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Task shifting from physicians to nurses in primary care in 39 countries: a cross-country comparative study

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Background: Primary care is in short supply in many countries. Task shifting from physicians to nurses is one strategy to improve access, but international research is scarce. We analysed the extent of task shifting in primary care and policy reforms in 39 countries. **Methods:** Cross-country comparative research, based on an international expert survey, plus literature scoping review. A total of 93 country experts participated, covering Europe, USA, Canada, Australia and New Zealand (response rate: 85.3%). Experts were selected according to pre-defined criteria. Survey responses were triangulated with the literature and analysed using policy, thematic and descriptive methods to assess developments in country-specific contexts. **Results:** Task shifting, where nurses take up advanced roles from physicians, was implemented in two-thirds of countries ($N=27$, 69%), yet its extent varied. Three clusters emerged: 11 countries with extensive (Australia, Canada, England, Northern Ireland, Scotland, Wales, Finland, Ireland, Netherlands, New Zealand and USA), 16 countries with limited and 12 countries with no task shifting. The high number of policy, regulatory and educational reforms, such as on nurse prescribing, demonstrate an evolving trend internationally toward expanding nurses' scope-of-practice in primary care. **Conclusions:** Many countries have implemented task-shifting reforms to maximise workforce capacity. Reforms have focused on removing regulatory and to a lower extent, financial barriers, yet were often lengthy and controversial. Countries early on in the process are primarily reforming their education. From an international and particularly European Union perspective, developing standardised definitions, minimum educational and practice requirements would facilitate recognition procedures in increasingly connected labour markets.

Introduction

Health systems worldwide are faced with workforce challenges in primary care as they strive toward achieving or maintaining

universal health coverage.¹ Shortages or geographical imbalances of primary care physicians exist in many countries; and medical students are less likely to choose primary care than in the past.² Increasing rates of chronic conditions are expected to intensify the

need for primary care providers in the future. New models of care and payment reforms are triggering changes to the workforce, particularly in primary care.

Task shifting from physicians to nurses or other non-medical providers has been identified as a strategy to alleviate shortages, improve quality and efficiency.³ Appropriately educated nurses working in advanced practice have shown to provide equivalent quality of care compared to physicians⁴; however, a cross-country comparison of the extent of task shifting in primary care and related policy reforms has been lacking.

In its Global Strategy on Human Resources for Health 2030, the World Health Organization highlighted the need to maximise the potential for mid-level practitioners to enhance workforce capacity.⁵ Moreover, the World Health Organization adopted global and European strategic directions to strengthen nursing and midwifery to improve population health.^{6,7} Yet, systematic cross-country research is scarce, particularly in Europe. Within Europe's single market, health professionals can practice in any other European free movement zone country. To date, however, only the basic professional nursing qualification is automatically recognized, unlike physicians, where specialisations are also covered.⁸ Hence, there is high relevance of assessing levels of advanced practice and educational qualifications to allow for cross-country comparability.

Existing international studies^{9–11} have focused on the education, titles and regulation of Nurse Practitioners/Advanced Practice Nurses (NP/APN), an umbrella term for nurses working in advanced practice with usually a Master's degree,¹² but none has systematically compared levels of practice. Moreover, within Europe, no study exists that covers all EU member states. We aimed to close this gap by analysing the clinical tasks and activities formerly provided by physicians and now officially authorised to be performed by nurses in 39 countries.

From a policy perspective, two studies covered the policy contexts of task shifting and nurse role advancements at the interface to the medical profession,^{10,13} but none has assessed major reforms. Yet, policy changes to regulation, finance and nurse education can drive or hinder task shifting and thereby impact implementation.¹⁴ At the same time, legislative processes and implementation can be lengthy, controversial and with unknown results.

The purpose of this study was two-fold: first, to analyse the extent of task shifting in primary care in 39 countries. Second, we identified major related policy reforms at country levels.

Materials and methods

Survey instrument

A survey was designed and piloted with a group of international researchers as to its applicability and comparability in different health system contexts (Supplementary Material). The final, TaskShift2Nurses Survey, covered six themes, including implementation and extent of official practice assessed by seven clinical activities, defined by the International Council of Nurses: prescriptive authority, medical diagnoses/advanced health assessments, ordering tests, medical treatment, responsibility for a panel of patients, referrals and first point of contact¹² (Supplementary Box S1). The survey also covered related educational requirements, financing, policy and regulatory reforms. The final survey was available in English language as an online survey and a fillable pdf version to allow respondents a choice. Institutional Review Board approval was obtained at the University of Pennsylvania.

Country coverage

We included 39 countries: 35 European countries (all EU member states, Switzerland, Norway, Iceland and Turkey), plus USA, Canada, New Zealand and Australia. We surveyed England, Wales, Northern Ireland and Scotland separately, since NHS decision making is

largely devolved. At least two experts were set as minimum for a country to be included, in order to allow for cross-checking of information.

Country selection from outside Europe was based on countries with a long tradition of NP/APNs, to allow for a rich experience base. A focus was given on Europe due to the relevance of the cross-country comparative research in the region's single market.⁸

Sampling method

The sampling method was based on a combination of snowballing and network strategies¹⁵ to counteract weaknesses associated with snowballing alone, such as selection bias or too homogeneous groups. The combined method suggests a group of independent nominators and selection criteria.¹⁵ Hence, we identified international experts from different disciplines to increase the likelihood of independent nominations. Country experts were selected according to pre-defined criteria, including relevant senior positions in academia, nursing associations or ministries of health, publications and proficient in English (Supplementary Material).

Data collection, validation and analysis

Data collection took place between January and April 2015. We contacted 109 country experts, providing access to the survey. Of those, 96 participated, three surveys were incomplete, hence 93 surveys were included (response rate 85.32%) (Supplementary table S1).

The validation phase comprised cross-checks of responses by country and were complemented with findings from a literature scoping review including Medline, CINAHL, Web of Science, international and national websites and the Health Systems in Transition Profiles that exist for all countries, published by the European Observatory on Health Systems and Policies¹⁶ (Supplementary Methods). Consolidated versions were fed back to country experts, inconsistencies resolved by e-mail and/or discussion.

Data analysis was based on policy-, thematic and descriptive analyses, to situate task shifting in countries' health systems. For each of the seven clinical activities covered, the detailed tasks designated as official practice (as per scope-of-practice) were summarized: (i) yes, a broad range of advanced activities, (ii) limited (range of activities) and (iii) no advanced activities (Supplementary Data Analysis). Informal practice was analysed separately.

We identified and included reforms directly related to task shifting, which were adopted or implemented between 2010 and 2015. Reforms were categorised into pilot projects, educational, financing/reimbursement policies and legal/regulatory reforms (nurse prescribing specifically and expanded scope-of-practice broadly).

Results

Extent of task shifting

Task shifting has been implemented in the majority of countries studied, yet its extent varied. Three clusters of countries emerged: countries with (i) extensive, (ii) limited and (iii) no official task shifting in primary care (figure 1).

Eleven countries (28% of $N = 39$ countries) showed extensive task shifting, where NP/APN are authorised to work at high levels of advanced practice, measured by all seven clinical activities.¹² Countries included Australia, Canada, Finland, Ireland, Netherlands, New Zealand, England, Northern Ireland, Wales, Scotland and the USA (figure 2).

Yet, differences existed in the details under each of the seven activities and the levels of independence versus physician supervision (Supplementary table S2). Within this cluster, NP/APNs were able to

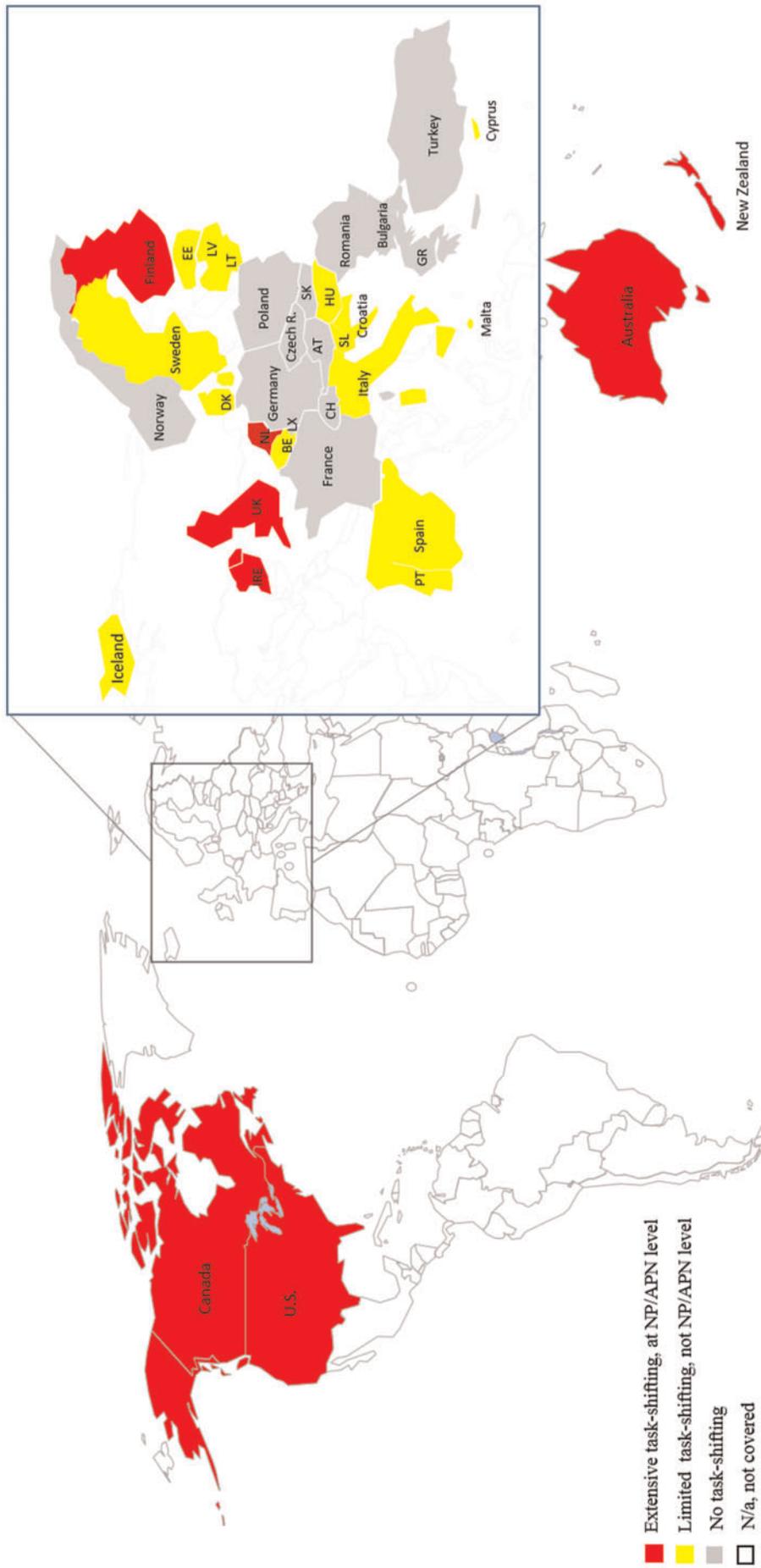


Figure 1 Overview of the extent of task shifting from physicians to nurses in primary care in 39 countries, 2015. Source: TASK-SHIFT2Nurses Survey 2015. Notes: NP/APN=Nurse, Practitioner/ Advance Practice Nurse (12), NA, not available; AT, Austria; BE, Belgium; CH, Switzerland; Czech R., Czech Republic; DK, Denmark; EE, Estonia; GR, Greece; HU, Hungary; IR, Ireland; LV, Latvia; LX, Luxembourg; LT, Lithuania; PT, Portugal; SL, Slovenia; SK, Slovakia; UK, United Kingdom (England, Northern Ireland, Wales, Scotland, individually assessed, shown aggregate).

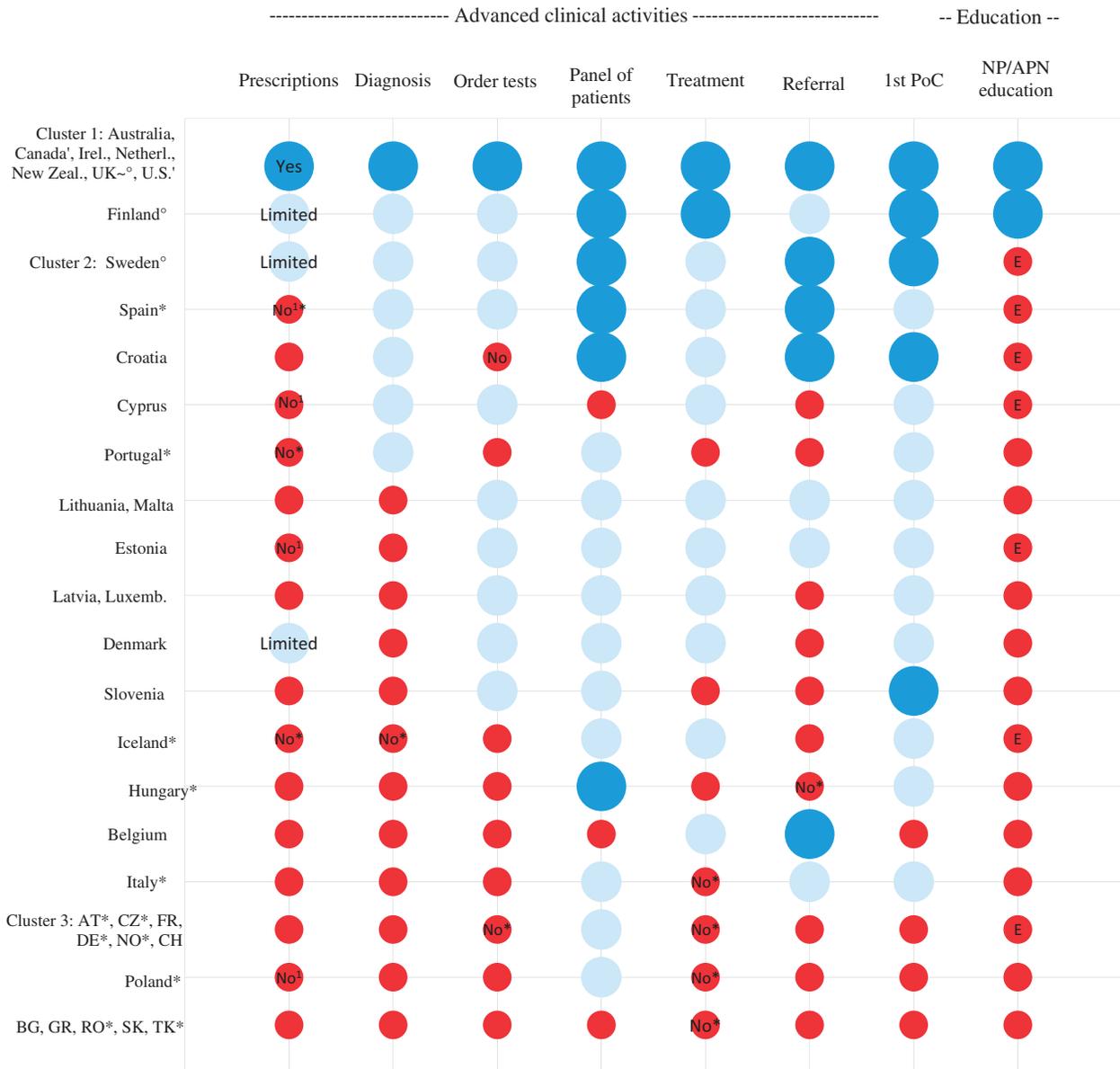


Figure 2 Extent of task shifting from physicians to nurses by seven clinical activities and educational requirements, 2015. Source: Authors' analysis, TASK-SHIFT2Nurses Survey 2015. Notes: PoC = Point of Contact, Large circles (Yes) = Official practice of a broad range of activities, e.g. prescriptive authority: wide range of medicines, at least initiation of (certain) medicines, Medium circles (Limited) = Official practice of limited set of activities, e.g. prescriptive authority: from a limited formulary, Small circles (No) = Not officially authorized to perform; No* = No official, but informal practice (see Supplement), No¹ = Legislation enacted, but not implemented as of 2015; ' = state- or province- wide differences, E = Emerging: NP/APN education emerging; ° = large practice variations exist, ~ = UK (England, Northern Ireland, Wales, Scotland, shown aggregate, assessed separately), Irel. = Ireland, Netherl.= Netherlands, New Zeal.= New Zealand, UK = United Kingdom, AT = Austria, CZ = Czech Republic, FR = France, DE = Germany, NO = Norway, CH = Switzerland; BG = Bulgaria, GR = Greece, RO = Romania, SK = Slovakia, TK = Turkey; Name/title of nurses referred to: Australia, Canada, New Zealand, U.S.: Nurse Practitioner; England, Northern Ireland, Scotland: Nurse consultant, Advanced Nurse Practitioner (titles vary by setting, employer), Wales: Nurse partner, Advanced Nurse Practitioner (titles vary), Ireland: Advanced Nurse Practitioner, Netherlands: Nurse specialist, Finland: Advanced nurse (titles vary), Sweden: Advanced Nursing Primary Care, Spain: Family and community nurse, Croatia: Public Health Nurse, Cyprus: Advanced practice nurse, Malta: Practice Nurse Primary Care, Lithuania: Community Nurse, Estonia: Primary Health Care Nurse, Latvia: Ambulatory Care Nurse, Denmark: Acute care nurse, Luxembourg: Nurse Specialist, Hungary: Health visitor/public health nurse, Belgium: Nurse educator, Italy: Community Nurse, Austria: Nurse with further education, Germany: Nurse with additional qualification, Norway: Advanced geriatric nurse, Romania: Community nurse, Switzerland: Diabetes educator specialist nurse, Czech Republic: Home care nurse/community nursing, Poland: Family nurse, Bulgaria, France, Greece, Slovakia, Turkey: no specific titles/may vary in primary care.

cover a full or almost full patient visit. The education was usually at the Master's level (Supplementary table S3).

Cluster 2 subsumed the majority of countries (16 countries, 41%, Sweden, Spain, Croatia, Cyprus, Portugal, Lithuania, Malta, Estonia, Latvia, Luxembourg, Denmark, Slovenia, Iceland, Hungary, Belgium and Italy), with some, albeit limited task shifting, measured by at

least two of the seven activities. Countries varied substantially; however, unlike cluster 1, scope-of-practice was not at the NP/APN level.¹²

Cluster 3 consisted of a total of 12 countries (31%) designated as no official task shifting, defined as one of the seven activities (seven countries, Austria, Czech Republic, France, Germany, Norway,

Table 1 Policy, finance and educational reforms, 2010–2015, and ongoing

Cluster of countries	Pilot/small scale projects	Educational reforms/new programs	Regulatory reforms: nurse prescribing of medicines	Regulatory reforms: other advanced activities ^a	Financing reforms
Extensive task shifting, at NP/APN level		Finland ^b	Australia, Canada, ^c England, ^c Finland, ^d Netherlands, ^d New Zealand, ^c Northern Ireland, ^c Scotland, ^c Wales, ^c USA ^e	Australia, Finland, Ireland, Netherlands, New Zealand, USA ^e	Australia, New Zealand, USA
Limited task shifting, not NP/APN		Cyprus, Iceland, Lithuania, Sweden	Cyprus, ^f Estonia, ^g Spain ^g	Cyprus, Hungary	
No task shifting	France, Germany, Switzerland	Austria, France, Germany, Norway, Switzerland	Poland ^g	France ^h	

Source: Authors' analysis, TASK-SHIFT2Nurses Survey 2015 (for further details, see Supplementary Material S4).

Note. SoP, Scope-of-Practice.

a: Expanded scope-of-practice, except for nurse prescribing.

b: Regulation on postgraduate education on prescriptive authority.

c: Existing prescriptive authority *expanded* (e.g. to include certain controlled drugs).

d: Law on prescriptive authority *newly* adopted and implemented.

e: Sub-national reforms ongoing due to state authority over scope-of-practice laws.

f: Cyprus: law enacted in 2012, no uptake in practice.

g: Estonia, Spain, Poland: laws newly adopted in 2015, implementation planned for 2016.

h: Ongoing/pending reforms as of 2015.

Switzerland and Poland), or none (five countries, Bulgaria, Greece, Romania, Slovakia, and Turkey).

Taken together, more than two-thirds of countries studied (clusters 1 and 2, 69%, $N=27$) had expanded nurses' official practice in primary care.

Informal practice

Task shifting occurred not only officially but also informally. Anecdotal evidence suggested informal practice of at least one of the seven activities in eleven countries (28.2%), four within cluster 2 and seven in cluster 3 (figure 2).

Policy, finance and educational reforms

Reforms have been implemented in many countries between 2010 and 2015 or are ongoing (table 1). Of the 11 countries with extensive task shifting, all have or are in the process of removing regulatory barriers to or expanding the scope-of-practice of NP/APNs. Canada and New Zealand revised laws to grant NPs full prescriptive authority in 2012 and 2014, respectively, including certain controlled drugs.^{17,18} The Netherlands adopted a so-called experimental law in 2011, authorising prescriptive authority and other activities for nurse specialists.¹⁹ England, Wales, Northern Ireland and Scotland expanded prescriptive authority for independent nurse prescribers in 2012 to include certain controlled drugs. Finland enacted legislation on limited nurse prescribing in 2010 for nurses fulfilling the requirements.²⁰ In the USA, as of 2015, 22 states plus DC have removed legislative barriers for NPs; however, 28 states still have restrictive scope-of-practice laws in place.²¹

Reforms were often lengthy and controversial, opposed by physicians or other stakeholders. The Netherlands experienced a comparatively short time span from introducing to enacting the law, perhaps due to its time limited duration, linked to a nationwide evaluation.¹⁹ In other countries, reforms took longer. In New Zealand, a so-called Health Practitioners Bill, proposed first in 2005, has been through its first reading in 2015. The Bill when passed will amend seven statutes simultaneously,²² a major policy change, yet after a 10-year process. In the USA, because of the decentralised, state-specific jurisdictional authority over scope-of-practice laws, changes have been ongoing for decades.²³

Reforms on financing policies were less frequent. In Australia, since 2010, patients treated by private NPs can be reimbursed for a set of, albeit limited, services by Medicare.²⁴ In the USA,

reimbursement rates are 85% of physicians' fee under Medicare and 75–100% by state under Medicaid.²⁵ Yet, NPs are not always recognised as primary care providers.²⁶ In New Zealand, because of changes to funding contracts in 2015, NPs can be reimbursed in the same way than primary care physicians.

Within cluster 2, regulatory reforms took place in Cyprus, Estonia, Spain and Hungary. Cyprus has enacted a law in 2012 granting prescriptive authority for Master's level-educated nurses yet pending uptake in practice. Estonia adopted a law in December 2015, granting limited prescriptive authority to family nurses who meet the requirements.²⁷ In Spain, a 2009 law enacted nurse prescribing but implementation was pending a consensus formulary for years. In October 2015, limited nurse prescribing was authorised.²⁸ Hungary expanded scope-of-practice for health visitors in 2010, to cervical cancer screenings, including pap smears.²⁹ Four countries have or are in the process of advancing the education to NP/APN or equivalent Master's level programs.

Within cluster 3, countries have focused on educational reforms and pilots. Pilot or small scale projects exist in France, Germany and Switzerland, triggered by new models of care or shortages in rural areas. Few legislative reforms were identified. France put forward a legislative proposal to Parliament in 2015. Poland adopted a law on limited nurse prescribing in November 2015.³⁰ Austria, France, Germany, Norway and Switzerland have established few NP/APN Master programs; however, at early stages in primary care and with variations in curricula.

Discussion

Task shifting, where nurses take up activities from physicians, has been implemented in more than two-thirds of countries studied (69%, $N=27$). Large variations exist. In the 11 countries with extensive task shifting, NP/APNs can cover a full or nearly full patient visit, which is important in terms of expanding access, continuity of care and efficiency. Countries with limited task shifting have advanced the practice profile of nurses within confined boundaries, usually under physician oversight. In countries with no official task shifting, pilots or small-scale developments exist. Policy and regulatory reforms suggest that the boundaries between medicine and nursing are shifting, across differently organised healthcare systems. One example is prescriptive authority: from 2010 to 2015, 14 countries (35.9%) newly enacted or expanded nurse prescribing of medicines.

Our findings both confirm and go beyond previous international research.^{9,10,31} Our results are in line with findings from study that indicated an increasing trend toward nurse role advancement; however, it did not systematically compare practice levels.¹⁰ In our study, we assessed both the level of advanced practice and the educational dimension, unlike previous surveys that focused on titles or education only but missed levels of advanced practice.³¹

Reasons for the stark differences across countries are unclear. Suggested drivers include physician shortages, a high supply of nurses, increasing healthcare needs and primary nursing education at the Bachelor level.^{10,14,32} Barriers include resistance by the medical profession, regulatory restrictions and financial barriers^{10,14,32}; however, they have not been empirically tested.

Informal practice was reported in 11 countries. Unofficial practice is rarely studied¹⁰ and may result from a mismatch between restrictive regulation, higher skill levels and/or growing healthcare needs. It may pose patient safety risks and liability risks for the nurses and physicians involved. If frequently occurring, it should be a signal to policy makers to review regulation of scope-of-practice. Indeed, informal practice was one of the main arguments in the Netherlands to enact legislation.³³

Countries have implemented a high number of reforms, with important lessons for policy makers. First, all countries in cluster 1 have implemented regulatory reforms to sanction advanced practice. Yet, reforms were often lengthy. Innovative policy instruments have emerged to expedite the reform process, such as the time-limited law in the Netherlands, combined with a nationwide evaluation.¹⁹ Other policy options are to periodically review and revise laws. Legislated regulation opens up the process to stakeholders' self-interests, which can delay reforms. An alternative option is for governments to delegate regulation via self-regulation, e.g. as exists for NPs in Australia. Nursing regulatory bodies specify levels of advanced practice based on education and skills, hence can update scope-of-practice faster than in legislated environments. Yet, non-nursing-specific laws, such as on controlled drugs may still influence practice, as demonstrated in Australia.²⁴

Second, the role of financing and payment policies on implementation is less well known. In the USA and Australia, fee-for-service reimbursement for NPs is commonly lower than for physicians. Lower reimbursement rates may pose financial disincentives for practices to employ NPs, incentivise billing under physician's names and had unintended consequences on NPs to work in primary care and on patient access,^{34,35} yet it may contribute to cost savings.³⁶ The role of financing requires further research in different country contexts.

Third, provider models play a critical role. Single General Practitioner offices were identified as potential barrier and larger providers, such as healthcare centres, as enablers to nurses taking up advanced activities.¹⁰ However, the integration of advanced roles depends on a range of factors, including supportive leadership, role clarity, transitional planning, as part of an overall conducive organisational environment.³⁷

Fourth, a well-educated nursing workforce is a pre-requisite for expanded practice. Many countries in Europe are reforming education and fully or partially moving nursing education to the Bachelor level, often followed by Master's programs.³⁸ Yet, curricula vary. The International Council of Nurses recommends Master-level education for NP/APNs, yet very limited minimum standards. Developing a curricula framework based on minimum levels of advanced practice would be an opportunity to set educational and practice requirements internationally.

Within Europe, levels of advanced practice and education vary considerably, suggesting that the automatic recognition of advanced nursing roles may not be feasible in the short term.⁸ However, the high number of reforms requires monitoring of how nurses' practice profiles will change in the future, for instance on prescriptive authority.

In response to the increasing mobility of health professionals globally, the development of standardised titles beyond the umbrella definition of NP/APNs to reflect practice levels and educational requirements would allow for improved comparability of titles, which in the mid-or longer term, may improve recognition procedures. In Australia and New Zealand, for instance, NPs are included in the Standard Classification of Occupation systems, based on tasks, qualification and skill level.³⁹ Globally, developing standardised titles, and adding those to the International Standard Classification of Occupation system, would improve data availability and monitoring.

Limitations

The study faces several limitations. The number of country experts was limited. The survey instrument, although extensively piloted, did not undergo formal testing for content validity and was only available in English. To mitigate these limitations, survey responses were carefully validated. We focused on official practice, actual practice may vary considerably within countries. Finally, by design our study focused on primary care, secondary/tertiary care settings were excluded.

Conclusions

Task shifting from physicians to nurses has become common in many countries worldwide, demonstrating its feasibility across differently organised and financed health systems.

Policy and educational reforms suggest that the boundaries between the medical and nursing professions may shift further in the future. As more countries are investing in an NP/APN workforce, maximising its use requires regulatory and financing structures flexible enough to adjust as the workforce changes.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Key points

- Task shifting from physicians to nurses has attracted interest among policy makers as a strategy to respond to shortages and increase access in primary care; however, there is limited cross-country research.
- On the basis of a survey with 93 country experts, we covered 39 countries, including 35 countries in Europe, where equivalence of practice is of high relevance due to its free movement zone;
- Two-thirds of countries ($N=27$, 69%) have implemented task shifting in primary care, measured by nurses (after additional education), authorised to perform all (cluster 1) or a limited set (cluster 2) of clinical activities traditionally reserved to the medical profession, including prescriptive, diagnostic, treatment authority, ordering medical tests, referrals, responsibility for a panel of patients and first point of contact.
- Many policy and educational reforms have been implemented: between 2010 and 2015, 14 countries have newly enacted or expanded prescriptive authority for nurses in strictly regulated contexts, with implications on the skill-mix and re-design of teams in primary care.
- From an international perspective, developing minimum educational and practice standards may facilitate the comparability and recognition of advanced nursing roles across borders.

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Positive effects of medical staffing on readmission within 30 days after discharge: a retrospective analysis of obstetrics and gynecology data

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Background: Improving quality of care is a major healthcare goal; however, the relationship between limited resources and appropriate healthcare distribution has always been problematic. Planning for resource shortages is important for improving healthcare quality. The aim of our study was to evaluate the effects of manpower planning on improvements in quality of care by estimating the effects of medical staffing on readmission within 30 days after discharge. **Methods:** We conducted an observational study using 2011–14 National Health Claim data from 692 hospitals and 633 461 admissions. The database included information on uterine (including adnexa) procedures (195 270 cases) and cesarean deliveries (438 191 cases). The outcome variable was readmission within 30 days after discharge. A generalized estimating equation model was used to evaluate associations between readmission and medical staffing. **Results:** The number of doctors and the proportion of registered nurses (RNs) were significantly associated with a lower risk of readmission within 30 days (proportion of RNs, Relative Risk (RR): 0.97, *P* values: 0.0025; number of doctors, RR: 0.96, *P* values: <0.0001). The number of nurses (RNs+licensed practical nurses) was not associated with readmission within 30 days (RR: 1.01, *P* values: <0.0001). **Conclusion:** Our results suggested that higher numbers of doctors and higher proportions of RNs were positively correlated with a lower risk of readmission within 30 days. Human resource planning to solve manpower shortages should carefully consider the qualitative aspects of clinical care and include long-term planning.

Introduction

Advances in healthcare technology have resulted in improvements in healthcare; however, quality of care continues to concern policymakers, healthcare providers and consumers.^{1,2} Given that health care systems have complex structures and consist of multifaceted processes, improvements in quality of care should be considered from both hospital and policy perspectives.^{2–4}

From the hospital perspective, quality of care is associated with size, skill-mix and geographical location.^{5–7} The human resources, which include doctors and nurses, are considered to be the cornerstones of health care. Appropriate distribution of manpower is associated with the quality of care patients receive from healthcare services. However, resource limitations result in manpower shortages and inefficient manpower distribution. According to the 2013 Organization for Economic Co-operation and Development (OECD) statistics, the number of doctors per capita in Korea was 2.2 per 1000 people, which was less than the OECD average of 3.2 per 1000 people.⁸ The number of nurses was also lower than the OECD average of 8.7 per 1000 people (Korea: 5.2 per 1000 people).⁸ The lower manpower supply implies an increase in labor intensity that results from increased workloads, and it also implies an associated lower quality of care.^{9,10}

From the political perspective, health policy provides a framework for improved quality of care and increased health efficiency.¹¹ New policies have been developed as the health system has been reformed. These changes affect reimbursement systems, incentive programs and human resource management. As quality of care depends on the performance of those who deliver care, human resource planning

has been an important part of the changes in the health system.^{11,12} An appropriate human resource distribution is associated with better performance and improvements in equity of access to healthcare services.¹¹ However, it is unclear how medical staffing affects quality of care under a new reimbursement system established in Korea.

A voluntary diagnosis-related group (DRG)-based payment system was introduced for seven disease groups in 2002 to control health expenditures in Korea.¹³ The recent mandatory adoption of the DRG system has resulted in changes to the reimbursement system. These changes were phased in beginning on 1 July 2012. Since this date, the DRG system has been mandatory for hospitals and clinics. It was applied to general hospitals and tertiary hospitals beginning on 1 July 2013. The medical community has been concerned about the mandatory adoption of the DRG system a possible association of this system with lower quality of care.

Few studies that examine the effects of mandatory adoption of the DRG system on quality of care have been performed in Korea. They included small sample sizes and focused only on the DRG payment system.^{14,15} In addition, staffing level is also associated with better patient outcomes.^{16–20} No studies have examined the effects of medical staffing and quality of care after mandatory adoption of this system. How the numbers of nurses and proportions of registered nurses (RNs) are associated with quality of care is also unclear. This information is needed for the evaluation, and improvement, of human resource planning.

In this study, we provide evidence to hospitals and policymakers that manpower planning should be included in quality-of-care