Skill mix in the health care workforce: reviewing the evidence

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Abstract This paper discusses the reasons for skill mix among health workers being important for health systems. It examines the evidence base (identifying its limitations), summarizes the main findings from a literature review, and highlights the evidence on skill mix that is available to inform health system managers, health professionals, health policy-makers and other stakeholders. Many published studies are merely descriptive accounts or have methodological weaknesses. With few exceptions, the published analytical studies were undertaken in the USA, and the findings may not be relevant to other health systems. The results from even the most rigorous of studies cannot necessarily be applied to a different setting. This reflects the basis on which skill mix should be examined — identifying the care needs of a specific patient population and using these to determine the required skills of staff. It is therefore not possible to prescribe in detail a ''universal'' ideal mix of health personnel. With these limitations in mind, the paper examines two main areas in which investigating current evidence can make a significant contribution to a better understanding of skill mix.

For the mix of nursing staff, the evidence suggests that increased use of less qualified staff will not be effective in all situations, although in some cases increased use of care assistants has led to greater organizational effectiveness. Evidence on the doctor–nurse overlap indicates that there is unrealized scope in many systems for extending the use of nursing staff. The effectiveness of different skill mixes across other groups of health workers and professions, and the associated issue of developing new roles remain relatively unexplored.

Keywords Health personnel; Clinical competence; Personnel staffing and scheduling; Patient care team; Nursing staff; Physicians; Allied health personnel/utilization; Professional role; Review literature; Meta-analysis (*source: MeSH, NLM*).

Mots clés Personnel sanitaire; Compétence clinique; Affectation personnel et organisation temps travail; Equipe soignante; Personnel infirmier; Médecin; Personnel paramédical/utilisation; Rôle professionnel; Revue de la littérature; Méta-analyse (*source: MeSH, INSERM*).

Palabras clave Personal de salud; Competencia clínica; Admisión y programación de personal; Grupo de atención al paciente; Personal de enfermería; Médicos; Técnicos medios en salud/utilización; Rol profesional; Literatura de revisión; Meta-análisis (*fuente: DeCS, BIREME*).

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Voir page 579 le résumé en français. En la página 579 figura un resumen en español.

Introduction

The World Health Report 2000 noted that determining and achieving the "right" mix of health personnel are major challenges for most health care organizations and health systems (*1*). Health care is labour-intensive and managers of health care provider units strive to identify the most effective mix of staff that can be achieved with the available resources, taking into consideration local priorities.

The term "skill mix" is usually used to describe the mix of posts, grades or occupations in an organization (strictly speaking, this is more accurately referred to as "grade mix"). It may also refer to the combinations of activities or skills needed for each job within the organization. This paper gives a brief overview of the determining factors that should be taken into consideration when assessing and adjusting skill mix. It then summarizes the main findings from a literature review, highlighting the evidence on skill mix that is available to inform health system managers, health professionals, health policy-makers and other stakeholders.

There is no common starting point for examining skill mix in different countries, sectors and health systems. Resource availability, regulatory environments, culture, custom and practice will all have played a role in determining the typical or normal mix of staff in a particular health system. To the extent that these factors vary, so will the typical mix. Indeed there are marked variations between countries and regions in terms of the mix of health care occupations (*2*). Table 1 highlights some of the key considerations that explain why skill mix is important in many health systems (*3*).

The factors that generate pressure for change in the skill mix are not mutually exclusive, and changing the skill mix is not the only option for responding to them. Employing organizations should also review other possibilities, such as improving the use of hospital beds, capital equipment and other resources; improving staffing patterns in relation to day-to-day fluctuations in workload and patient dependency; and adjusting the distribution of resources (e.g. between tertiary, secondary and primary care).

Reviewing skill mix

Our review of publications examining skill mix in health care was based on two literature searches. The first was undertaken for the World Health Organization (WHO), and focused on English-language material published between 1986 and 1996 found through CINAHL, Medline, RCN Nurse ROM, ASSIA Plus, and FirstSearch (*4*). The second comprised a follow-up search of English-language material published in the period 1996–2000 through CINAHL, Medline, ASSIA and Nurse

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Table 1. **Skill mix: determinants, requirements and possible interventions**[a]

Determinant	Requirement	Possible interventions
Skill shortages	Response to shortages of staff in particular occupations or professions	Undertake skill substitution; improve use of available skills
Cost containment	Improved management of organizational costs, specifically labour costs	Reduce unit labour costs or improve productivity by altering staff mix or level
Quality improvement	Improved quality of care	Improve use and deployment of staff skills to achieve best mix
Technological innovation; new medical interventions	Cost-effective use of new medical technology and interventions	Re-train staff in new skills; introduce different mix or new types of worker
New health sector programmes or initiatives (e.g. Roll Back Malaria)	Maximum health benefits of programme implementation, by having appropriately skilled workers in place	Determine the cost-effective mix of staff required; enhance skills of current staff; introduce new types of worker
Health sector reform	Cost containment, improvements in quality of care and performance, and responsiveness of health sector organizations	Adjust staff roles; introduce new roles and new types of worker
Changes in the legislative/regulatory environment (note: this is also a possible intervention)	Scope for changes in (or constraints on) role for different occupations, professions	Adjust staff roles; introduce new skills and new types of worker

[a] For further discussion of these issues see Buchan et al. (*3*).

Online. The search terms used were: "skill mix", "skill substitution", "personnel mix", "reprofiling", "staffing levels", and "staffing mix". The term "changing roles" was also included for the second search.

The review indicated a growing interest in skill mix, with more than twice as many publications recorded for the period 1996–2000 as for the previous 10 years (1986–96). The main findings are grouped as follows: reviews and meta-analyses; large-scale ("macro") data surveys; single-site ("micro") examinations of roles and mix in nursing and other non-medical health professions; single-site ("micro") examinations of role overlap between doctors and other health professionals; and studies on introductions of new types of worker.

There are several limitations to the review. First, there may be publication bias, because unsuccessful attempts at changing skill mix may be less likely to be recorded and published. Second, searches rely on the use of key words; skill mix is covered by a broad range of possible key words, and some relevant publications may have been missed. Third, most of the publications reviewed are in English; this will lead to bias in terms of the countries and health systems being examined. In particular, the majority of the publications are from the USA, where the health system is predominantly in the private sector and there is a free-market approach to employment legislation and job stability.

Reviews and meta-analyses

The small number of meta-analyses includes two North American papers that focus on doctor–nurse roles and overlap (*5*, *6*). Two international reviews (drawing heavily on United States sources) have recently been undertaken in the United Kingdom (*4*, *7*), along with a review focusing specifically on the doctor–nurse mix in primary care (*8*).

While meta-analyses support a more conclusive overview than can be drawn from individual studies, they have limitations when applied to a context-bound issue such as the assessment of skill mix. The meta-analyses reviewed reveal evidence (mainly but not exclusively from the United States) that, in settings where there is actual or potential role overlap between registered nurses and doctors, there is scope for a cost-effective increase in the role and deployment of the former. In particular, the use of clinical nurse specialists, nurse practitioners and clinical nurse midwives can improve care outcomes (often measured by patient satisfaction), while maintaining or reducing costs.

Large-scale ("macro") data surveys

These studies assess large datasets, often from multiple sites, to determine the extent to which variations in measures of outcome can be attributed to differences in staffing level or staffing mix. As with meta-analyses, the majority of these studies have been conducted in the USA. Recent reports are summarized in Table 2 (*9*–*11*).

These large-scale analyses of secondary data can give some insight into the relation between staffing level or mix and indicators of cost or quality. They can also provide potential benchmarks for employing organizations, see, for example, the discussion of the early stages of a multicountry comparative study (*12*, *13*), a multicountry study examining the extent of use of "trained" nurses and overall resource use in long-term care in England, Japan, Sweden, Spain and the USA (*14*), and a multicountry analysis of variations in doctor–nurse ratios (*15*).

While large-scale surveys have the potential to increase our understanding of the complex relationships between staffing, cost and outcome variables, they have two main weaknesses. First, by definition, they are retrospective, and it may be some time before the lessons of the analysis are known. (For example, one study (*11*) was published in 1998, but uses datasets from 1993.) So while they may inform policy, they are less likely to have an immediate impact on practice at the operational level. Secondly, they rely on secondary data from available datasets, which means that the findings are predicated on the accuracy and completeness of the data.

Table 2. **Examples of large data surveys on skill mix**

Focus	Key findings
Registered nurse staffing in relation to total staffing and outcomes in 494 United States nursing homes (*9*)	Although registered nurse staffing is more expensive, it is the key to improving outcomes in residents
Hospital characteristics, staffing level and mortality rates in 3763 United States hospitals. Multiple regression analysis, controlling for severity of illness (*10*)	Mortality rates decreased as staffing per occupied bed increased for medical residents, registered nurses, registered pharmacists and medical technologists. Mortality rates increased as staffing levels per occupied bed increased for licensed practical nurses and for administrators
Relationship between registered-nurse-adjusted patient days (a measure of nurse staffing levels) and various adverse events (e.g. urinary tract infections after major surgery, pneumonia after surgery; thrombosis after surgery) (*11*)	Inverse relationship between registered nurse staffing and adverse events; the higher the proportion of registered nurses, the lower the incidence of adverse events

Single-site (''micro'') examinations of roles and mix in nursing and other non-medical health professions

The literature on the effect of different mixes of health professionals and unqualified nurse aides, assistants and/or support workers primarily comprises individual descriptive studies. The vast majority of these focus on mixes of different grades of qualified nurse, or of qualified nurses and nursing auxiliaries/care assistants. Relatively few published analytical studies cover other, non-medical health professionals or health care workers. The two most common topics examined in this field are the effectiveness of an all-qualified nursing workforce in comparison with a qualified/unqualified mix, and the impact on organizational costs and effectiveness of increasing the proportion of care assistants/support workers in the nursing workforce. A third topic, which is relatively under-explored, is the implication for cost and quality of care of the involvement of traditional practitioners (e.g. traditional birth attendants) (*16*), relatives (*17*) and volunteers (*18*, *19*) as part of the care team.

The first topic, care provided entirely by qualified nurses, was mainly examined in North America in the period up to the mid–late 1980s; since then it has become less apparent in the literature. The second topic, a qualified/unqualified, mix became particularly apparent in the 1990s, as cost-containment led to a re-examination of nursing skill mix in many countries, organizations and sectors. There are also some non-nursing examples, including the use of care assistants in physiotherapy (*20*).

Substitution of cheaper care assistants for more expensive nurses for cost-containment purposes has become increasingly apparent in recent years in many countries. Many of the publications in this area are written by and for qualified nurses, and set out their concerns about being replaced or having their skills undervalued (*21*, *22*). These papers argue that a cheaper skill mix may be no more cost-effective because of the various hidden costs associated with skill dilution. This argument cites factors such as higher absence and turnover rates of less qualified staff; higher levels of unproductive time because care assistants have less autonomy and capacity to act independently, and reported concerns about possible harm to patients if care assistants are required to work beyond their technical or legislated capacity. Most of these studies tend to be unit-level before-and-after examinations of the effects of introducing or increasing the use of care assistants. There is no unanimity in results or conclusions, even setting aside issues of methodology and comparability.

The work of Gardner (*23*) and Krapohl and Larson (*24*) indicates a number of models of qualified/unqualified mix in nursing:

- *Traditional aides/assistants/auxiliaries*, mainly trained on the job, performing simple nursing tasks in support of registered nurses.
- *Non-clinical assistants/extender clerks/aides*, mainly involved in non-clinical clerical/housekeeping work (can be multi-skilled support workers).
- *Technical assistants/operating department assistants* with a specified remit in relation to complex technological processes, assisting nurses.
- *Primary practice partner nursing assistants,* paired with primary nurses to maintain delivery of care by primary nursing.
- *Vocationally trained/qualified carers*, traditional nurse aides undergoing an additional training programme of several weeks or months, in some countries leading to a vocational qualification, to take on nursing care responsibilities under the direction of registered nurses or other health professionals.

The model in use can be determined on the basis of whether the support staff are being used to supplement, complement or replace (substitute for) qualified nurses.

Studies of the impact of the introduction of unlicensed assistants in the USA have shown mixed results (*25*). Some have suggested a positive impact: cost savings using patient care assistants (*26*), and using nurse aides with no adverse effect on patient satisfaction (*27*). Other studies have been less clear cut, or have found the opposite, highlighting problem areas such as decreased quality and increased on-call work, sick leave and overtime working (*28*), reported higher workload for registered nurses and, initially, a higher turnover of patient care technicians (*29*), and a larger proportion of more highly qualified nurses being related to higher reported quality of care (*30*).

While the qualified/unqualified mix in nursing has received a comparatively high level of attention in the literature, there are major limitations to the findings. Many of the studies are methodologically weak; they often report on short-term implementation, and are often written by those who champion the use of unqualified support staff. As in other areas of research, there may also be a bias towards publishing studies with clear and positive findings.

Occupations other than nurses have received relatively little attention. In some countries, especially in Latin America and the Caribbean, there has been some examination of different mixes of technicians (*31*). Although the number of

these technicians is large and growing in some cases, no analytical study was found. Studies on pharmacists tend to focus on an analysis of activity related to the control of prescriptions and expenditures or even on the interaction with patients and their families (*32*, *33*). Few studies attempt to evaluate the pharmacists' work in relation to that of other health workers (*34*).

Another fundamental limitation is that very few studies and reports really examine role or skill. In practice, most of those that attempt to assess costs and quality implications focus on grade, qualification or job title rather than skill or role. Grade or job title is used as a proxy for level of skills or as a definition of a role.

Single-site (''micro'') examinations of role overlap between doctors and other health professionals

Skill substitution and the development of alternative models of care delivery using nursing/midwifery staff rather than doctors have been examined in a number of studies. There have been some randomized controlled trials to assess quality/outcome, and some meta-analyses of research studies (see above). The evidence on overlap and scope for substitution between nurses and doctors has been reviewed by several teams of researchers (for example, *5–7*, *35*, *36*). There are also a number of studies of skill mix in dentistry, but these are not covered by this review.

Contributions to a recent issue of the *BMJ* argue that the time is ripe for a major reconstruction of the working relationship between doctors and nurses (*37–39*). The editorial in the same issue highlighted a growing concern that the relatively expensive (and often scarce) skills of medical practitioners should be better deployed, with less role overlap, and with nurses working in advanced roles. The first of three randomized controlled trials examining general practitioner (GP)/nurse practitioner overlap looked at nurse-led management of patients with minor illnesses in general practice. It found that the nurses were effective and that patients reported higher levels of satisfaction than with GPs (*37*). The second, which examined the care given by nurse practitioners and GPs, found that patients were more satisfied with the care given by the nurse practitioners, that drug prescription rates were similar between the two groups, and that the nurses provided more relevant information to patients than the doctors (*38*). The third report examined the cost-effectiveness of GPs and nurse practitioners (*39*). It found similar patterns of drug prescription between the two groups, and no significant cost differences, because the nurses spent more time, on average, with each patient than did the doctors. Reported patient satisfaction was higher for the nurses.

A review of research in this area supports the view that, in defined situations, there is scope for maintaining or improving quality of care, while maintaining or reducing organizational costs, by increasing the role and deployment of clinical nurse specialists, nurse practitioners and clinical nurse midwives. The available research does not, however, fully map out the parameters of role overlap/substitution, and many possible models remain untested. The definition of an ideal balance between doctors and nurses also has to take into account potential constraints on change relating to legislation, professional regulation and associated organizational and contextual factors.

Studies on introductions of new types of worker

Many health systems have considered or implemented the introduction of new cadres or groups of health worker to fill a skills gap or improve the cost-effectiveness of the skill mix in the health workforce. In practice, these are often persons in existing occupations or grades with additional skills or an extended role. In some countries, such cadres have been most evident in rural and remote areas, where it may be difficult to recruit conventional health professionals. They include:

- conventional support workers (in catering, patient transport, cleaning, catering and food distribution, and clerical areas) who are multiskilled or have an extended role;
- care assistants and auxiliaries who are multiskilled, have undergone "cross-training" or have an extended role (e.g. health community agents in the family health programme in Brazil (*40*));
- current health care professionals (e.g. nurse practitioners) with an extended role;
- technicians with new roles (e.g. in surgery or anaesthesiology, as in Mozambique (Pellis G., unpublished WHO consultant report, 1998)).

The extent to which truly "new" cadres of worker have been introduced to health systems is difficult to determine as there is much blurring of roles, with conventional workers being given extended roles, perhaps with a new job title. So are there new types of workers or simply new types of work being undertaken by existing staff? Moreover, cultural, professional and organizational differences mean that the role of a specified worker or professional in one country or health system may be different from that in another. Some country health systems have developed roles that are country-specific or system-specific, such as nurse anaesthetists, respiratory therapists and medical assistants/clinical officers in Africa; and physician assistants in the USA. Many of these roles have been developed as a solution for the shortage of doctors.

Conclusions

There are significant limitations to the current evidence on skill mix in the health workforce. Many published studies in this area are merely descriptive accounts, which add little in terms of use of methods or interpretation of results. Where studies do move beyond description, their usefulness is often constrained by methodological weaknesses, lack of appropriate evaluations of quality/outcome and cost, and/or use of small sample sizes. Moreover, many of the studies were undertaken in the USA, and the findings may not be relevant to other health systems and countries. The results may therefore be suspect, and of little use for comparative purposes or in drawing general conclusions.

The results from even the most rigorous studies cannot necessarily be applied to a different setting, organization or health system. They remain true only for the time and place from which they are derived. This is the basis on which skill mix is examined — the need to identify the care needs of a specific patient population and match these to the skills of staff available. It is thus impossible to prescribe in detail a universal ideal mix of health personnel. Skill mix is both a determinant of, and determined by, organizational and system context. Reviewing, and perhaps adjusting skill mix therefore requires

the capacity to analyse the context, identify appropriate solutions, and manage sustained change within the system (*41*).

Despite these limitations, examination of the current evidence can make a significant contribution to a better understanding of skill mix among nursing staff and in the doctor/nurse balance. The evidence suggests that increased use of less qualified (cheaper) nursing staff will not be effective in all situations, although in some greater use of care assistants has improved organizational efficiency. Evidence on the doctor/nurse overlap indicates that there is unrealized scope, within the constraints of country- and system-specific regulations, for extending the use of nursing staff and for further development of care delivery led by nurses/midwives, for example, in maternity units.

The effectiveness of different skill mixes across other groups of health workers and the associated question of the development of new roles remain comparatively underexplored. It is evident from this brief overview that determining the skill mix and defining roles in the health care workforce will continue to present a major challenge to health professionals, managers and policy-makers. More robust guidelines, based on sound evaluation of existing skill mix patterns, and better dissemination of good practice are needed to expand the evidence base and support informed decision-making in this area. ■

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Résumé

Dosage des compétences parmi les personnels de santé : examen des données

Le présent article examine les raisons pour lesquelles le dosage des compétences parmi les personnels de santé est important pour les systèmes de santé. Il passe en revue les données existantes (et en identifie les limites), résume les principaux résultats publiés et relève les données disponibles qui peuvent intéresser les responsables des systèmes de santé, les professionnels de santé, les responsables des politiques de santé et autres acteurs des systèmes de santé. La plupart des articles publiés sont uniquement descriptifs ou présentent des faiblesses méthodologiques. A quelques exceptions près, les analyses publiées ont été réalisées aux Etats-Unis d'Amérique, et leurs résultats peuvent ne pas être applicables à d'autres systèmes de santé. Les résultats des études même les plus rigoureuses ne sont d'ailleurs pas nécessairement applicables dans d'autres contextes. Ces remarques montrent sur quelles bases doit se faire l'examen du dosage des compétences – identifier les besoins en soins dans une population de patients et partir de ces besoins pour déterminer les compétences requises du personnel de santé. Il n'est donc pas possible de prescrire en détail un dosage théorique « universel » de compétences parmi le personnel de santé. Compte tenu de ces limites, l'article examine deux grands domaines dans lesquels l'étude des données actuelles peut apporter une contribution importante à la question de la définition du dosage optimal des compétences.

En ce qui concerne le personnel infirmier, les données montrent que le recours accru à un personnel moins qualifié ne sera pas efficace dans toutes les situations, même si dans certains cas on a pu améliorer l'efficacité organisationnelle en faisant davantage appel à des aides-soignants. Les données sur le recoupement des compétences entre médecins et infirmières montrent que bien des systèmes pourraient recourir beaucoup plus largement au personnel infirmier. La question de l'efficacité de différents dosages de compétences dans d'autres groupes d'agents et de professions de santé ainsi que la question connexe de l'élaboration de nouveaux rôles sont encore assez peu explorées.

Resumen

Combinación de aptitudes entre el personal sanitario: examen de la evidencia

En el presente artículo se analizan las razones que aconsejan una buena combinación de aptitudes entre el personal sanitario. Se examina la evidencia disponible (identificando sus limitaciones), se resumen los principales hallazgos de una revisión de la literatura y se ponen de relieve los datos sobre combinación de aptitudes de que se dispone para informar a los administradores de los sistemas de salud, los profesionales sanitarios, los formuladores de políticas de salud y otros interesados directos. Muchos de los estudios publicados son meramente descriptivos o presentan fallos metodológicos. Con pocas excepciones, los estudios analíticos publicados se llevaron a cabo en los Estados Unidos, por lo que los resultados quizá no sean pertinentes para otros sistemas de salud. Incluso los resultados del más riguroso de los estudios pueden perder toda validez en un entorno distinto. De aquí se desprende la manera de proceder para examinar la combinación de aptitudes: hay que identificar las necesidades de atención de una población específica de pacientes, y utilizarlas para determinar las aptitudes que se requerirán del personal. Por consiguiente, no es posible prescribir detalladamente una combinación ideal «universal» de personal sanitario. Teniendo en cuenta estas limitaciones, el documento examina dos áreas básicas en las que la investigación de la evidencia disponible puede contribuir sensiblemente a arrojar luz sobre la combinación de aptitudes necesaria.

En cuanto a la combinación de personal de enfermería, los datos al alcance indican que una mayor utilización del personal menos calificado no será una opción eficaz en todas las situaciones, aunque en algunos casos el aumento del recurso a auxiliares ha redundado en una mayor eficacia organizacional. La evidencia disponible sobre la superposición de funciones entre los médicos y las enfermeras indica que en muchos sistemas hay un margen desaprovechado para recurrir más al personal de enfermería. La eficacia de diferentes combinaciones de aptitudes en otros grupos de agentes de salud y profesiones y la cuestión asociada del desarrollo de nuevas funciones constituyen un campo que permanece relativamente inexplorado.

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