses, perhaps more than any other professional group, are affected by clinical, educational, and managerial developments in the health and social services. Consequently, decisions about the size and mix of nursing teams are critical areas for health service managers generally and nursing workforce planners specifically. Overstaffed, undermanned and unbalanced nursing teams have implications for the quality and cost of patient care. Nurses' job satisfaction and the effective education of student nurses and other staff also may be jeopardised by poorly configured nursing teams. In short, never before has it been so vital that nurses are armed with appropriate instruments and data to help them plan and implement efficient and effective nursing teams.

The aims of this summary and the main report, therefore, are to help you make sense of the complex and uncertain world of nursing workforce planning and to make better decisions about cost-effective numbers and mixes of nurses. Consequently, five commonly used workforce planning methods are reviewed and described. Indeed, the review of the nursing workforce planning literature in the main report is the most extensive since the DHSS studies in the mid-eighties (p.22)[1] .

Considerable effort has gone into explaining the strengths and weaknesses of five nursing workforce planning systems briefly described here and fully explained in the main report:

1. Professional judgement approach (p.7).
2. Nurses per occupied bed method (p.10).
3. Acuity-quality method (p.13).
4. Timed-task/activity approaches (p.18).
5. Regression-based systems (p.20).

Annotated bibliographies are provided from p.22 onwards in the main report where you can follow-up theoretical and practical points. Selections from 500 publications covering demand-side nursing workforce planning and related issues are summarised and organised mainly under headings 1 to 5 above. Moreover, two methods of locating bibliographic materials have been created. You can identify publications relevant to categories 1 to 5 in the main report. For example, texts from the 500 that explore the Professional Judgement method have been sifted and listed separately. Alternatively, you can look up annotated texts listed alphabetically in the full Harvard-style reference list. The web site, where these and related materials can be found, is given at the end of this document.

[1] The p.number refers to pages in the main report where issues are explored in detail.

HOW TO USE THIS SHORT AND THE MAIN REPORT

Explanations and exercises for the five commonly used methods for estimating or evaluating the size and mix of your nursing teams go from simple to complex (p.7). However, it is anticipated that you may want to use two or more methods. Opportunities for comparing methods and results, therefore, are provided. If an issue within any of the five approaches isn't clear, or you want to follow-up theoretical or practical points then go to the appropriate annotated bibliography in the main report. Although you'll manage the steps in this summary using a calculator, some of the five main methods require calculations that can be simplified by spreadsheets, which also can be downloaded free of charge from the web site address given at the end of this summary.

THE PROFESSIONAL JUDGEMENT METHOD OF ESTIMATING THE SIZE AND MIX OF NURSING TEAMS

Telford's early work, using expert, professional judgement to agree the most appropriate size and mix of ward nursing teams has stood the test of time. This technique simply helps you to convert your duty rotas into whole time equivalents (WTE's). This method, as the algorithm below shows, is simple to use and is an excellent starting point before you tackle the more sophisticated methods that come later. You'll find this method invaluable for quickly adjusting your nursing establishments following policy or practice changes such as hand-over or break-time amendments (p.7).

In the following example from a 15 bed surgical ward, a decision is made to roster three nurses for the morning and afternoon shifts, and two nurses for the night shift. A 30 minute morning to afternoon shift hand-over period, and a 15 minute afternoon to night shift hand-over is included because it is part of the usual work pattern. You can substitute local times and your preferred number of staff for different contexts.

Table 1. Seven Day Ward Professional Judgement Staffing Formula

Step 1. Calculate the number of working hours needed:

Early shift: 0700 to 1430	=	*7.5 hrs x 3 nurses x 7 days*	*157.5 hrs*
Late shift: 1400 to 2130	=	*7.5 hrs x 3 nurses x 7 days*	*157.5 hrs*
Night shift 2115 to 0715	=	*10 hrs x 2 nurses x 7 days*	*140 hrs*
Total			= *455 hrs*

However, these hours assume that nurses are never sick or take holidays, etc. A 'time-out' adjustment to cover leave of all kinds, therefore, is necessary. The 22% allowance used in the formula below was obtained from a 'time-out' study of 300+ general wards in the UK. However, if you wish then you can substitute a local figure (obtainable from your personnel department).

Step 2. Adding the time-out allowance.

455 hrs x 1.22 (time-out) = 555.1hrs/37.5hrs (1 WTE) = 14.8 WTE's.

A staffing pattern of three nurses for the morning, three nurses for the afternoon/evening and two nurses at night, therefore, requires almost 15 full-time nurses for this small surgical ward. The same approach can be used for five-day wards but different hand-over allowances are used in Table 2 below.

Table 2. Five Day Ward Professional Judgement Formula

Early shift: 0700 to 1445	=	*7.75 hrs x 3 nurses x 5 days*	*116.25 hrs*
Late shift 1400 to 2145	=	*7.75 hrs x 3 nurses x 5 days*	*116.25 hrs*
Night shift 2115 to 0730	=	*10.25 hrs x 2 nurses x 4 days*	*82 hrs*
Total	=		*314.5 hrs*

The five-day ward time-out value would not be as great as a seven-day ward; therefore, 315 hrs x 1.18 (time out) = 371. 7 hrs/37.5 hrs = 9.9 WTE. Again, you can substitute local time-out values.

CALCULATING THE NUMBER OF NURSES PER SHIFT

One spin-off from the professional judgement staffing formula used in the seven-day and five-day ward examples above is that the technique can be 'reversed' to calculate the available nurses per shift from a ward's actual (names on the duty rota) or funded (what the budget allows) nursing establishment. The process goes as follows:

1. A seven day ward requires 21 shifts (7 days x 3 shifts per day) to be staffed by nurses.
2. Each full-time nurse works 5 shifts.
3. Therefore, 4.2 WTE nurses provides 1 nurse per shift (21/5 = 4.2).
4. Two nurses per shift require 8.4 WTEs, and so on.
5. However, we're faced with the same time-out problem discussed above. That is, the 4.2 WTE nurse figure lacks an allowance for paid and unpaid leave.
6. Therefore, 4.2 x 1.22 (22% time out) = 5.1 WTE nurses provides one nurse per shift.

Applying this technique to the specimen ward in the following table shows its value.

Table 3. Calculating Shift WTE from Funded Nursing Establishments

Grade	*Funded WTE's*	*Divisor*	*Nurses per Shift*
G	*1*	*5.1*	*0.2*
F	*1.5*	*5.1*	*0.3*
E	*2.5*	*5.1*	*0.5*
D	*5.5*	*5.1*	*1.1*
C	*5*	*5.1*	*1*
B	*5*	*5.1*	*1*
A	*5*	*5.1*	*1*
Total	*25.5*	*5.1*	*5*

The funded nursing establishment in Table 3 above allows:

One G or F grade nurse on duty every other shift.
One E grade on duty every other shift.
One D grade on duty every shift.
One C grade health care assistant on duty each shift.
One B grade nursing assistant on duty each shift.
One A grade on duty each shift.

In total five nurses per shift. In practice, the 25.5 nurses would be equitably distributed between day, night and weekend shifts. The next logical step would be to build a duty rota from these findings.

STRENGTHS AND WEAKNESSES

The professional judgement method has many strengths. It's quick, simple and inexpensive to use and can be applied to any speciality, no matter how many hours a day the service operates. Consequently, results are easy to update and little adjustment is needed for other care groups.

This method acts as an excellent springboard to more sophisticated methods and it is often used to check the results from other methods, a kind of belt and braces approach to operational management. Similar results from two or more methods (known as triangulation) gives you confidence about your decisions.

Little adjustment is required for different care groups. Also, new and sometimes unmeasurable variables, for example, introducing technology

into the ward, are easily handled by simply agreeing how many more or fewer nurses are needed to deal with new ways of working. Finally, the effects of adjusting nurse staffing on the quality of care and job satisfaction can be measured by one of several nursing quality and nurses' job satisfaction surveys.

As the literature often explains, no nursing workforce planning method is perfect (p.22) and the professional judgement method has its weaknesses. For example, the relationship between staffing levels and nursing quality is hard to explain using this method. That is, how do we know if 25.5 WTE nurses is enough to maintain an acceptable standard of care, or to ensure equitable workloads, job satisfaction and therefore, a desire to stay in the job? A follow-up study of nursing care quality and nurses' job satisfaction is essential to check the adequacy of the ward's establishment, which arguably is no bad thing under any circumstances.

The professional judgement method is less flexible when patient numbers and especially patient dependency mix change; that is, the ward will often be over- or understaffed. As a result, the method is deemed too subjective; that is, should professionals themselves be determining their own staffing levels without an independent check? Finally, calculations get awkward when unusual shifts are worked such as long days. However, computer spreadsheets ease the burden.

NURSES PER OCCUPIED BED METHOD

Average nurses per occupied bed (NPOB) is another popular and simple method of determining or evaluating the number and mix of ward staff. The formulas shown below were compiled from a study of 300 plus hospital wards in the UK (p.10). The 1.35 WTE nurses per occupied medical ward bed figure in Table 4 below, for example, was obtained from 83 medical ward nursing establishments. The 'actual' establishment rather than the 'funded' is used in that actual establishments includes overtime, agency and bank hours. Ward 'overhead' and 'time-out' allowances are built into the formulas to add the indirect care, associated work and leave/absence components. It's worth pointing out at this stage that the main report contains a glossary (p.3) that defines most workforce planning esoteric phrases.

Table 4. Calculating Staffing from Average NPOB

Care Group	*Medic.*	*Elderly*	*Surg.*	*Ophth.*	*ENT*	*Gynae.*	*Ortho.*	*Paed.*
Number of wards	*83*	*54*	*66*	*5*	*9*	*11*	*53*	*26*
Average occupancy	*24*	*24*	*22*	*13*	*16*	*20*	*22*	*15*
G/H/I per occ. bed	*0.06*	*0.05*	*0.05*	*0.11*	*0.09*	*0.06*	*0.05*	*0.13*
F grade	*0.12*	*0.06*	*0.07*	*0.09*	*0.15*	*0.09*	*0.05*	*0.2*
E grade	*0.32*	*0.24*	*0.27*	*0.22*	*0.45*	*0.14*	*0.24*	*0.49*
D grade	*0.48*	*0.31*	*0.38*	*1.03*	*0.55*	*0.45*	*0.38*	*0.53*
C grade	*0.07*	*0.04*	*0.06*	*0.07*	*0.03*	*0.02*	*0.05*	*0.11*
Nursing assistant	*0.3*	*0.51*	*0.31*	*0.25*	*0.23*	*0.12*	*0.44*	*0.27*
Total	*1.35*	*1.21*	*1.14*	*1.77*	*1.50*	*0.88*	*1.21*	*1.73*

In the elderly ward example in Table 4 above, one patient requires 1.21 WTE nurses to meet his or her needs. An average of 24 patients requires a nursing establishment of 29 WTE nurses (24 x 1.21), or put another way, 29 full-time nurses on the duty rota. Remember, leave of all kinds comes out of this establishment, and as we saw above, at any time one nurse in five is away from the ward. These formulas are less generous in this light. Calculating the grade mix follows the same process - multiplying the average number of occupied beds with the grade mix proportion.

STRENGTHS AND WEAKNESSES

If nothing else, these data provide opportunities to benchmark your wards. The method can also be used to verify professional judgement method findings. Clearly, the NPOB method comes into its own if your ward bed complement changes and you need to modify the nursing establishment. Another strength is that the keep-it-simple method of demand-side workforce planning is honoured.

The staffing and grade mix formulas in Table 4 above have been empirically derived and the formulas use data collected systematically; for example, bed occupancy and payroll information. Also, formulas for the main specialities are unique because they are derived from data collected only in same-speciality wards. Moreover, the wards providing these data have passed a quality test; that is, none fell below a pre determined quality standard (p.13) to avoid projecting from inadequately staffed wards. Learners are supernumerary in the staffing projections and if the base wards' staffing is fair then mentoring and supervision ought to be easily accommodated.

This approach, as we saw above, makes determining establishments and generating the

ward's grade mix easy since formulas are broken down by nursing grade. Even though you may not have the financial or staffing resources to boost your establishment to levels recommended by NPOB formulas, at least you can benchmark your own establishments. Finally, the data are easily built into a computerised spreadsheet for 'what-if?' purposes, which can be downloaded FoC from the website given at the end of this report.

On the downside, this method assumes that base staffing was rationally determined. However, there's evidence in the literature that ward establishments are historical and sometimes bare little relationship to ward occupancy (p.44). As it happens, the NPOB averages above were derived from 'quality assured' wards. Unlike the data in Table 4 above, there's no guarantee that the averages from other sources (such as ones found in the literature) come from wards that deliver an acceptable standard of care. If you decide to gather your own data then you should try to accommodate this important principle.

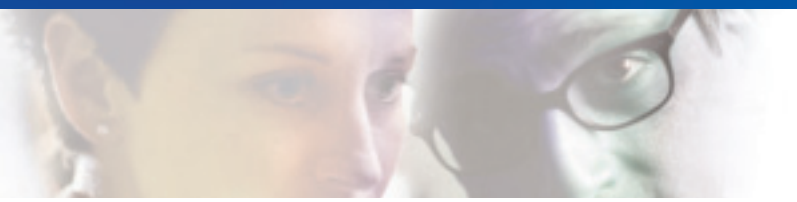
These NPOB staffing formulas are insensitive to patient dependency changes; that is, the formulas recommend the same number of nurses for patient populations that are predominantly low dependency as it does for high dependency inpatients. As we'll see later, dependency can have a striking effect on nursing workload (p.13).

Formulas are costly to update; extensive fieldwork is required to alter formulas for a speciality that changes nursing practice in some way. Routinely collected data, such as bed occupancies used in staffing formulas, are more error-prone than those that are deliberately and systematically collected because empirical data are usually confirmed in some way.

The NPOB formulas in Table 4, like those in the literature, contain hidden structures and processes that need to be made explicit. For example, the ophthalmic ward data in Table 4 above are drawn from wards where nurses also staff operating theatres, hence what seems at first glance to be a generous number of nurses per occupied bed. Similarly, NPOB data may be drawn from wards that are geographically different to your wards; that is, hub and spoke units have subtle nursing activity differences compared to Nightingale-type wards. However, layout is a much less important workload variable than dependency, for example. Finally, learner nurses' contributions, or alternatively their demand on qualified staffs' time, warrant special consideration to which some NPOB formulas are insensitive.

ACUITY-QUALITY METHOD

A third way of estimating or evaluating the size and mix of ward nursing teams is (in full) the dependency-activity-quality or acuity-quality method for short (p.13). This staffing method overcomes most of the weaknesses highlighted in the professional judgement (p.7) and the NPOB methods (p.10). It is useful for wards where patient numbers and mix fluctuate. Consequently, medical and surgical admission unit managers find the acuity-quality method invaluable.



Formulas are not only sensitive to the number and mix of inpatients but also have a floor below which nursing care standards shouldn't fall. Formulas are, therefore, more complex to construct and apply. Analysis usually requires computer spreadsheets especially when 'what-if?' questions are asked such as what to do if the ward has a sudden influx of high-dependency patients. To help you understand the acuity-quality method, a step-by-step algorithm and a base-data table are given below that make the task manageable (p.14). The specimen results can easily be checked with a calculator. The data averages in this example are from 83 quality assured UK medical wards (see Table 5 below).

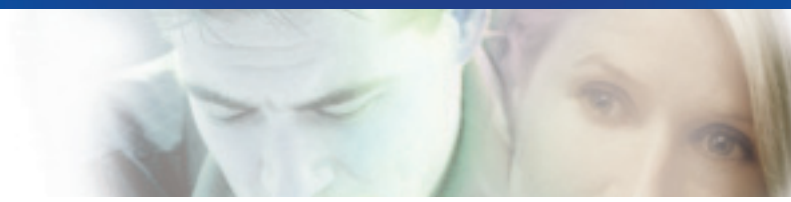
Step 1. Obtain the average number of patients in dependency categories 1 to 4. From Table 5, the dependency numbers are obtained by multiplying the bed occupancy by the proportion of dependency 1 patients, etc.:

Dependency Category	*1*	*2*	*3*	*4*	*Total*
Number of patients	*5*	*10*	*7*	*3*	*25*

Dependency category 1 patients are virtually independent of nurses. Dependency 4 patients, on the other hand, are dependent on nurses for most if not all their needs. We use a four-group dependency model in this algorithm but other configurations work equally well. The patient dependency annotated bibliography on p.55 in the main report provides several sources of dependency rating scales. Alternatively, e-mailing Keith Hurst on <k.hurst@leeds.ac.uk> will generate one.

Step 2. Record the average amount of direct care time given to each dependency category per day (using data only from quality assured wards, see Table 5 below):

Dependency Category	*1*	*2*	*3*	*4*
Daily time in minutes	*46*	*106*	*197*	*336*



The daily times (in minutes) were obtained from observing 3000+ hours of nursing care in 83 medical wards (see Table 5). In short, the lowest dependency (1) patient gets three-quarters of an hour of hands-on care each day. The most dependent (4) patient, on the other hand, receives 5.6 hours of nursing care a day. Because this care is direct or hands-on care, the 'ward overhead' needs adding later. The annotated bibliography on p.69 provides several sources of activity analysis instruments from which these direct care times can be generated. Alternatively, e-mailing the author <k.hurst@leeds.ac.uk> will generate one.

Step 3. Convert the times in Step 2 above into ratios by dividing dependency category 1 minutes into dependency 2 minutes, dependency 1 into dependency 3 and dependency 1 into dependency 4:

Dependency Category	*1*	*2*	*3*	*4*
Ratios	*1*	*2.3*	*4.3*	*7.3*

This seems an odd step but calculations using care ratios make the remaining task easier and more meaningful. In short, we can see that dependency 4 patients get seven times more nursing care than dependency 1 patients (which reflects the 4's higher dependency).

Step 4. Multiply the ratios by the average daily number of patients in each dependency category to obtain the workload index (WLI) or acuity (hence the method's name):

Dependency Category	*1*	*2*	*3*	*4*	*Total*
Ratios	*1*	*2.3*	*4.3*	*7.3*	
Number of patients	*5*	*10*	*7*	*3*	*25*
Workload index/Acuity	*5*	*23*	*30*	*22*	*80*

Step 5. In other words, the WLI/Acuity is equal to the nursing work needed to care for 80 dependency 1 patients. Dividing WLI by the occupancy (80/25 = 3.2) gives the bed acuity. The WLI (80) and the bed acuity (3.2) are good benchmarks. Once you get accustomed to using them they will have the same meaning as room temperature – you'll know when it's comfortable. However, you need both values because acuity is meaningless if the number of occupied beds isn't known.

Step 6. The nursing time required for good quality care for a dependency 1 patient, as we saw above, is 46 minutes per day (see Table 5). It's a good time to reiterate that the 83 medical wards used in this example have passed 'the quality test' so that we don't extrapolate from poor practice wards. The annotated bibliography on p.90 describes several nursing quality rating scales. Alternatively, the author <k.hurst@leeds.ac.uk> can provide one

The direct care time for all patients is:

80 (WLI) x 46 minutes = 3680 minutes/60 minutes = 61.3 hours per day.

Step 7. We also know from our studies of nursing care in 83 medical wards that nurses spend 42% of their time in direct nursing care. Adding the indirect care component (or ward overhead), therefore, involves:

61.3/42 x 100 = 146 hours per day x 7 days = 1022 hours per week.

Step 8. Nurses in the 83 medical wards took meal and drink breaks averaging 10% of their working day (see Table 5). As you might expect, this time was included in the activity analysis but it is not part of the 37.5 hour week. Ten per cent, therefore, is deducted:

1022 hours - (1022 x 0.1) = 920 hours

Step 9. The nursing hours calculated so far assume that ward staff do not take annual or sick leave, etc. Again, from our study of 83 medical wards, we note that nurses account for a 22% time-out value (see Table 5). An allowance for paid and unpaid leave, therefore, is added:

920 x 1.22 = 1122 hours

Step 10. Convert the total nursing hours for the week into whole time equivalents:

1122/37.5 hours = 30 WTEs.

This specimen medical ward, therefore, requires 30 full-time nurses to care for patients 24 hours a day seven days a week.

Step 11. In recent years we've embellished the acuity-quality method by adding a grade mix component. The grade proportions below were obtained from a 'who should do what' study of 83 medical wards. These data are up-to-date at the time of publication. They are, however, revised at least yearly. In short, we multiply the required WTEs (from Step 10) by the appropriate grade mix proportion from the medical column in Table 5.

Grade	Medical Ward Proportion			WTE
G/H/I	4%	(30 x 0.04)	=	1.2
F	11%	(30 x 0.11)	=	3.3
E	21%	(30 x 0.21)	=	6.3
D	33%	(30 x 0.33)	=	10
C	12%	(30 x 0.12)	=	3.6
Nurs.Ass.	19%	(30 x 0.19)	=	5.7
Total			=	30

In practice, there's only likely to be one ward leader and the other WTE decimal places will be adjusted to create more realistic contracts such as 3.5 full time HCA grade C.

Table 5. Acuity Method Base Data

Variable	Care Group							
	Medic.	Elderly	Surg.	Ophth.	ENT	Gynae.	Ortho.	Paed.
N wards	83	54	66	5	9	11	53	26
Occupancy	25	24	22	13	16	20	22	15
Dep 1	19%	12%	19%	23%	28%	29%	21%	8%
Dep 2	42%	23%	40%	55%	39%	44%	36%	31%
Dep 3	28%	47%	28%	21%	26%	17%	34%	47%
Dep 4	11%	18%	13%	1%	7%	10%	9%	14%
Daily mins								
Dep 1	46	26	67	62	79	79	53	67
Dep 2	106	79	98	170	156	120	106	110
Dep 3	197	154	240	178	164	185	185	218
Dep 4	336	214	295	276	278	271	278	341

Table 5. Acuity Method Base Data (continued)

Variable	*Care Group*							
	Medic.	*Elderly*	*Surg.*	*Ophth.*	*ENT*	*Gynae.*	*Ortho.*	*Paed.*
Direct care	*42%*	*45%*	*43%*	*29%*	*34%*	*39%*	*42%*	*41%*
Meal break	*10%*	*8%*	*9%*	*8%*	*11%*	*8%*	*9%*	*9%*
Time out	*22%*	*23%*	*21%*	*22%*	*25%*	*23%*	*22%*	*21%*
Grade mix								
G/H/I	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*
F	*11%*	*8%*	*10%*	*11%*	*12%*	*10%*	*9%*	*10%*
E	*21%*	*15%*	*21%*	*23%*	*24%*	*22%*	*19%*	*21%*
D	*33%*	*30%*	*35%*	*32%*	*34%*	*35%*	*33%*	*39%*
C	*12%*	*15%*	*12%*	*11%*	*10%*	*12%*	*14%*	*10%*
Nurs.Ass.	*19%*	*28%*	*18%*	*19%*	*16%*	*17%*	*21%*	*16%*

STRENGTHS AND WEAKNESSES

One of the strengths of the acuity-quality method is that you can substitute data in Table 5 above with local values. For example, the average medical ward patient dependencies can be replaced with local numbers. If you don't have patient dependency data then you can convert your occupancies into typical dependency mixes simply by multiplying your ward's bed occupancy by the patient dependency proportions given in Table 5. This alternative, however, diminishes the acuity-quality method's power.

Recently, high patient throughput wards, such as medical admission units, convert short-stay patients into patient whole-time equivalents (PWTE). Simply counting heads at some census point is deemed less valuable in these wards than summing the daily patient hours for each dependency group and dividing by 24 to arrive at PWTEs. This new approach gives a more accurate WLI in 'busy' wards.

Default direct care and time-out components in Table 5 can also be overwritten with local values, which unlike substituting dependency numbers, do not reduce the method's sensitivity. However, the direct care and time-out percentages in the main report are robust data and have been corroborated not only empirically but also by the literature (see the annotated bibliography on p.102). Therefore, we should not overwrite the averages on a whim. Changing ward variables, however, especially patient numbers and dependency mixes, is easily accommodated by

the acuity-quality algorithm, and especially by the software on the website (see the end of this report).

The data in Table 5 are drawn only from wards that achieve a pre-set level of quality. In theory at least, the data, algorithm and software should recommend establishments that achieve the same quality of care in different settings.

You can turn the acuity-quality method around and adjust your ward's occupancy and patient dependency mix to suit the available nursing resources. Either way, nurses are matched to the peaks and troughs of ward activity. This method is one way of deploying nurses where the need is greatest thereby making workloads equitable. Once a computer is set up, it is possible to calculate staffing numbers for individual shifts. Software also allows manipulation of a single or a combination of variables in a 'what if?' way.

Finally, nursing benchmarks and performance indicators (such as nursing cost per occupied bed) are a natural spin-off from the acuity-quality method. These data are often staggering; for example, the daily nursing cost per occupied bed in some wards can be double that in similar wards without any obvious care-quality gain.

One of the main weaknesses is that compared to the professional judgement and the NPOB staffing formulas, the acuity-quality method is complex. However, it is felt that the extra effort pays dividends since more variables, known to influence nursing workload, are accommodated. Another downside is that the daily direct care minutes for each dependency category have to be accepted unless local nursing activity values can be obtained. However, you may feel that adopting patient and nursing activity from other hospitals is unpalatable. Moreover, the sense of ownership that is engendered by using local information may be lost when external data are used. Also, in order to capitalise on the acuity-quality method's power and flexibility, computer software, such as spreadsheets, are needed, which can be downloaded FoC from the website at the end of this report.

Collapsing patient numbers and related nursing activity data into dependency groups ignores individual patient characteristics. One patient's special needs may have only a minor effect on acuity-quality staffing formulas even though one-to-one nursing care may be needed. A similar criticism levied at acuity methods is that nursing activity, used to obtain the amount of nursing time required, sometimes fails to measure the psychological component of patient care. However, most of the alternative methods are even less sensitive to these issues.

Acuity-quality methods in some situations can recommend nursing establishments insufficient to provide at least one qualified nurse per shift because the formula is workload as well as occupancy-based. Patient populations less than 12, especially if the patients are low dependency for example, create the so-called 'small ward' problem.

Acuity-quality systems add to ward nurses' workload because additional patient information

is required. That is, the named nurse is the best person to assess his or her patient's dependency. Similarly, obtaining up-to-date data can be expensive; for example, representative, nursing activity and nursing quality data require two independent non-participant nurse observers spending several days in the ward. Despite matching nursing activity with nursing quality, the relationship between the two can be confounded; that is, some understaffed wards achieve high-quality care and vice-versa. The relationship between staffing and outcome is complex and uncertain.

Even though the formulas in the main report are designed to overcome inappropriate working, the grade mix configurations may not suit your ward's context. For example, it may not be local policy to employ Level 3 or 4 health care assistants. Reconfiguring the grade mix according to local policy, and adjusting the acuity-quality algorithm at the same time, takes considerable fieldwork and skill. Finally, the acuity-quality method lends itself less well to forecasting the number of staff than other methods we'll explore next.

TIMED-TASK/ACTIVITY METHOD

This method of estimating or evaluating the size and mix of nursing teams arose mainly from a belief that acuity-quality staffing methods, for example, were inferior staffing predictors. The type and frequency of nursing interventions required by patients are felt to be a better predictor than patient dependency (p.18). If nurses are comfortable with constructing patient care plans then the timed-task/activity method simply requires nursing minutes to be added to each intervention in the plan thereby generating the number of nursing hours needed. This method will suit wards in which care plans are systematically constructed, and for wards where patients' nursing needs can be confidently predicted; notably those that admit from waiting lists.

In practice, each patient's daily direct nursing care needs are recorded either manually or electronically on a locally developed checklist of nursing interventions. The number of nursing interventions from which to chose varies from system to system. Because each intervention is paired with a locally agreed completion time, the patient's care plan and nursing time requirement is systematically built. The value attached to each intervention is generally the amount of time needed to carry out the care for one patient over a 24 hour period. As with the acuity-quality method, a ward 'overhead' is added to cater for the indirect care and other aspects of nurses' time. Similarly, breaks and time-out have to be considered and ideally, the method should be computerised.

STRENGTHS AND WEAKNESSES

The method generates results that can be easily corroborated by other methods (see annotated bibliography on p.122). It is easily computerised so that the method becomes part of a nursing information system. As you might expect, commercial IM&T- based systems, such as GRASP, are readily available which makes it easier to update base information. Indeed, periodic reviews of nursing interventions and times are a good idea. Adopting the system in other care settings is possible without destroying its integrity. However, protagonists warn users to check validity and reliability if grand care plans are transplanted into new nursing settings.

Despite one of the first rules of workforce planning: that it shouldn't add to the nurses' workload, the effort needed to maintain detailed care plans for each patient every shift adds considerably to the ward 'overhead'. Consequently, timed task/activity commercial systems are the most expensive of all the methods described. Setting up and implementing the system is also time consuming. But like the acuity-quality method, these are largely capital rather than recurrent costs.

Finally, reducing nursing care to a work-study type list horrifies some nurses. However, to reiterate, the completed detailed list of required nursing interventions for an individual is no different to a comprehensive nursing care plan.

REGRESSION ANALYSIS METHOD

The annotated bibliography for this approach on p.129 of the main report shows that some authors were unable to find a demand-side nursing workforce planning method that answered all their staffing questions. Consequently, powerful regression-based predictions to estimate or monitor staffing levels have been developed (p.20). Broadly, regression methods predict the required number of nurses for a given level of activity. The predictor is called the independent variable and the outcome or level of staff is known as the dependent variable. Although the statistical analysis is challenging, once completed, all we need to know is the independent variable value to predict the number of staff (dependent variable). For example, one study developed a nurse-staffing model from an analysis of ward establishments and bed occupancies. Regression analysis showed that the number of nurses (dependent variable) increased as bed occupancy (independent variable) rose thus allowing staffing estimations. Other independent variables in the literature include the number of theatre sessions and day surgery cases. In short, once the base data are collected and analysed then the calculations are as straightforward as the NPOB method.

STRENGTHS AND WEAKNESSES

One of the regression method's strengths is that it is useful for situations where predictions are possible, such as the number of planned admissions. This approach helps managers to forecast and prepare for extra demands. Once established, it tends to be a cheaper method because data are easier to collect and can be aggregated from similar wards. Moreover, independent variable data are usually inexpensive to update. The regression method, therefore, is especially useful to managers with limited resources, and who cannot afford to carry out full dependency-activity-quality or a timed-task/activity study.

The outcomes of regression models tend to be corroborated with independent evidence. Consequently, staffing formulas are judged valid, reliable and also more usable than the detailed and expensive acuity-quality and timed-task/activity methods. Staffing recommendations from regression analyses are relatively easily tested for accuracy by checking how well nursing time is used following enactment of staffing recommendations drawn from regression models. Most care groups can be analysed in this way, therefore the ease of use across specialities is another strength.

On the down side, since the number of variables for consideration in a ward setting are likely to be great, the knowledge and skills of a statistician will be needed to help you design and implement fieldwork that collects the most appropriate data for regression analysis. Transferring staffing formulas derived from regression coefficients from one setting to another isn't encouraged owing to unique variables (such as ward layout). However, validity and reliability tests help to check if transplanting is safe. Some independent variables are qualitative while others are deemed subjective such as the ward manager's perceptions of ideal staffing. Sometimes, nominal data have to be assigned to variables and readers with statistical knowledge and skills know that regression analysis models are usually based on interval or ratio data.

Wards providing data for regression analysis are assumed to operate efficiently and effectively; that is, wards supplying establishment and bed occupancy data have had staffing varied according to patient demand. Similarly, including data from wards with excess absenteeism or poor quality care can distort and invalidate results. It's unsafe to predict staffing levels outside the regression model's observed range. That is, if your data came from wards with no more than 25 beds then extrapolating to wards with 30 occupied beds, for example, can lead to errors because we can't be sure that linear relationships between independent and dependent variables exist beyond 25 beds. Finally, imposing regression statistical techniques has alienated some nurses owing to a lack of ownership and understanding.

SUMMARY

From a wide and deep literature review, five main demand-side workforce planning methods and related data have been extracted. These range from the quick and easy to complex and powerful approaches. You have a choice of selection and application. However, triangulating two or more methods will give you confidence that your staffing recommendations are appropriate.

SUPPLEMENTARY WORKSHOPS

This short report and the main document will be supplemented by at least two seminars early in 2003. These events are free of charge and will be offered on a first-come first-served basis. If you would like to pre-book places then contact Keith Hurst; details are given below.

FOR MORE INFORMATION

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The web site for the main report and related materials is:

http://www.nuffield.leeds.ac.uk/content/research/health_social_care_systems/main.asp

The site includes:

1. The main report referred to in this summary, including annotated bibliographies organised along the lines of the five main workforce planning methods.
2. Five hundred annotated workforce planning references in alphabetical order.
3. Software for checking calculations or for asking 'what-if?' questions.

Finally, a help line is available to assist you to select and use the methods described in this report. In the first instance, please e-mail k.hurst@leeds.ac.uk with your query, giving:

1. Your name.
2. Address.
3. Daytime telephone number.
4. A short account of your query.

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