Modeling and managing the patients' need for clinical care: Enhancing evidence-based practice and management
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STAFFING ON CLINICAL WARDS
STUDIES ON WORKFORCE PLANNING TOOL FOR NURSE STAFFING AND HUMAN RESOURCE MANAGEMENT IN UNIVERSITY HOSPITALS

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J Nurs Manag. Provisionally accepted
ABSTRACT

AIM: Investigating the reliability, validity and feasibility of the RAFAELA workforce planning system (including the Oulu patient classification system (OPCq)), before implementation in Dutch hospitals.

BACKGROUND: Budgetary restraints and demand for high-quality patient care have ignited the need for transparent hospital workforce planning.

METHODS: Nurses from 12 wards of two Dutch university hospitals were trained to test the reliability of the OPCq by investigating the agreement of nursing care intensity (NCI) measurements among nurses. Validity was tested by assessing whether optimal NCI/nurse as calculated by RAFAELA was realistic. System feasibility was investigated through a questionnaire among all nurses involved.

RESULTS: Almost 67,000 NCI-measurements were performed between December 2013 and June 2014. Absolute agreement using the OPCq varied between 38% and 91%. For only 1/12 wards the optimal NCI area calculated was judged as valid. Although the majority of respondents was positive about the applicability and user-friendliness, RAFAELA was not accepted as useful workforce planning system.

CONCLUSION AND IMPLICATIONS FOR NURSING MANAGEMENT: The nurses’ performance using the RAFAELA system did not warrant its implementation. Hospital managers should first focus on enlarging the readiness of nurses regarding the implementation of a workforce planning system.

KEY WORDS: WORKFORCE PLANNING; PATIENT CLASSIFICATION SYSTEM; WORKLOAD; PERSONNEL STAFFING AND SCHEDULING; NURSING CARE INTENSITY; DEMAND FOR CARE; NURSING; RELIABILITY; VALIDITY; FEASIBILITY

BACKGROUND

Present-day developments in care complexity, budgetary restraints and demand for safe and high-quality patient care have ignited the need for systematic and transparent workforce planning in hospitals. Many studies show an evident association between nurse staffing levels (in quantity and skill mix) and patient outcomes. In hospitals with low nurse-to-patient ratios (NPRs), adverse events occur more frequently, and patients experience higher mortality and failure-to-rescue rates. Furthermore, nurses in hospitals with low NPRs are more likely to experience burnout and job dissatisfaction. Thus, it is important for nurse managers and policy makers to know what determines the optimal number and skill mix of nurses required to deliver high quality and cost effective patient care.

While NPRs are easily intelligible for politicians, public and policy makers to understand, nurse managers have to guarantee sufficient staffing to meet the patients’ demand for care. Therefore, appreciating the impact of the demand for care on nursing care intensity (NCI) would help managers to plan the optimal number and skill mix of nurses. For this purpose, a uniform and valid measurement and communication tool is lacking. Such a tool would enable nurse managers and nurses to balance NCI and nurse staffing levels, not only on the tactical management level (i.e., hospital directors and policymakers) for determining optimal nurse staffing levels, but also on the operational level in terms of admission planning (with planners and physicians), daily nurse allocation and nurse-to-patient assignment (with nursing colleagues). The need for a tool to quantify NCI is especially high in some European countries where legislation or a national policy on nurse staffing is lacking, unlike for instance in California (NPR) and Australia (NHPPD).

NCI is defined as ‘patient-related workload’, as measured with a wide range of patient classification systems (PCSs). However, in the way these systems are commonly used, the resulting NCI is not considered an objective measure because of reliability and validity problems. This has rarely been investigated because methods for validating these instruments, for instance time and motion studies, are time-consuming. At present a variety of unreliable and invalidated PCSs are used in hospitals, which causes difficulties in comparing nursing intensity scores among wards and hospitals.

A positive exception on these common but unreliable PCSs is a workforce planning tool based on NCI, called the “RAFAELA patient classification system” which was developed and introduced in Finland by Fagerstrom and Rainio in the late 1990s. The validity and feasibility of the different parts of this system have been...
assessed in many clinical studies. Furthermore the RAFAELA system offers a fully ICT-supported and uniform system for all clinical nursing wards, which facilitates a clear communication about nursing care intensity on all management levels throughout the hospital, and even on regional and national levels. Given these purported merits, we investigated the reliability, validity and feasibility of the RAFAELA-system in two university hospitals in the Netherlands, before a final decision could be made on a broad implementation of this system.

**METHODS**

For the proper conduct and description of this study the Standard of Quality Improvement Reporting Excellence (SQUIRE) checklist was used.

**Ethics**

Our local medical ethics review board (Academic Medical Center, Amsterdam, The Netherlands) approved the study but waived the need for written informed consent, as the study had no effect on the patient’s treatment or psychological wellbeing. Furthermore, the authors state they have no conflicts of interest in implementing and evaluating RAFAELA.

**Setting**

Two Dutch university hospitals, each with approximately 700-1000 beds, contributed to the study; the Academic Medical Center (AMC) and the Free University VU Medical Center (VUmc) in Amsterdam. These hospitals were represented by at least five wards of different specialties per hospital (Table 1). Each of these wards had 20-47 operational beds and employed 11-49 Full Time Equivalents (FTE) nurses at both Licensed Vocational Nurse (LVN) and Bachelor Science Nurse (BSN) levels and working 8-hour shifts. Staffing policies in both hospitals did not differentiate between LVN or BSN levels.

**Intervention of interest**

The RAFAELA system consists of three subsystems: 1) the Oulu Patient Classification qualsian (OPCq), 2) a database of available nursing resources, in which one resource unit is equal to eight nursing hours per day, and 3) the Professional Assessment of the Optimal Nursing Care Intensity Level (PAONCIL) tool. The OPCq instrument determines the individual patients’ caring needs (NCI) per 24 hours and is based on nursing experiences and the patient reports documented by the nurses of each contributing ward. The OPCq consists of six subsections, or nursing areas, regarding patient care that are to be scored; 1) planning and coordination of nursing care, 2) breathing, blood circulation and symptoms of disease, 3) nutrition and medication, 4) personal hygiene and secretion, 5) activity, sleep and rest, and 6) teaching, guidance in (follow-up) care and emotional support. Each subsection is scored on a four-point scale; ‘slight’ up to ‘very demanding’ or ‘continuous’. Therefore, the total NCI-score can vary between six and 24 points per patient. To determine an estimate of the optimal NCI/N per ward, the daily NCI/Ns are compared with the average PAONCIL values by means of a regression analysis, which is integrated in the system. The resulting estimate is used to determine the optimal NCI range (i.e., optimum value +/- 15%). Comparing this area with the daily NCI/N provides information about the adequacy of the current nurse staffing level and facilitates solutions for (ad hoc) staff (re-)allocation.

Several conditions must be met to enable calculation of the optimal NCI area; 1) Assessment of the OPCq should be reliable, i.e., the agreement among nurses when scoring NCI measurements by two nurses of the same patient should be at least 70%. 2) The OPCq instrument also includes 12 additional non-patient factors to assess ward processes and aspects that may affect nurses’ workload during a shift, i.e. organizational and planning issues, managerial roles, staff situations, meetings, trainings or other absences, students, collaboration among nursing team members, collaboration with physicians, collaboration with other disciplines, nurses own physical and mental state and other factors.

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### Design

This study contained three parts, based on the three study questions:

1. a reliability study, investigating the agreement among nurses when scoring NCI using the OPCq of the RAFAELA system.
2. a validity study, in which head nurses were to assess whether these NCI scores, together with the nurses’ appreciation of their workload, would result in a realistic NCI/N score as calculated and presented graphically by the RAFAELA system. This would supply them with valuable information regarding staff allocation and benchmarking.
3. a feasibility study (in terms of user-friendliness, applicability and acceptability) of the whole RAFAELA system, as judged by all nurses involved.
Each of these study parts would result in a ‘go’ or ‘no-go’ outcome regarding a hospital-wide implementation of the RAFAELA system. Criteria for a ‘go’ were a 70% agreement regarding the reliability, a ‘realistic’ verdict as to its validity, and 50% of the nurses should appreciate the RAFAELA system as ‘feasible’. Feasibility was justified if the median Likert-score was ≥5 and less than 25% of the scores were below the 25% percentile. Results of the different study parts had no consequences for current ward processes or policies, as this study was a pre-implementation study.

Study conduct

The OPCq and the PAONCIL instruments were translated into Dutch by the researchers based on forward and backward translation. Data collection for the three study parts took place from December 2013 until June 2014. All nurses on the participating wards were to measure their patients’ NCI once per 24-hours, seven days a week, between December 2013 and June 2014. To facilitate the introduction of RAFAELA on the nursing wards, a users’ support team was composed in each hospital. These teams consisted of one ‘super-user’ (a researcher), for conducting the study, and at least two ‘key-users’ (nurses) per participating hospital ward, for teaching and motivating the nursing team involved. All super- and key-users attended three dedicated RAFAELA trainings conducted by an associate of the Finnish supplier of RAFAELA, FCG International Ltd., Helsinki. During a three-month practicing period, nurses gained experience in measuring the nursing care intensity by the OPCq, while members of the support team practiced recording nursing resources.

PART 1: reliability study

After the training period, the NCI of at least 50 patients per ward were scored using the OPCq in the RAFAELA system by two nurses independently. These parallel measurements were taken once per 24-hours during a one-week period. The RAFAELA system provides an absolute measure of agreement between two parallel OPCq measurements in the same patient. Agreement was defined as a difference between the nurses’ scores of less than two NCI points.

PART 2: validity study

Nurses were to score the PAONCIL every shift and the NCI once per 24 hours during a six-week period. Based on these data, the RAFAELA system generates output about the NCI/N for each ward. Subsequently, these management reports regarding the optimum NCI/N would be presented to the head nurses of each contributing ward to assess face validity of the RAFAELA system.

PART 3: feasibility study

Nurses of all contributing wards were asked to evaluate the user-friendliness (functionality), applicability, and the acceptability of RAFAELA by means of a digital questionnaire (SurveyMonkey.com). The questionnaire contained 17 questions, each with a 10-point Likert scale, and 4 open questions about the use of RAFAELA (Appendix). Nurses were given two weeks to complete the questionnaire and received two reminders if needed.

RESULTS

From December 2013 until June 2014, 38,819 and 26,261 OPCq measurements and 1,441 and 405 PAONCIL measurements were performed by 443 nurses, respectively for hospital A and B, totalling 66,926 measurements.

Table 1 Agreement based on the parallel measurements for total nursing care intensity points (NCI) per ward

<table>
<thead>
<tr>
<th>SPECIALTY</th>
<th>HOSPITAL A</th>
<th>HOSPITAL B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Period 1</td>
<td>Period 2</td>
</tr>
<tr>
<td>Neurology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>1</td>
<td>48</td>
</tr>
<tr>
<td>Neurosurgery/orthopedics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastro-Intestinal-surgery/hematology</td>
<td>2</td>
<td>56</td>
</tr>
<tr>
<td>Vascular surgery/Urology</td>
<td>2</td>
<td>X*</td>
</tr>
<tr>
<td>Cardio-thoracic surgery</td>
<td>3</td>
<td>67</td>
</tr>
<tr>
<td>Short-stay surgery</td>
<td>4</td>
<td>69</td>
</tr>
<tr>
<td>Internal medicine</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Pulmonology/Gastro-Intestinal medicine</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Kidney transplantation</td>
<td>5</td>
<td>45</td>
</tr>
<tr>
<td>Cardiology</td>
<td>6</td>
<td>41</td>
</tr>
<tr>
<td>Pediatrics &gt;1-10 years</td>
<td>7</td>
<td>60</td>
</tr>
</tbody>
</table>

*not able to participate in the parallel period; **performed less than 50 parallel measurements; ***To continue the consensus proportion was set at 60%; X = no data
PART 1: reliability study
Agreement for the OPCq measurements ranged from 40% to 67% for hospital A and 50% to 69% for hospital B. Given these low agreement results, it was decided to allow a second measurement after another one-month training and motivation period of the nurses involved, and accepting an agreement of at least 60%. This resulted in agreements between 59% and 91% for hospital A, and between 38% and 76% for hospital B (Table 1). The number of performed measurements increased by 20% (Figure 1). A total of 8 wards scored a sufficient agreement to continue on to part 2: In hospital A five out of seven, in hospital B three wards out of the five passed.

PART 2: validity study
Only the nurses on the neurology/neurosurgery ward in hospital A performed enough PAONCIL measurements (77%; Figure 2) to calculate an optimal NCI area for their ward (Figure 3). The variance explained by the regression model was 29.4%. The head nurse involved judged the output to be valid and valuable for staff planning and benchmarking.

PART 3: feasibility study
Response rate of the questionnaire was 30%. Median scores for each question varied between 4 and 8, while 23.4% of the scores were below the 25th percentile (Table 2), for the questions (Q) 9 to 17, respectively (Appendix 1). The respondents perceived the OPCq as a suitable instrument to measure all aspects of the nursing care intensity (Table 2; Q9; 10% <25th percentile). However, the OPCq was not perceived as a correct reflection of the nursing care intensity (Table 2; Q10; 20% <25 percentile). The respondents were positive about the usability of RAFAELA (Table 2; Q13 & Q15; 7% and 15% <25th percentile), but did not see RAFAELA as an improvement (Table 2; Q16 & Q17; 30% and 34% <25th percentile). The respondents were positive about the usability of RAFAELA (Table 2; Q13 & Q15; 7% and 15% <25th percentile), but did not see RAFAELA as an improvement (Table 2; Q16 & Q17; 30% and 34% <25th percentile). In the open questions about half of the respondents was positive and appreciated the benefits of RAFAELA on the operational level, i.e. (ad hoc) allocation of nursing resources and nurse-patient assignment.

Sensitivity analysis (i.e. by selecting subgroups of nurses based on their role on the ward) of these data showed that only team leaders and members of the support team were able to appreciate some of the benefits of RAFAELA for the tactical and strategic levels, i.e. evaluating nurse staffing levels and benchmarking. Difficulties the respondents experienced with RAFAELA were: the nursing areas in the OPCq were considered too abstract and a checklist with patient acuity items was preferred, there was no confidence in the 24-hour measurement as nurses felt the previous patient reports were not sufficient, and the benefit of an uniform measure was not clear for nurses on an operational level.
DISCUSSION

This study examined the reliability, face validity and feasibility of the RAFAELA system in two Dutch hospitals to decide upon its implementation. In the first place, the OPCq instrument to measure NCI was found reliable for a subset of 8 out of 12 wards; second, the calculated optimal NCI area was found to be valid for only 1 out of 8 wards; and third, the questionnaire showed a small majority of the respondents was positive about the applicability and user-friendliness of RAFAELA.

These results suggest that the Dutch version of RAFAELA provides valid information, but the present circumstances are not ready for implementation of the system. The agreement between NCI-scores remained insufficient for some wards, even after a second training period. This is commensurate with the results from other investigators in Norway who also experienced the need for continuous verification, quality assurance and training in using the system to guarantee a reliable NCI. Nurses found it difficult to reflect on the care they gave. They appeared to score care complexity rather than care intensity, e.g. they scored highly what they thought was beyond their routine and complex work to perform instead of assessing patients' caring needs as 'slight', 'very demanding' or 'continuously'. This resulted in an erroneous estimation of the NCI and low scores for the OPCq’s ability to reflect the nursing care intensity.

Most of the wards did not perform enough PAONCIL measurements to calculate an optimal NCI area. We anticipated nurses to be enthusiastic about assessing their NCI and give additional information about their ward-related workload.
However, despite repeated extensive trainings and motivation sessions, the number of performed PAONCIL measurements remained low, which appeared to be a sign of the lack of acceptance of the RAFAELA system as found in the questionnaire. Nurses preferred a ward-specific checklist to measure NCI rather than a tool that triggers nurses to assess the real patient needs and to reflect on the given quality of nursing care. Furthermore, insufficient nursing documentation seemed a reason for nurses to dismiss a reliable and valid workforce planning tool (if correctly used). Nurses experiencing high workload and those working on wards with relatively few BSN-trained nurses, appeared to have a narrow vision of high quality of patient care. They prefer direct patient-related nursing tasks. Moreover, these nurses tended to have limited sense of professionalism i.e. they were very inwardly focused and felt administrative tasks to control quality of care and innovation projects keep them away from their patients. Even if nurses believed a workforce planning tool can change their working conditions, testing RAFAELA in its full extent was seen as an addition to the administrative burden by nurses in the hospitals under study. However, because in the Netherlands the majority of the nursing working population is trained as LVN, nursing workload will probably remain high due to increasing demand for care and limited healthcare budgets. Hence, it is not likely that nurses will increase their professionalism and broaden their scope on quality on patient care without help. As nurses play a crucial role in delivering high quality patient care, nurses should be facilitated and motivated to achieve a high professional standard, for instance by showing more leadership, selective employment of BSN-trained nurses, and providing opportunities and time to develop skills for interdisciplinary collaboration, innovation, clinical reasoning, evidence-based practice and leadership.

Nurses in this study apparently did not clearly see the benefits of the RAFAELA system; improving person centered care for patients, improving workforce planning, and improving patient and personnel care. Previous studies have shown that this is likely caused by the length of the implementation process for RAFAELA, competitive implementations or organizational changes affecting nurses work, and support by organizational leaders. The implementation duration and competitive implementations are therefore limitations of our study. Time to perform this pre-implementation study was indeed limited due to other simultaneous implementation processes, but this seems to be a continuous hazard. It is also likely that nurses with less sense of professionalism could not appreciate the benefits because of lacking skills, which would be a smaller problem in more professionally functioning environments. Furthermore, our implementation strategy was predominantly focused on education and motivation of the professionals, in retrospect we should have focused more on the social context, e.g. team functioning.

CONCLUSION AND IMPLICATIONS FOR NURSING MANAGEMENT

The RAFAELA system has its merits as a tool to appreciate nursing care intensity and to plan workforce, as was experienced in Scandinavian countries, but creating readiness and the right conditions for its acceptance and implementation is not simple. For this purpose hospital managers should consider an extensive implementation process with emphasis on the individual (e.g. education and motivation strategies) and the social context (e.g. strategies to enhance team functioning, professional development and leadership). Furthermore, nursing managers should discuss how they can move from a basic functional model to a professional functional model for their nurses.

COMPETING INTEREST

The authors declare that they have no competing interests.

ACKNOWLEDGEMENTS

We thank the many nurses for their effort to record care intensity and to fill out the questionnaire. We are also grateful to the team that advised and facilitated data collection on the wards. Furthermore, we want to thank the nursing directors from the participating hospitals and the local advisory boards for their expert knowledge and critical reflection.
REFERENCES


11. Fagerström L. The Patients caring Needs to Understand and Measure the Unmeasurable. 1999. Åbo Akademi University, Finland.


13. Frilund M. A Synthesizer of Caritative Ethics and Nursing Intensity. 2013. Åbo Akademi, University, Turku, Finland.


**APPENDIX QUESTIONNAIRE**

### EVALUATION USER-FRIENDLINESS, APPLICABILITY AND ACCEPTABILITY OF RAFAELA

**Questions**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In which hospital do you work?</td>
<td>A /B</td>
</tr>
<tr>
<td>2. On which nursing ward do you work?</td>
<td>1 to 7 (A)/ 1 to 5 (B)</td>
</tr>
<tr>
<td>3. What is your role on the ward?</td>
<td>student/ junior nurse/ nurse/ senior nurse/ head nurse/ key-user</td>
</tr>
<tr>
<td>4. What is your gender?</td>
<td>male/ female</td>
</tr>
<tr>
<td>5. What is your age?</td>
<td>open</td>
</tr>
<tr>
<td>6. What is your highest education?</td>
<td>LVN/ BSN/ Post Bachelor/ Master</td>
</tr>
<tr>
<td>7. What is your work experience after graduation in years?</td>
<td>open</td>
</tr>
<tr>
<td>8. On my ward a nursing care intensity measure was already used?</td>
<td>yes/ no</td>
</tr>
</tbody>
</table>

**Applicability**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer options</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. The 6 nursing care areas of the OPCq correspond with my clinical view of the patient</td>
<td>10-point Likert scale</td>
</tr>
<tr>
<td>10. The OPCq score is a correct reflection of the nursing care intensity</td>
<td>10-point Likert scale</td>
</tr>
<tr>
<td>11. The OPCq score is suitable to balance the nursing care intensity on the ward</td>
<td>10-point Likert scale</td>
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**User-friendliness**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer options</th>
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</thead>
<tbody>
<tr>
<td>12. The start screen for RAFAELA is easy accessible</td>
<td>10-point Likert scale</td>
</tr>
<tr>
<td>13. The explanation in the RAFAELA-system provides enough information about the usage of the OPCq and PAONCIL</td>
<td>10-point Likert scale</td>
</tr>
<tr>
<td>14. The language used in the explanation in the RAFAELA-system is clear</td>
<td>10-point Likert scale</td>
</tr>
<tr>
<td>15. It takes little time to measure the nursing care intensity by RAFAELA</td>
<td>10-point Likert scale</td>
</tr>
</tbody>
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**Acceptability**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer options</th>
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</thead>
<tbody>
<tr>
<td>16. RAFAELA is an improvement compared to the previous situation</td>
<td>10-point Likert scale</td>
</tr>
<tr>
<td>17. I would like to continue working with RAFAELA</td>
<td>10-point Likert scale</td>
</tr>
<tr>
<td>18. What are my perceived benefits of RAFAELA?</td>
<td>open</td>
</tr>
<tr>
<td>19. What are my perceived disadvantages of RAFAELA?</td>
<td>open</td>
</tr>
<tr>
<td>20. What profit is there to be gained with RAFAELA?</td>
<td>open</td>
</tr>
</tbody>
</table>

LVN = Licensed Vocational Nurse; BSN = Bachelor of Science in Nurse; OPCq = Oulu Patient Classification Qualisan; PAONCIL = Professional Assessment of the Optimal Nursing Care Intensity Level