**Summary description of the project context and the main objectives (4 pages)**

Numeric, skill and geographical imbalances in the health and nursing workforce are a major concern for providing safe patient care. Driven by ageing populations, demand for healthcare and for nurses will continue to grow, whilst the supply of available nurses will drop [1,2]. It is therefore expected that the shortages will accelerate in the coming decade and will be more serious than the cyclical shortages of the past [1]. This nursing shortage will ultimately constrain health system reform and innovation, and contribute to escalating costs [3]. Two comprehensive analyses of global human resources for health, the 2004 Joint Learning Initiative and the 2006 World Health Report, concluded that all countries can accelerate health gains through more strategic investments in and management of their nursing workforce [4,5].

Evidence-based workforce planning methods could provide an important tool to rationalize policy makers’ decisions and strategies for avoiding dynamic workforce shortages. However, the conclusion of a review of current nursing workforce planning and forecasting was that they all show serious shortcomings in terms of comprehensiveness and accuracy of forecasts [6]. The multiplicity of inputs and consequences of societal, health systems, and professional trends, makes the determination of the optimal number of nurses for any given country very complex. The simplest approaches use only the ratio of healthcare workers for their predictions [7]. Other country-specific forecasts of the need for nursing personnel generally take into account demand as well as supply factors based on historically established staffing levels, resources and estimates of demand for health services.

A significant point for improvement to current methods is to address the available evidence on the association between the organization of nursing system delivery strategies and quality and safety of healthcare. Research confirms that organizational features of nursing care, from better patient-to-nurse staffing ratios to sound work environments, are associated with improved nurse wellbeing and better patient outcomes, including patient mortality and satisfaction with care [8-13]. This body of evidence comes from US studies primarily, where it has been translated into practice and public policies through, for example, the enacting of nurse staffing legislation and Magnet accreditation for excellence in nurse work environments.

There is little evidence of uptake of these research findings and evidence-based best practices in Europe, even though a few country-specific studies have reported similar findings [14,15]. Researchers from twelve European countries (Belgium, Finland, Germany, Greece, Ireland, Norway, Poland, Spain, Sweden, Switzerland, The Netherlands and England) therefore collaborated in the Registered Nurse Forecasting (RN4CAST) study, one of the largest nursing workforce studies ever conducted in the EU [16]. The RN4CAST consortium was strengthened by the 15 years of experience at the Centre for Health Outcomes and Policy Research at the University of Pennsylvania in conducting policy-relevant international studies of the nurse workforce. The study is also conducted in three countries outside Europe (Botswana, China, and South Africa) to provide a broader international perspective in later phases.

The selection of countries allows for an evaluation of the US evidence in a broader European context in which a wide range of health systems are in place. The aim of the RN4CAST project was to study the effects of nursing workforce dynamics such as number of nurse staff, skill-mix and working environment on nurse job satisfaction, intention-to-leave, patient satisfaction and patient outcomes. The consortium studies whether the same associations are seen in all countries, whether some countries have been able to provide substantially better hospital work environments and greater patient satisfaction than others, and if so, why? We hypothesized that in hospitals where the organizational context of care is good, that is, where hospital nurse staffing and nurse work environments are better, patients benefit and the nurse workforce stability is enhanced. To measure these constructs, a multilevel cross sectional design was set up in which nurses and patients were sampled within nursing units within hospitals within countries. During this period of data collection, we also aimed to evaluate and appraise the current nurse workforce projection models and forecasts. As such, we can expand and refine typical forecasting models with factors that take into account how features of work environments and qualifications of the nurse workforce impact on nurse wellbeing and patient outcomes.

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**Description of the main S & T results/foregrounds (25 pages)**

1. Methods
   1. Design

This 3-year project involved two major phases. The first phase of the project (January 2009 - June 2010) focused on instrument development, instrument validation and data collection. We favoured a rigorous quantitative multi-country cross-sectional design on the basis of research methods used in a five-nation study of critical issues in nurse staffing and the impact on patient care [1]. The data requirements and options of data acquirement were specified in an overall data collection protocol. This way of standardizing data collection procedures and instruments enabled comparability of measures across sites and facilitated cross-country analyses. Also during the first half of the project, we appraised and evaluated the current models and methods used in health care human resources planning in nursing. A two-step approach was followed. The first step included a comprehensive literature review to identify the available sources describing the use of current models in human resource planning in nursing. The data were collected from international databases. Additional country specific data were retrieved from the grey literature. The research teams in each country contacted institutions and stakeholders to obtain published and unpublished data and reports about forecasting models. The second step produced a template for data collection of data about demand and supply factors.   
The second phase of the project (July 2010 - December 2011) focused on data analysis and policy synthesis.

* 1. Study sample

We focused on general acute hospitals (with at least 100 beds) that either had mixed age clienteles or treated adults only. This setting was chosen since general acute hospitals are the largest employers of nurses and thus exert major influence on demand for nurses in most countries [2]. In addition, general acute hospitals represent the largest share of national health expenditures and are the sites of the largest proportion of medical errors leading to serious injury or death [3]. In each of the twelve European countries (except Sweden) a study was conducted in at least 30 hospitals depending upon country size and number of hospitals. The selected hospitals represent either all of the relevant institutions in the country (Ireland, Norway) or were randomly selected, per country, from a registry of all general non-specialized hospitals. In Belgium, Germany, The Netherlands, Switzerland, England and Spain this selection was done at random/quota within strata (geographical location within the countries, hospital size, and hospital type). In case selected hospitals declined to participate a second or third wave of hospitals were invited. In Belgium and Germany, hospitals (that are not selected at random) were also given the opportunity to participate on a voluntary basis. In Finland, Poland and Greece hospitals were selected via purposive sampling (i.e. geographical spread, hospital size, hospital type). Representativeness checks (i.e. hospital type and size) were carried out in each country to assure that the sample represents the population appropriately. Within each hospital a minimum of 2 nursing units (1 general surgical and 1 general medical nursing unit) were randomly selected from a master list of nursing units. The study sample included only adult medical-surgical care nursing units since the science of linking different elements of nursing practice environment (including nurse staffing) to patient safety and clinical outcomes is best documented within this area. Specialized nursing units (e.g. intensive care and high dependency units, transplant care units, pediatric unit, geriatric and long-term care nursing units) were excluded from the sampling frame. The minimum number of nursing units per hospital that were sampled varied between the country-specific protocols, ranging from 2 nursing units in Switzerland and Finland to all eligible nursing units in England (with a maximum of 10) and Norway. In Sweden, nurses were not approached through hospitals but via the Swedish Nursing Association (covering 85% of all nurses). Via the member register al registered nurses employed in hospitals and working in medical and surgical departments were selected. Nurses were asked to verify the hospital in which they work and that they worked with direct patient care. Six countries (Belgium, the Netherlands, Switzerland, Finland, Spain and Germany) sampled a variable number of nursing units based on hospital size (e.g. Belgium: 4 nursing units in hospitals with <500 beds; 6 nursing units in hospitals with 500 beds or more). Within this setting, the RN4CAST consortium aimed to collect data from four sources: a nurse survey to measure organizational attributes, wellbeing, and quality of care; a patient survey to measure patient satisfaction with care; an organizational profile survey about general hospital-wide characteristics; and routinely collected administrative patient data.   
The first source of information for this study were nurses. Through a survey of hospital nurses, we measured organizational attributes such as the nursing work environment (e.g. nurse-doctor relations, nurse leadership), educational level of nurses, nurse-to-patient ratios, and measures of nurse wellbeing (job satisfaction, burnout, intention-to-leave) and nurse perceived quality of care. In each country all staff nurses (except nurses on sick leave, maternity leave or those who are on vacation) providing direct care to patients on the selected nursing units were included in the nurse survey. Nurses are defined in each country as those meeting the European Union definition of trained and licensed nurses according to directive 2005/36/EC. 2169 nursing units and 457 hospitals participated in the nurse survey. The sample consists of 33731 nurses (62% response rate) from Belgium (n=3186), England (n=2990), Finland (n=1131), Germany (n=1508), Greece (n=367), Ireland (n=1406), the Netherlands (n=2217), Norway (n=3752), Poland (n=2605), Spain (n=2804), Sweden (n=10133), and Switzerland (n=1632).

The second data source was a survey of patients. This survey focused on satisfaction with care from nurses, care from doctors, the hospital environment, experiences in the hospital, discharge from the hospital, and overall rating of the hospital. Due to funding constraints (survey not foreseen in EU-funding), England, the Netherlands, Norway, and Sweden did not participate in the patient satisfaction survey. In five countries (Belgium, Poland, Greece, Finland, and Switzerland) all the selected hospitals were included in the patient survey, whilst in other countries the patient survey was only conducted in a selection (Spain, Germany, and Ireland). A one-day census approach was used to select patients of the selected nursing units. All eligible patients (i.e. able to speak and understand the language of the questionnaire and to respond to the questions), present on the selected nursing units on the day of the census, were included in the study sample. A sub selection of 825 nursing units and 210 hospitals participated to the patient survey. The sample consists of 11567 patients (71% response rate) from Belgium (n=2623), Finland (n=1947), Germany (n=262), Greece (n=847), Ireland (n=285), Poland (n=4136), Spain (n=470), and Switzerland (n=997).

A third data source was the survey of the hospital management of the participating hospitals about general hospital-wide characteristics like bed size, teaching status and technology level.

A fourth data source was routinely collected administrative databases, used to derive patient level data on mortality and other patient outcomes. Routinely collected administrative data are available for about seven million hospital stays.

* 1. Study measures

These were the key available (deduced) measures from the nurse and patient survey, organizational profile survey, and patient outcomes data collection:

Nurse survey:

*Organization of nursing care*

* Nurse staffing was calculated for each hospital from nurse surveys as a ratio of patients to nurses on the ward on each nurse’s last shift, averaged across all direct inpatient care nurses in the sampled hospitals.
* Nurse work environment was measured using the Practice Environment Scale of the Nursing Work Index (PES-NWI), an internationally validated measure [4]. The PES-NWI measures modifiable organizational behaviors including managerial support for nursing, nurse participation in hospital affairs, doctor-nurse relations, and promotion of care quality. Subscales of the Practice Environment Scale of the Nursing Work Index-Revised were used to derive a three-category measure differentiating hospitals with lowest (worst) quartile, middle 50%, and highest (best) quartile work environment scores.
* Nurse education level calculated for each hospital from nurse surveys as the proportion of nurse indication they had obtained a bachelor degree in nursing, averaged across all direct inpatient care nurses in the sampled wards and hospitals.

*Nurse wellbeing, quality of care, and patient safety*

* Nurse burnout was measured with the Emotional Exhaustion subscale of the Maslach Burnout Inventory an instrument with established reliability and validity in international research [5].
* Other nurse outcomes and nurse-reported measures were derived from survey items, to contrast between nurses who were dissatisfied (vs. satisfied) with their jobs; who intended to leave their job in the next year (vs. those who did not); who reported that the quality of care on their ward was fair or poor (vs. good or excellent); who were less than confident (vs. confident) that patients could manage their own care when discharged; and who were less than confident (vs. confident) that management would resolve patient care problems.
* Using an item derived from the Agency for Healthcare Research and Quality (AHRQ) Hospital Survey on Patient Safety Culture, nurses gave their ward an overall grade on patient safety, allowing us to compare nurses that gave poor or failing grades with those who gave excellent, very good, or acceptable grades [6].
* Nurses were also asked whether they would recommend their hospitals to family and friends.

*Variables for risk adjustment*

Age, gender, education, years of experience, migratory status.

Patient survey:

*Variables for risk adjustment*

Age, gender, education, years of experience, migratory status.

Patient satisfaction was measured with the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS)[7]:

* Patients rated their hospitals on a scale from 0 (worst) to 10 (best)
* Patients indicated whether they would recommend their hospital to family and friends
* A composite measure of satisfaction with nursing was derived from three items asking patients whether nurses always 1) treated them with respect, 2) listened carefully, and 3) explained things in a clear manner.

Hospital profile survey:

*Variables for risk-adjustment*

Size, teaching status, and technology (open heart surgery and/or organ transplantation defined high technology hospitals).

Administrative discharge data:

*Patient clinical outcomes*

* Patient in-hospital 30-day mortality: patient dying in the hospital within first 30 days of hospital stay

*Variables for risk-adjustment*

* Patient’s sex, age, type of admission.
* Co-morbidity was calculated based on previous work on algorithms for the Charlson Co-morbidity Index (Myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, peptic ulcer disease, mild liver disease, diabetes without complications, diabetes with complications, paraplegia and hemiplegia, renal disease, cancer, moderate of severe liver disease, metastatic carcinoma, AIDS/HIV) [8-10].
* DRGs: Cross-mapping were carried out for the codes used in the different algorithms because the use of different local coding languages and grouping systems. This transformation process of internationally available algorithms to the context of local databases had already been achieved with success by several project partners [11-12].
  1. Statistical analysis

We integrated our data by means of common nursing unit and hospital identifiers. This meta-database contained information at the hospital level (organizational characteristics of nursing care and hospital characteristics for risk adjustment), the individual nurse level (nurse survey data on nurse wellbeing, quality of care, patient safety, and nurse characteristics for risk adjustment) and the patient level (patient survey data on patient satisfaction with care and patient outcomes data on patient mortality, length of stay, and patient risk-adjustment data including patient age, gender, type of admission and co-morbidity).

Two major types of analysis were done. The first involved descriptive and comparative analyses of variables reflecting commonalities and differences, policy implications and the strengths and weaknesses of the nurse workforce across countries. The second type of analysis involved the modeling of relationships between organizational characteristics of nursing care and nurse wellbeing, patient satisfaction, and patient clinical outcomes. In order to model the relationship between organizational characteristics of nursing care and nurse wellbeing, patient satisfaction, and patient clinical outcomes we calculated from the nurse survey hospital aggregated measures of nurse staffing, nurse practicing environments, and nurse education. We controlled for hospital characteristics including size, teaching status, and technology (open heart surgery and/or organ transplantation defined high technology hospitals). In analyzing nurse outcomes, we adjusted regression estimates (odds ratios) at the hospital-level for between-hospital (and between-country) differences in the composition of nurses — their age, sex, full-time employment status, and specialty — by a multi-level model structure in which nurses are nested within hospitals and countries. In analyzing patient outcomes with patient-level data in Europe, similar adjustments were made using a multi-level model in which patients are nested within hospitals and countries. Odds ratios for United States hospitals were estimated "about" the mean odds ratio using coefficients from linear regression models as individual data are not available. Robust logistic regression with clustering provided the same result as hierarchical modeling and the results are more straightforward to interpret.

1. Results

Findings from the nurse and patient survey were published in the British Medical Journal. The section below is extracted from this article.

Table 3 shows the difference in nurse workloads across our sample of hospitals. The average patient-to-nurse ratio across hospitals (and across all shifts) ranges from 5.4 in Norway to 13.0 in Germany, and the average ratio of patient-to-all-care-staff (including professional nurses or registered nurses and non- registered nurses) ranges from 3.3 in Norway to 10.5 in Germany.

Table 3. Nurse staffing in 12 RN4CAST countries

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Nurse staffing ratio of** | | | | |
| **Country** | **Patients/RNs** | | **Patients/Total Staff** | |
|  | **Mean** | **SD** | **Mean** | **SD** |
| Belgium | 10.7 | 2.2 | 7.9 | 1.7 |
| England | 8.6 | 1.5 | 4.8 | 0.6 |
| Finland | 8.3 | 2.2 | 5.3 | 0.8 |
| Germany | 13.0 | 2.3 | 10.5 | 1.6 |
| Greece | 10.2 | 2.8 | 6.2 | 2.1 |
| Ireland | 6.9 | 1.0 | 5.0 | 0.8 |
| Netherlands | 7.0 | 0.8 | 5.0 | 0.7 |
| Norway | 5.4 | 1.0 | 3.3 | 0.5 |
| Poland | 10.5 | 1.9 | 7.1 | 1.4 |
| Spain | 12.6 | 1.9 | 6.8 | 1.0 |
| Sweden | 7.7 | 1.1 | 4.2 | 0.6 |
| Switzerland | 7.9 | 1.5 | 5.0 | 1.0 |

Table 4 shows that a substantial proportion of nurses in every country report quality of care deficits and high nurse burnout, job dissatisfaction, and intent to leave current positions. Greece was particularly high on nurse burnout, dissatisfaction, and intent to leave. Nearly half of Greek nurses reported working on wards that they characterized as providing “poor” or “fair” quality of care and 17% (61/358) gave their hospitals a poor or failing safety grade. In the Netherlands, nurse burnout, dissatisfaction, and intent to leave were lower but still reflected adverse outcomes for between 10% (211/2061) to 19% (418/2197) of nurses; while only 6% (123/2187) of nurses gave their wards a poor or failing safety grade, and 35% (756/2185) rated care on their wards as fair or poor.

Table 4. Nurse wellbeing in 12 RN4CAST countries

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Nurse reports – Percentages of nurses who** | | | | | | | |
| **Country** | **Report poor or fair ward quality** | **Report poor or failing safety grade** | **Are burned out** | **Are dissatisfied with their job** | **Intend to leave** | **Are not confident patient can manage care** | **Are not confident that management resolves patient problems** |
| Belgium | 28 | 6 | 25 | 22 | 30 | 61 | 80 |
| England | 19 | 7 | 42 | 39 | 44 | 34 | 64 |
| Finland | 13 | 7 | 22 | 27 | 49 | 40 | 81 |
| Germany | 35 | 6 | 30 | 37 | 36 | 31 | 58 |
| Greece | 47 | 17 | 78 | 56 | 49 | 65 | 87 |
| Ireland | 11 | 8 | 41 | 42 | 44 | 42 | 63 |
| Netherlands | 35 | 6 | 10 | 11 | 19 | 41 | 81 |
| Norway | 13 | 5 | 24 | 21 | 25 | 57 | 74 |
| Poland | 26 | 18 | 40 | 26 | 44 | 74 | 85 |
| Spain | 32 | 6 | 29 | 38 | 27 | 56 | 86 |
| Sweden | 27 | 11 | 29 | 22 | 34 | 28 | 73 |
| Switzerland | 20 | 4 | 15 | 21 | 28 | 35 | 75 |

As shown in Table 5, the percentage of patients who gave high overall ratings to their hospital ranged from 35% (166/469) in Spain to about 60% in Switzerland (587/976), Finland (1128/1862), and Ireland (171/282). High patient ratings are associated with the propensity to “definitely” recommend the hospital. Variability in what both nurses and patients experience within hospitals is, in general, even greater within countries than it is between countries, but the relationships between indicators across hospitals are quite similar.

Table 5. Patient satisfaction with care in 12 RN4CAST countries

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Patient reports – Percentages of patients who** | | | | | |
| **Country** | **Rate the hospital 9 or 10** | **Would definitely recommend the hospital** | **Say nurses always treat them with respect** | **Say nurses always listen carefully to them** | **Say nurses always explain things in a way they could understand** |
| Belgium | 47 | 60 | 76 | 58 | 53 |
| Finland | 61 | 67 | 73 | 58 | 60 |
| Germany | 48 | 66 | 75 | 52 | 50 |
| Greece | 42 | 53 | 75 | 65 | 39 |
| Ireland | 61 | 74 | 86 | 70 | 66 |
| Poland | 55 | 57 | 76 | 70 | 66 |
| Spain | 35 | 55 | 76 | 64 | 61 |
| Switzerland | 60 | 78 | 85 | 70 | 70 |

In Table 6 we estimate the effects of practice environments and staffing on nurse outcomes and quality. Two models are shown for each combination of outcome and “effect” (practice environment or staffing): 1) robust logistic regression models which estimate the effects of nurse staffing and the work environment separately without controls with the within-country slopes fixed to be equivalent across Europe; and 2) multivariate models (also with robust standard errors) which estimate the joint effects of nurse staffing and the practice environment after controlling for across-hospital differences in characteristics of nurses, differences in structural characteristics of hospitals, and unmeasured differences in outcomes across countries. A better work environment has pronounced negative effects on every negatively-scaled outcome, with and without nurse, hospital, and country controls. After adjusting for hospital and nurse characteristics, nurses in hospitals with better work environments were half as likely to report poor or fair care quality and to give their hospitals poor or failing grades on patient safety. Each additional patient per nurse increased the odds on nurses reporting poor or fair quality care and poor or failing safety grades. Nurse outcomes (high burnout, dissatisfaction, and intent to leave) are similarly associated with staffing and the work environment, and the work environment effect is generally stronger than the specific staffing effect. Similarities are evident among countries at all levels of health expenditure. Better work environments have the anticipated effect on every outcome, as do higher nurse workloads on most of them.

Table 6. Odds ratios indicating the effects of nurse staffing and the nurse work environment on nurse outcomes and nurse reported quality of care

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Odds ratios from models in which effects are** | | | | |
|  |  | **Unadjusted** | | **Adjusted** | |
| **Outcome** | **Effect** | **OR** | **95% CI** | **OR** | **95% CI** |
| **Poor/fair unit quality** | **Work environment** | 0.58 | (0.53 to 0.63) | 0.56 | (0.51 to 0.61) |
|  | **Staffing** | 1.11 | (1.08 to 1.13) | 1.11 | (1.07 to 1.15) |
| **Poor/failing safety grade** | **Work environment** | 0.50 | (0.43 to 0.57) | 0.50 | (0.44 to 0.56) |
|  | **Staffing** | 1.04 | (1.01 to 1.08) | 1.10 | (1.05 to 1.16) |
| **High burnout** | **Work environment** | 0.69 | (0.63 to 0.76) | 0.67 | (0.61 to 0.73) |
|  | **Staffing** | 1.06 | (1.04 to 1.08) | 1.05 | (1.02 to 1.09) |
| **Job dissatisfaction** | **Work environment** | 0.63 | (0.57 to 0.69) | 0.52 | (0.47 to 0.57) |
|  | **Staffing** | 1.10 | (1.08 to 1.12) | 1.07 | (1.04 to 1.11) |
| **Intent to leave** | **Work environment** | 0.72 | (0.66 to 0.79) | 0.61 | (0.56 to 0.67) |
|  | **Staffing** | 1.04 | (1.01 to 1.06) | 1.05 | (1.02 to 1.09) |
| **Not confident patients can manage care** | **Work environment** | 0.62 | (0.56 to 0.69) | 0.73 | (0.69 to 0.78) |
|  | **Staffing** | 1.08 | (1.05 to 1.11) | 1.03 | (1.00 to 1.05) |
| **Not confident management resolves patient problems** | **Work environment** | 0.50 | (0.46 to 0.54) | 0.53 | (0.48 to 0.58) |
|  | **Staffing** | 1.04 | (1.01 to 1.07) | 1.02 | (0.98 to 1.06) |

Table 7 shows the results of using similar robust logistic regression models that allow for the clustering of patients within hospitals and estimate the separate effects of the different nursing factors and nurse characteristics on 1) the odds of patients rating their hospital highly (9 or 10 vs. <9), 2) the odds of patients indicating that they would definitely recommend their hospital, and 3) the odds of patients responding that nurses always treated them with courtesy and respect, listened to them carefully, and explained things in a clear manner. The work environment has a sizable and positive effect on all three positively scaled patient measures in all countries. Patients in hospitals with better work environments were more likely to rate their hospital highly and to recommend their hospital, while patients in hospitals with higher patient-to-nurse ratios were less likely to rate their hospital highly and to recommend their hospital. Table 7 also shows that the odds of patients rating their hospital highly, recommending their hospital, and responding favourably about nurses are lower in hospitals that have higher percentages of nurses reporting only fair or poor quality care and poorer failing safety grades. Patients exhibit less satisfaction in hospitals with higher percentages of burned out or dissatisfied nurses, and in hospitals where more nurses lack confidence in management.

Table 7. Odds ratios indicating the effects of nursing factors and nurse characteristics on patient outcomes

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Rating hospital 9 or 10** | | | | **Definitely recommending hospital** | | | | **Favourable nurse communication** | | | |
|  | **Unadjusted** | | **Adjusted** | | **Unadjusted** | | **Adjusted** | | **Unadjusted** | | **Adjusted** | |
| **Factors** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** |
| **Patient-to-nurse ratio** | 0.91 | (0.88 to 0.94) | 0.94 | (0.91 to 0.97) | 0.90 | (0.87 to 0.93) | 0.95 | (0.91 to 0.98) | 0.98 | (0.95 to 1.01) | 0.99 | (0.96 to 1.02) |
| **Nurse work environment** | 1.24 | (1.11 to 1.38) | 1.16 | (1.03 to 1.32) | 1.41 | (1.22 to 1.62) | 1.20 | (1.05 to 1.37) | 1.05 | (0.93 to 1.19) | 1.11 | (1.00 to 1.23) |
| **10-percent increase in nurses that** |  |  |  |  |  |  |  |  |  |  |  |  |
| * **Report hospital care is fair or poor** | 0.83 | (0.80 to 0.87) | 0.88 | (0.84 to 0.92) | 0.85 | (0.80 to 0.89) | 0.87 | (0.82 to 0.92) | 0.93 | (0.88 to 0.97) | 0.94 | (0.90 to 0.98) |
| * **Report poor/failing patient safety** | 0.90 | (0.83 to 0.98) | 0.85 | (0.77 to 0.94) | 0.79 | (0.73 to 0.86) | 0.85 | (0.76 to 0.94) | 1.06 | (0.99 to 1.13) | 0.93 | (0.87 to 0.99) |
| * **Have high burnout** | 0.92 | (0.89 to 0.96) | 0.93 | (0.88 to 0.97) | 0.89 | (0.85 to 0.94) | 0.94 | (0.89 to 1.00) | 0.97 | (0.93 to 1.01) | 0.95 | (0.91 to 1.00) |
| * **Are dissatisfied with their job** | 0.90 | (0.86 to 0.94) | 0.92 | (0.87 to 0.96) | 0.91 | (0.86 to 0.97) | 0.91 | (0.87 to 0.96) | 0.92 | (0.88 to 0.96) | 0.95 | (0.91 to 0.98) |
| * **Intend to leave** | 0.98 | (0.93 to 1.04) | 0.91 | (0.85 to 0.98) | 0.93 | (0.87 to 0.98) | 0.92 | (0.86 to 0.98) | 0.95 | (0.91 to 1.00) | 0.95 | (0.91 to 0.99) |
| * **Lack confidence in management** | 0.97 | (0.92 to 1.02) | 0.96 | (0.90 to 1.02) | 0.91 | (0.85 to 0.97) | 0.95 | (0.89 to 1.01) | 0.99 | (0.93 to 1.05) | 0.95 | (0.90 to 0.99) |
| * **Lack confidence that patients can manage their own care** | 0.93 | (0.89 to 0.97) | 0.91 | (0.85 to 0.97) | 0.86 | (0.82 to 0.89) | 0.91 | (0.86 to 0.98) | 1.03 | (0.98 to 1.07) | 0.92 | (0.87 to 0.97) |

In conclusion, findings suggest that all sampled countries, representing differently organized and financed national health care systems, have hospital quality, safety, and staff retention problems associated with organizational features of nursing care. In all countries, nurse staffing and the quality of the hospital work environment were significantly associated with patient satisfaction, quality and safety of care, and measures of nurse wellbeing. That is, hospitals with superior work environments and better nurse staffing had better outcomes for patients and nurses alike. Preliminary analyses show similar findings for the relationship between organizational features of nursing care and patient mortality. Patients’ ratings of hospitals are similar to nurses’ ratings, and whether patients rate their hospital as excellent and whether patients would recommend their hospital to others is associated significantly with nurses’ ratings of their hospital work environment and their reports of nurse staffing. A general failure of hospital management is suggested by the majority of nurses in every country reporting a lack of confidence that hospital management will solve identified patient care problems. Management’s skepticism that nurses’ complaints about care quality reflect objective clinical observations might need to be tempered by our findings showing that nurses’ assessments concur with those made independently by patients. In hospitals with high patient-to-nurse ratios, poor work environments, and lower proportions of nurses educated at the bachelor level, patients experience higher mortality rates. Differences in quality of care assessments were noted among countries. Nurses’ ratings of quality and job satisfaction is worst in Greece, whose health system has been experiencing severe economic difficulties and where there have been widespread protests about the government’s austerity measures. There have also been austerity protests in Spain, which ranks third worst on quality. Germany, ranking second worst, has not faced protests but nursing workload is believed to have increased following the introduction of case-based payment. At the other end of the spectrum, nurses in Ireland and Finland report high levels of quality, although both countries have also suffered considerable economic downturns, while the performance of Norway’s well-resourced health system is where one might expect it to be. There is no clear association between the views of nurses and patients with several plausible country-level correlates, such as nurses per capita or health expenditure as a percentage of Gross Domestic Product. Perhaps these national-level indicators do not reflect differences in hospital-level investments that our study suggests impact quality, such as better work environments and nurse staffing. The United States, for example, has fewer nurses per capita than most Organization for Economic Co-operation and Development (OECD) countries, but comparatively more nurses per hospitalized patient. Several high-profile initiatives have occurred in the United States recently with regard to achieving safe nurse staffing and improved work environments. Over 20 states in the United States have enacted or are considering nurse staffing legislation [13], and Magnet accreditation promoting improved work environments has grown to almost 400 of hospitals (7% of total). Similar activity is less apparent in Europe. One National Health Service trust in England achieved Magnet status in the past but management was not supportive of retaining its designation [14]. Magnet accreditation is international with recognized hospitals in Australia, New Zealand, and Singapore, among others but there is not a single Magnet hospital in Europe or the equivalent recognition of nursing excellence.   
Preliminary analysis shows that nurse staffing and education is associated with in-hospital 30-day patient mortality. In the coming months, this relationship will be further investigated. Our findings thus support the conclusion reached by the World Alliance for Patient Safety that organizational behaviors are important in promoting patient safety [15].

For a selection of countries (Belgium, England, Ireland, Norway, and Switzerland), findings from these analyses were linked to projections relating to the supply and demand for nursing into the future and major policy issues facing nursing across Europe over the next 10 to 30 years. This work was guided by a conceptual model of the contribution of nurse services to the production of health care [16]. This model illustrates the complexity of workforce planning brought about by the interaction of inflows and outflows of staff. Also included are the number and productivity of nurses and other healthcare staff as well as the reciprocal relationship these elements of planning have with the quantity and quality of healthcare and the resulting impact on the patient. All of these interactions are impacted by internal and external environmental factors.

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**Description of the potential impact and the main dissemination activities and the exploitation of results (10 pages)**

1. Societal implications

The RN4CAST project has made an important contribution to both the intended impacts identified in call 2012.3.2-1 and to the wider goals of the FP7 Work Programme for Health by identifying and addressing opportunities for exploitation and contributing to getting knowledge into practice. We have provided new evidence on the association between organizational features of nursing care and nurse wellbeing and patient outcomes.

A number of population, education, health systems change and other government policy related issues will have serious implications for the future of the nursing workforce across Europe if appropriate actions are not taken immediately and in the mid to longer term. In particular, population growth and ageing and associated attrition from the workforce as well as a general increase in the reliance of the population on health care will increase the need for nursing care into the future. Of significance is the potential impact that changes in the configuration of health care delivery across partner countries will have on the requirement for nurses into the future. The move to a community care based model of care may or may not impact the number of nurses required within the acute sector. The implication may be that moves to community based care will lead to a reduction in the number of acute hospital beds, however, the ageing population coupled with increasing chronic disease and increased reliance upon health care may impact inpatient bed requirements i.e. lead to a relatively high level of demand.

Our projections infer that nurse to patient ratios within hospitals across the five partner countries discussed (Belgium, England, Ireland, Norway and Switzerland) will be reduced as a result of reduced inflows into and increased outflows from the nursing profession. There is a clear need for the recruitment of new entrants into the nursing profession to maintain and improve nurse-to-patient ratios at ward level. The hypothetical RN4CAST results, based on projected shortages in the nursing workforce, infer that reduced nurse staffing levels will ultimately increase patient mortality rates with serious consequence for patient safety across health services in Europe, leading to significant care deficits within as well as across countries. These results also infer an increase in nurses leaving the workforce due to burnout and job dissatisfaction. Additionally, burnout and job dissatisfaction within the nursing profession can lead to a negative image of nursing for those considering entry into the profession, with the knock on effect of reducing the supply of nurses i.e. numbers of nurse graduates, into the future. If care deficits are to be avoided we recommend that the overall thrust of policy formulation and implementation should be directed towards enhancing and sustaining the participation rates of current and future nurses in the workforce. This has a number of key elements.

First, it is essential that we consider the implications of different policy options aimed at increasing inflows into nursing and stemming outflows from the profession. Increasing the attractiveness of the workplace throughout the career cycle of nurses as well as productivity through strong leadership and the development of healthy work environments are vital to creating sustainable environments for healthcare. Second, ambitions to increase efficiencies within health care through moving to a community based mode of care are likely to be optimised through significant investment in creating positive work environments and in the skills of the workforce. De-skilling the workforce, that is, through the reduction in nursing numbers and/ or the deployment of less qualified ‘nursing’ staff is not supported as cost effective by existing evidence [1,2] and is therefore unlikely to succeed as an option in the future organisation of the health service. Rather, investment in the development of a nursing workforce that is skilled in the delivery of primary care services and parallel investment in the development and maintenance of positive work environments is likely to be a more effective way forward.

Third, inflows into the nursing profession can be improved by increasing the number of students opting to complete nursing studies at tertiary level, and by attracting those who have left the profession back into nursing or by recruiting nurses from overseas. In order to achieve any of the above, policy makers need to implement policies that are well adapted to the life and career cycles of nurses themselves. Given the average age of the nursing student is increasing and rising age of the national nursing workforces many nurses have families, are planning to have families and have caring responsibilities outside of the workplace. Human resource policies must be put in place to accommodate the age profile as well as the ageing workforce to ensure a satisfied workforce, with low levels of burnout and low levels of intention to leave the profession. We use the term ‘healthy work environments’ to describe the type of workplace that will ultimately serve to facilitate the much needed recruitment of new entrants and re-entrants into the profession as well as serving to reduce outflows and unnecessary attrition from the nursing workforce.

Supporting workplaces to be family-friendly will ultimately increase the value and consequently enhance the image of the nursing profession. Many women who would have entered nursing in the past are now entering higher value managerial and professional occupations, occupations that were once traditionally male dominated [3]. Policy options aimed at increasing the value of nursing include the following: First, making workplaces more family friendly and adapted to the demographics of the workforce does not necessarily demand the investment of increased resources. As we have seen nurses are keen to be involved in decisions around how they are managed and this is likely to pay dividends in terms of how nurses respond to the work environment. Findings suggest that this could be a significant but low cost lever for change. Second, making nurse salaries competitive enough to attract the right quality and quantity of new entrants into the nursing profession. Again, the economic situation in Europe will challenge this recommendation at present but there will be room for salary change in the future; Third, raising the minimum nurse qualification requirements to degree level for countries where this is not currently in place. Increasing numbers of school leavers are opting to go to university to study for a degree therefore making nursing a degree level profession should increase the number of enrolments on nursing courses. Furthermore, nursing units in which there are higher levels of degree educated nurses were found to have better patient outcomes.

Decreasing outflows from the nursing profession might thus in summary be achieved by implementing such policies as:

1. Making the salaries and benefits of nurses attractive enough to prevent overly high levels of attrition from the workforce. This may be challenging given the current economic difficulties across the EU.

2. Provision of non-monetary incentives to stay in the workplace e.g. positive feedback for work done, career development opportunities, job enrichment and nurse empowerment through for example, the promotion of independent and shared decision making.

3. Ensuring that nurses trained to a high level are given the opportunities to exploit their skills in areas such as e.g. nurse prescribing, community nurse-led initiatives such as those in cardiac and diabetes care.

4. Potentially increasing the retirement age for nurses (a policy already being considered in many EU countries and across professions).

5. Ensuring an appropriate work environment to accommodate an ageing workforce. Loss of older nurses results in a loss of clinical expertise that can negatively impact patient outcomes. With this in mind human resource managers should implement policies that aim to retain older, more experienced nurses and succession plan in a manner that ensures cascading of skills from the more to the less experienced staff. These policies might include for example:

* Ensuring supportive and flexible work arrangements and practices (e.g. modified workloads, flexible scheduling options, reduction in hours of work, etc.)
* An organisational culture that promotes participation in decision-making and autonomy over practice
* Work recognition, encouragement and positive feedback from supervisors.
* Ergonomically friendly, safe and effective work environments.
* Access to professional development activities that target the needs of experienced nurses [4].

Our main policy recommendations centre around the development and maintenance of healthy work environments to both attract and retain high quality staff. Healthy work environments are consistently characterised by the support, leadership and empowerment of visionary leaders who are in tune with the workforce [5]. Work environments that value the contribution of the workforce, offer shared and delegated professional decision making, provide staff with opportunities to develop their skill set and build collaborative and supportive structures are healthier, more productive environments in which people want to work. Implementation of management structures and staff training that promote inter and intra-disciplinary collaboration as well as shared decision-making could increase the attractiveness of the nursing profession to potential new entrants. Strong nurse leaders can create a work environment characterised by an organizational climate that promotes shared decision making and employee development including opportunities for advancement and collaboration.

Nurse leadership is critical to the successful development of healthy work environments. However, past nurse training and practice is thought to have resulted in a lack of focus on the importance of leadership within the realm of human resource management in nursing. This has led to a need for focus on the development of strong leadership in the nursing profession globally, something the International Council of Nurses has recently highlighted.

Reid and Weller [6] have proposed a competency framework detailing six domains of practice for nursing human resources planning and management to focus on in the development of competent nurse leaders who promote staff development, empower employees, encourage and support shared decision making and collegial collaboration and ultimately create attractive work environments. We recommend the adoption of this framework which includes the following domains:

1. The ethics and standards domain, which details competencies required to ensure nurses practice within an ethical and professional practice framework.
2. The resource management domain, which details competencies required of a leader to effectively administer and organise relevant records and personnel systems.
3. The workforce planning domain, which includes for example the development of competencies relating to developing projections of staffing levels required to deliver on goals and priorities; implementing changes to service delivery; developing and implementing strategies to recruit and retain staff and identifying and implementing measures to improve quality and productivity
4. The work environment domain, which involves the creation of a positive work environment by ensuring that the safety and security of staff is maximized; that the physical environment, facilities and equipment are adequate; that staff feel valued and have opportunities to contribute to planning, problem solving and decision making; and a work-life balance is promoted
5. The staff management, support and performance domain, which involves the provision of opportunities for ongoing training, education and professional development and growth for staff. Staff are supported by management and this support helps attract, develop and retain the nursing workforce in an enabling work environment
6. The leadership domain involves ensuring the individual leader has the knowledge, skills and capacities to empower those around him/her and to harness their strengths toward collective effort [6].

Closely linked to the development of strong nurse leadership and healthy work environments is the development of high performance work teams. High performance health care teams, including collaborative nurse-physician teams have been found to improve patient care and patient safety, organisational effectiveness and health care delivery in general. These positive outcomes are realised through the impact that effective teamwork can have on employee satisfaction, reducing perceived levels of burnout among staff and increasing staff intention to stay in the workplace [8-10]. In recommending the development of effective nursing and interdisciplinary teamwork within health care units, team size needs to be given serious consideration. Experts in the field of ‘teamwork’ recommend that for a team to be effective it should consist of between 5 and 8 members. This however is not the reality in the healthcare environment where a nurse can work with far in excess of this number on a regular basis [10].

Familiarity with team members, stability of the team, a shared common purpose and destiny among team members as well as a physical working environment that is conducive to staff engagement are all thought to facilitate high performance teams. Kalisch and Begeney [7] set out a number of recommendations aimed at achieving effective teams working, we endorse these recommendations as follows:

1. Wherever possible, develop smaller teams by breaking larger units into a number of smaller units within which teams could consistently work together over a specified period of time, long enough to establish positive team working attributes e.g. familiarity, stability etc.
2. Cluster larger teams by breaking them down into smaller teams by virtue of patient proximity and the physical environment
3. Consider the move from a mix of both 8 and 12 hour shifts to consistent shifts durations to limit the redistribution of patients to staff remaining on longer shifts and consequently increasing the consistency of staff interactions
4. Reduce staff turnover and absenteeism through the development of collegial relationships, loyalties and increased satisfaction among team members. This has the knock on effect of increasing team stability, resulting in better patient and staff outcomes
5. Reward staff to increase their intrinsic motivation. This is not necessarily done through monetary reward, but rather through reward via positive feedback in recognition of work done, the provision of career development opportunities and empowerment through devolvement of decision making to staff members

To conclude, policy makers need to be very aware of the impact of organisational characteristics such as leadership, team work, rewards systems and job flexibility on how nurses view their workplace and ultimately on nurse recruitment and retention. Nursing leaders and managers need to be fully aware of the nurses’ levels of job satisfaction, burnout and intention to stay or leave their job so that they know when to act in the interest of maintaining a healthy work environment. Leaders and managers in the nursing profession should equip themselves on an ongoing basis with the evidence and information required to improve job satisfaction, interdisciplinary teamwork, and retention, ultimately improving the quality of health care delivery. Indeed, the usefulness of this information would likely be considerably improved if it were linked with ongoing patient-safety monitoring and quality-improvement activities within the organization [10]. Leaders equipped with evidence can be proactive by assessing both nurse perceptions and that outcomes to ensure safety processes are adhered to consistently to improve both patient and nurse outcomes. A satisfied workforce, now and in the future, is essential to providing quality care, lower levels of stress and burnout and higher levels of patient safety [10]. Improving work environments can lead to both increase satisfaction and increased productivity within the workplace.

Significant change to the way in which health care across many of the partner countries is currently delivered is anticipated with the move from a system of care that is currently based mainly in the acute hospital sector to one that will be based within the community. This is likely to have a notable impact on the delivery of care from a human resource perspective. These new models of care delivery ultimately aim to address problems with the current models by improving the organisation and efficiency of the current primary care infrastructure. This should result in more integrated services with effective primary care teams who work to diagnose, treat, prevent and rehabilitate patients in the community thereby decreasing the need for inpatient care and reducing associated costs. However, the move from secondary care towards primary care will increase the burden already facing community health care personnel, including nurses. Commitment to change at many levels will be required to meet the challenges and build the appropriate capacity into the future. The aspiration is that an increase in patients attending community health services will lead to a parallel decrease in those attending hospital services. If the planned move to a primary care model is fully and successfully implemented, it is assumed that it will lead to a decreased requirement for nurses working in the acute hospital setting across many partner countries. It is therefore essential that, in line with change, nurses receive appropriate training and development opportunities to prepare them for the increased demand for community based care. This will include training and development for nurses across specialties. Work from within the RN4CAST consortium directly supports the argument that moving care out of acute settings does not mean that the issue of nurse staffing does not equally apply to other care settings. Griffiths and colleagues showed that there are also associations between nurse staffing and quality of chronic disease management [11].

A commitment by governments and relevant policy decision makers to the professional development of nurses will mean the provision of adequate funding. In addition, freeing up nurses to apply their skills across more varied health care contexts will be crucial to improving any county’s health system model. Further to this, a commitment to professional development at management level will be essential to a successful move to a primary care based model. Managers will need to show leadership and encouragement to ensure nurses take up professional development opportunities. They will need to provide support through the provision of funding, time, and through the fostering of an atmosphere of collegial support.

Of note is the fact that, while some argue that such a move to primary care will decrease the need for nursing care in the acute sector this argument is contested when considered in light of the ageing demographic and the consequential increased need for acute, long term and residential care beds. Government policy in for example Ireland, England, Norway and Switzerland among other EU partner countries to reduce the number of in-patients in hospitals by moving to an integrated health system model with an increased emphasis on primary care, is set against the backdrop of an ageing population. In Ireland for example, by 2036 it is projected that there will be more elderly than young persons in the population. The Economic and Social Research Institute in Ireland predict that significant population ageing will occur to 2021 with the number of those aged 85 years and over more than doubling from 48,000 to nearly 106,000 and those aged 74-84 years increasing by over a half from 157,000 to 248,000. This would bring the proportion of older people in the population from one of the lowest in the OECD to above average by 2021. This in turn would ultimately lead to an increase in the requirement for acute hospital beds and nurses at the bedside. So, there is a very specific challenge associated with decreasing acute hospital bed usage in light of the fact that 'high users' of these beds are elderly, often suffering from multiple morbidities and chronic conditions [12]. Furthermore, strengthening community health service delivery includes a requirement for nurses equipped to take service delivery leadership roles in the development and roll out of nursing led services.

1. Dissemination activities and the exploitation of results

Our dissemination and exploitation activities ensured that the findings of our study are recognized and validated on a wide scale. We completed initiatives to appropriate policy makers and human resources managers in an organization, national, and international context. Key to the achievement of our goals has been the efforts of single partners’ and multi-partner initiatives in exploiting opportunities to generate exposure of the project. This was due to the RN4CAST consortium being based on previous collaborations between the involved partners and the existing strong ties with policy making some of our partners had.

We have striven to achieve dissemination and exploitation goals by adhering to a series of guiding principles: 1. Continuously identify stakeholders on a national and international level, reference groups, and core EU-policy makers; 2. Endeavour to actively liaise with these national and international stakeholder groups; 3. Endeavour to actively liaise with ongoing European initiatives related to the RN4CAST context; 4. Establish close collaborative contacts with related (EU-funded) projects; 5. Publish project findings in relevant international scientific journals; 6.Organize seminars/conferences to share the project’s findings; and 7. Maintain a dedicated public web site.

Our dissemination and exploitation activities commenced at the start of the project, were continued throughout the whole duration of the project, and will continue beyond the completion of the project. With the organization of three future major publication and dissemination events, the RN4CAST consortium aims at continuing to generate knowledge on the RN4CAST project findings. For 2012, we plan to launch a book within the European Observatory on Health Systems and Policies OUP series, complete an RN4CAST special issue in the peer-reviewed International Journal of Nursing Studies with room for comparative collaborative papers, discussion papers, and a review, and organize an international conference ‘Nursing workforce and quality of care in European hospitals’ on 14 September 2012 in Basel, Switzerland (http://nursing.unibas.ch/rn4cast). All dissemination activities and publications in the project have acknowledged the European Commission's funding through the Seventh Framework Programme.

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