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Assessment for improving the performance of NICUs: The Italian experience

This is a pre print version of the following article:

*Original*

Assessment for improving the performance of NICUs: The Italian experience / Fanelli, Simone; Zangrandi, Antonello. - In: HEALTH SERVICES MANAGEMENT RESEARCH. - ISSN 0951-4848. - 30:3(2017), pp. 168-178. [10.1177/0951484817710856]

*Availability:*

This version is available at: 11381/2831591 since: 2021-11-17T10:51:19Z

*Publisher:*

SAGE Publications Ltd

*Published*

DOI:10.1177/0951484817710856

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(Article begins on next page)

11 June 2023

## **Assessment for improving the performance of NICUs: the Italian experience**

### **Abstract**

This paper describes Neonatal Intensive Care Units (NICU) in Italy using a set of organizational variables identifying management profile. The correlations between variables, and how these are impacted by structural aspects of the department or hospital, are investigated. The research was conducted within the five-year far-reaching and complex SONAR study run by the Italian Neonatal Network, which maps NICU, monitors outcomes of member centres, defines organizational models and identifies best practices to improve care quality. Seven variables relating to activities, organization processes and behaviour models used in the SONAR study were used here to assess NICU. Data from 54 Italian NICUs, 1601 nursing staff and 643 doctors were used. We identified high levels of variation in NICUs for all aspects of organization. We also identified important opportunities for improvement, especially in the areas of performance measurement, quality improvement and learning for healthcare staff. In terms of structural characteristics, we identified big differences between NICUs in the north and south of Italy.

The findings provide a description of NICUs in Italy and identify a set of variables useful for management in assessing NICU, which are among the most complex and costly operational units in a hospital.

### **Keywords**

NICU, assessment model, healthcare management, performance improvement

## Assessment for improving the performance of NICUs: the Italian experience

### Introduction

#### *Neonatal Intensive Care Units (NICUs)*

The Neonatal Intensive Care Unit (NICU) is one of the most complex and expensive areas in a hospital, because of patients' age, conditions and incidence.<sup>1</sup> In fact, all neonates are vulnerable, but preterm babies are particularly weak: they comprise infants with birth weights of 401 to 1500 grams or gestational ages between 22 weeks 0 days and 29 weeks 6 days, and are also termed Very Low Birth Weight (VLBW). Every year about 15 million babies are born prematurely, or 1% of all babies born all around the world. In addition, neonate deaths (within first month of life) account for 40% of all deaths among children under 5 years old. Prematurity is the world's single biggest cause of neonate death, and the second leading cause of all child deaths, after pneumonia. Many preterm babies who survive face a lifetime of disability.<sup>2</sup>

Preterm births are not exclusively located in developing countries; prematurity is a world-wide criticality, although it has different incidence over the countries. For all these reasons, healthcare management around the world needs to be able to assess NICU strategically for monitoring and developing models to improve performance in terms of efficiency and efficacy.

#### *An assessment experience*

Perhaps more than others, this critical service urgently needs to improve quality and safety, to reduce costs, and to avoid adverse events. Overall, many hospitals are searching for ways to improve quality of care and promote effective quality improvement strategies. Several scholars have investigated the critical factors to support high-quality care and successful quality improvement programs in hospitals. Meyer et al.<sup>3</sup> identify specific internal factors and external pressures that drive quality. They classify internal factors into four categories: developing the right culture for quality to flourish; attracting and retaining the right people; devising and updating the right in-house processes for quality improvement and giving staff the right tools

to do the job. External influences can be local market competition and public or private health quality initiatives and standards. Secanell et al.<sup>4</sup> define seven ways to improve quality and safety in hospitals: align organisational processes with external pressure; put quality high on the agenda; implement a supportive organisation-wide system for quality improvement; assure responsibilities and team expertise at department level; organise care pathways based on evidence of quality and safety interventions; implement pathway-oriented information system; conduct regular assessment and provide feedback. Øvretveit<sup>5</sup> states that best strategies to ensure quality in hospitals are based on: systematic performance and results reviews, increasing resources, reorganizations, strengthening management, standards and guideline formulation and implementation, patient empowerment and rights, quality management system, quality assessment and accreditation (internal or external), total quality management and continuous quality improvement, quality collaborative, re-engineering, quality indicator comparison, benchmarking, risk management and safety strategies, and national quality strategies.

The existing literature on quality improvement strategies is thus unanimous on the necessity to define complex systems and tools to promote and assess quality at the level of both hospital and single unit. In particular, neonatal intensive care is a very complex and multidimensional activity, and the measurement of its quality should reflect this fact.<sup>6</sup> However, focusing on the single unit such as NICU, the literature presents many examples of assessment systems but most paper focus on a single item; e.g. management of a specific disease,<sup>7</sup> cost of resources,<sup>8</sup> relationships between staffing and outcomes,<sup>1</sup> patient and staff satisfaction.<sup>9</sup>

There is a clear need for research evaluating more than one item in order to assess possible correlations.

#### *An assessment model*

NICUs can be assessed in terms of their organizational and clinical features. We start from the WHO study by Øvretveit<sup>5</sup> to develop a model to assess NICU. We define an assessment model made up of seven variables. Many authors consider the approach described in the WHO study as a positive example for the

definition of strategies for quality improvement.<sup>10-13</sup> However, the literature agrees that this approach needs to be adapted to the specific context.<sup>14-16</sup>

According to the WHO study by Øvretveit,<sup>5</sup> different strategies are possible to ensure quality and safety in a hospital. The items can be grouped in the following areas:

*Area A. Performance and results review.* Performance and results can be evaluated through indicators and data regarding activity volumes, outcomes, incident reporting, infection rates, sentinel events, claims, etc. Every performance assessment system requires quantitative tools so that qualitative aspects can be assessed scientifically.<sup>17,18</sup>

*Area B. Benchmarking.* A great number of research studies on healthcare services and performance are based on comparison between different organizations or different Countries/Regions. Other studies aim at describing successful experience or best practice. Information and data describing a method or strategy to turn “inefficiency” into “efficiency” contributes to building a benchmark.<sup>19,20</sup>

*Area C. Leadership.* Many research studies highlight the importance of leadership in managing healthcare organizations, or part of them. An interesting study indicates four benefits in quality and efficiency resulting from leadership development programs:<sup>21</sup> 1) Increasing the calibre of the workforce; 2) Enhancing efficiency in education and development activities of the organization; 3) Reducing turnover and related expenses; 4) Focusing organizational attention on specific strategic priorities. Programs however can only be considered effective if they involve all professional categories.<sup>22</sup>

*Area D. Clinical guidelines, protocols and procedures.* In every organization (healthcare or other), managers and leaders use guidelines, protocols and procedures in order to reduce variability and increase coordination between behaviours. These are not the only tools, but they are the ones most widely used.<sup>23</sup> In healthcare organizations, head physicians and head nurses often refer to guidelines and protocols to drive clinical and nursing behaviours and to ensure that activities are addressed by scientific evidence and best practice. Managers, on the other hand, tend to define organizational procedures in order to coordinate

actions (e.g. filling in patient charts, transferring a patient from one ward to another), to prevent errors (i.e. using checklists before surgery), to collect significant data (e.g. rules on collecting data and information for performance indicators).

*Area E. Patient and staff satisfaction.* Satisfaction is another key measure of good performance in an organization. **Managers and leaders need to ensure the good opinion of patients and job satisfaction of staff.**

In NICUs nurses are the professionals most involved in patient care; because of the highly specialized nature of this type of nursing, NICU nurses can experience high levels of psychological and physical stress.

**Burnout is a response to workplace stress that results in emotional and mental exhaustion, depersonalization, and decreased sense of personal accomplishment. Job satisfaction, emotional support, and self-care are important components for preventing burnout in staff.**

As regards patient satisfaction, NICUs are an unusual case as the opinion on the quality of services is usually expressed by the patient's parents. Literature reports some examples of strategies that can lead to a good levels of parent satisfaction:

1) Implementation of strategies helping parents recognize and understand infant cues and gain confidence in everyday routines such as diapering, feeding, general caregiving, and taking the baby out of the home for the first time;<sup>24</sup> 2) Moving patients to single-bed rooms;<sup>25</sup> 3) **Telephone support and communication to expectant mothers during pregnancy and the first six weeks postpartum.**<sup>26</sup>

A complete NICU assessment model needs to cover all or most of the above areas.

This study aims to assess NICUs in Italy on the basis of a set of organizational variables characterizing the management profile. The variables identified have been used in neonate research and are linked to areas A-E of the assessment model described above. Correlations between these variables were also identified and assessed. It was also investigated whether these variables are impacted by structural aspects of the department or hospital, geographical location, size of the NICU, endowment of nursing and medical staff. The findings give a description of NICUs in Italy and provide a set of variables useful for management in **assessing** NICU and improving quality of care.

### **SONAR study: monitoring to improve the quality of care**

The issue of data collection in healthcare in general, and hence in newborn care, is closely linked to quality interpreted as a continuous process of improvement in care delivery. It is basic to any discussion of clinical governance.<sup>27</sup>

Over time, diversity in the delivery of newborn healthcare, revealed by the variations in outcome indicators used,<sup>28</sup> has led to the creation of national and international organizations promoting data collection and identifying and disseminating best practices. In Italy, the Italian Neonatal Network (INN) comprises 93 NICU and aims to improve the quality of care and safety in neonate care through coordinated programmes of research, training and quality improvement projects. Since 2004, INN has been a member of the Vermont-Oxford Network (VON), the largest monitoring network of VLBW new-borns, which includes almost 1,000 centres throughout the world (<https://public.vtoxford.org/>). In 2009 the INN set up the five year study “Studio Osservazionale in Neonatologia: Assistenza e CuRe” (Observational Study in Neonatology; Assistance and Care (SONAR). SONAR groups 63 NICUs which take part on a voluntary basis. The study aims to describe the characteristics of NICUs, monitor outcomes of member centres, and identify best practices with the overall aim of improving care.

The present study uses data from 54 NICU taking part in SONAR; but only data from those centres presenting full and complete data for the variables of interest.

### **Method**

#### *Data collection*

SONAR involves healthcare professionals (physicians and nursing staff) working in intensive newborn care, and with high-risk newborns and their parents. Healthcare professionals (physicians and nurses) were asked to complete a questionnaire about the activities of the department, respondent characteristics and operative and management models of the NICU. The questionnaire was drawn up by the Steering

Committee of SONAR on the basis of meetings with healthcare professionals and a review of international literature. The survey focused on specific issues regarding NICU organization and management (e.g. Nurse Parent Support Tool,<sup>29</sup> Practice Environment Scale – Nursing Work Index (PES-NWI),<sup>30</sup> etc.). The questionnaires were also piloted at several centres taking part in the study and validated by the Steering Committee and the Advisory Board of SONAR. These bodies are responsible for the scientific coordination of SONAR and comprise professionals from various fields in clinical practice, organization and management of neonatology. The questionnaires were distributed in written form from March 2010 and the response period was 12 months. This study used only those responses relating to the NICU as Operational Unit (OU), nursing staff and medical staff.

The description of each Operational Unit was drawn up at the end of the study by the Local SONAR coordinator who belongs to the medical team of the unit. It shows information about the NICU and its activities in 2010.

Nursing and medical staff who consented to take part in the study and who had worked at the NICU for at least three months completed the questionnaire once. Their responses show the professional profiles, the atmosphere in medical organization and the working environment for nursing staff.

Any new staff joining the NICU were permitted to take part only after three months' service. All respondents were guaranteed complete anonymity and all responses were processed anonymously.

#### *Variables*

The questionnaire used seven variables identifying **organizational and managerial aspects** of NICU which were useful for the present research. Each variable is linked to an aspect of the Operational Unit (activities, organizational processes and behaviour models) linked to one of the areas in the assessment model described in Øvretveit's WHO study.<sup>5</sup> These variables can be used by management to **assess** NICUs.

- *Variable No. 1 (V1): Level of complexity of Operational Unit*



Variable 1 (V1) measures the level of complexity of cases dealt with in the OU. The OU profile showed the number of DRG (Diagnosis Related Groups) occurring in the NICU in 2010. The following DRG were selected for our purposes: No. 386 (extremely premature newborns or newborns with respiratory distress syndrome); No. 387 (premature newborns with serious disorders); No. 388 (premature newborns without serious disorders); No. 389 (full term newborns with serious disorders); No. 390 (newborns with other significant disorders).

On the basis each DRG and its weighting, expressing the complexity of the DRG as defined by the Italian Health Ministry, a Case Mix Index (CMI) was calculated for each NICU. DRG requiring more complex treatment are weighted more heavily, so NICU with a high value of V1 deal with more complex cases on average, and those with a lower value deal with less serious cases.

Case mix, care quality and random chance are the three main components leading to variability in outcomes in neonatology.<sup>31</sup> Case mix is thus an indicator of volume of activity and reflects on Area A (Performance and results review).

- *Variable No.2 (V2): Level of collaboration formalized*

Variable No.2 (V2) measures the degree of cooperation between healthcare professionals. The Physician profile shows the monthly frequency of meetings of the OU team on the following topics: discussion of clinical cases treated, organizational aspects, updating. The indicator was constructed for each NICU by multiplying the frequency of the three types of meeting together. A higher value for V2 indicates a higher degree of professional collaboration and probably indicates an internal model oriented towards teamwork.<sup>32</sup> Moreover, collaboration between nurses and physicians is linked to positive outcomes for patients, especially in the intensive care unit.<sup>33</sup> V2 is thus related to Area C (Leadership).

- *Variable No.3 (V3): Method of performance measurement*

The Physician profile also showed the method used to assess quality performance in the OU. Respondents were asked to rate on a scale from 1 to 5 a series of statements describing their unit.

Two extremes can be noted: a system in which the quality assessment is robust and systematic and, at the other extreme, an elementary system of assessment. Robust systems base evaluation on quality indicators by external parties or meetings between colleagues to discuss clinical cases.<sup>34,35</sup> In these organisations, there is an underlying organizational planning of quality system; in other words the NICU is able to establish assessment criteria that will systematically implement improvements in both clinical and organizational processes.<sup>36</sup> At the other extreme, assessment systems are not well-defined and information about quality performance is provided sporadically, or each professional analyses information independently, without discussion with colleagues.<sup>37,38</sup> In these organizations, there is a non-structured evaluation system, and evaluation is perhaps delegated to individual professionals, and in any case, criteria defined by formal organizational processes are lacking.

At the two extremes the approach to quality is very different: a) there is a clear organizational program to manage and evaluate performance in the NICU (with the quality program oriented to outcomes or to welfare and organizational processes); b) the organization has no programs in place and any quality improvement projects are identified and managed independently by individual professionals.

The statements are shown in Table 1 in the order in which they were presented, along with the score for each one.

[Table 1 here]

The value of V3 for each NICU is the average of scores given by its medical staff, and varies between 1 and 5. A high value shows greater use of measurement and evaluation of results.<sup>39</sup> The use of performance measurement systems is a necessary condition for benchmarking. V3 is therefore linked to Area B (Benchmarking).

- *Variable No.4 (V4): Motivation of physicians*

The questionnaire asked physicians to measure their own motivation on a four-point Likert scale as follows: 1 high, 2 average, 3 low, 4 very low. V4 is therefore the average level of motivation for the medical staff

of each NICU. The OU with an average score near to 1 have personnel more highly motivated than those with a score near to 4. Motivation is essential for user satisfaction, productivity, organizational performance and well-performing for hospital staff.<sup>40</sup> Low levels of motivation on the other hand lead to higher turnover among health care providers and reduce the quality of service and organizational commitment.<sup>41,42</sup> V4 is therefore linked to Area E (Patient and staff satisfaction).

- *Variable No.5 (V5): Motivation of nursing staff*

The questionnaire for nursing staff included the Practice Environment Scale of the Nursing Work Index (PES-NWI) drawn up by Lake.<sup>30</sup> PES-NWI is a tool for measuring the working environment and has a high degree of validity and reliability. The questionnaire comprised 31 questions with responses made on a four point Likert scale (1 complete disagreement; 4 maximum agreement). The PES-NWI for each NICU is the average of evaluations of its nursing staff. PES-NWI values near 4 show higher quality of work environment while values near 1 indicate low levels of motivation among nursing staff.<sup>43</sup> PES-NWI is thus used to proxy motivation of nursing staff and is linked to Area E (Patient and staff satisfaction).

- *Variable No.6 (V6): Opportunities for learning*

Within PES-NWI several items are particularly useful in revealing organizational behaviour in important aspects of the OU. V6 measures orientation towards profession, intended as opportunities for nurses to develop skills and knowledge within the OU. Three items were selected: “Active in-service/continuing education programs for nurses”; “There is enough time and opportunity to discuss patient care problems with other nurses”; “Staff nurses have the opportunity to serve on hospital and nursing department committees”. V6 was constructed in the same way as V5. Policy to help learning (skills, knowledge and abilities) is crucial for hospitals to be able to respond to ongoing changes in demographics, epidemiology and technology.<sup>44</sup> V6 therefore reflects organization and development of professional skills and is part of Area C (Leadership).

- *Variable No.7 (V7): Orientation to quality*

A second group of items within PES-NWI constitute an indicator of the level of quality in the OU. These are: “There is an active quality assurance program”; “Staff nurses are involved in the internal governance of the hospital”; “There are written and up-to-date nursing care plans for all patients”. V7 was constructed in the same way as V5. NICU with a value of V7 near to 4 therefore show greater interest in research and quality than those with a value near 1. It is recognized that quality planning, written procedures and shared governance help higher quality levels in hospital performance.<sup>45,46</sup> V7 can thus be considered to be part of Area D (Clinical guidelines, protocols and procedure).

#### *Statistical analysis*

Data from the questionnaire was processed using IBM SPSS Statistics V21.0. Correlations were analysed using the Pearson index and a threshold level of significance of 10% (p-value:  $\alpha < 0.10$ ). Given the small size of our sample ( $N = 54$ ), correlations between variables can be considered statistically significant when  $\alpha$  lies between 5% and 10%.<sup>47</sup> We used the categorization proposed by Dancey and Reidy<sup>48</sup> to classify the strength of the correlation: “weak” with a Pearson index between 0.1 and 0.3, “moderate” between 0.4 and 0.6 and “strong” between 0.7 and 0.9.

In order to better interpret the variables and gain a fuller description of the NICU, correlations with other key elements of the OU were also analysed. These were structural aspects: a) Size (number of beds available, b) Geographical location (north or south of Italy), c) HR endowment (number of physicians and nurses per bed).

Lastly, in order to identify statistically significant differences between averages in groups formed by the dichotomous variable geographical location (north or south of Italy) a T-test was run and the hypothesis of homogeneity in variance between groups was verified with the Levene test ( $\alpha > 5\%$ ).

## **Results**

### *The sample*

The 54 NICU analysed make up 58% of NICU belonging to INN, or 45% of all such OU existing in Italy (population: 120<sup>1</sup>). Across Italy, OU treating VLBW newborns vary a great deal in size, and can be extremely small. However, the NICU belonging to INN cared for about 90% of newborns nationally and the OU in the SONAR study about 72% of pre-term newborns in the two years 2010-11. The majority of NICU making up the sample are located in the north (33) (61.11%), and the remaining 21 (38.89%) are in the south of Italy.

In terms of the number of beds, the NICU in the sample have an average of 17.31 (median: 16), and range from a minimum of 4 to a maximum of 50 (SD: 9.2). Lastly, the endowment of personnel is on average 40.17 staff (physicians and nurses) for each NICU, median 38, and ranges from a minimum of 12 to a maximum of 88 (SD: 15). On average, there are 0.60 physicians and 1.38 nurses per bed, with SD respectively of 0.42 and 1.08.

These figures show that Italian NICU operate in widely differing organizational contexts.

For the 54 NICU in the sample, a total of 1601 questionnaires were analysed from nurses, and a total of 643 from physicians.

#### *Description of analysis variables*

Table 2 reports the main descriptive statistics (mean, median, standard deviation (SD), minimum and maximum) for the seven variables used in the analysis.

[Table 2 here]

We now discuss each variable:

*VI*: On average, cases treated by an NICU have a level of complexity of 2.647. The minimum (0.897) and maximum (6.999) figures however show that some OUs on average treat many more complex cases than others. The standard deviation (SD) in fact is 1.259.

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<sup>1</sup> Source: [http://www.salute.gov.it/portale/documentazione/p6\\_2\\_8\\_1\\_1.jsp?lingua=italiano&id=6](http://www.salute.gov.it/portale/documentazione/p6_2_8_1_1.jsp?lingua=italiano&id=6)

V2: The indicator of the degree of collaboration has an average value of 7.405, but there is great variation (SD: 5.32). The type of meetings impact on the index in descending order: Meetings on clinical cases (average frequency: 5.63), meetings on organizational matters (0.94), updating (0.82).

V3: Performance evaluation systems are clearly underdeveloped. The average and median values for the sample are lower than the average of the scale used (3). The value is higher than 3 in only 14.81% of the OUs.

V4: Physicians working in NICU are on average satisfied (1.90) although this level cannot be considered satisfactory. In fact, in 44.4% of cases the level of physician satisfaction lies between 2 (average) and 3 (low).

V5: Motivation is not sufficiently high for nursing staff either. Both the mean average and the median values are slightly below the average level (2.5) on the Likert scale used to measure motivation, and it is higher in only 35.18% of cases.

V6: Learning opportunities for nursing staff show a more positive result. The mean is 2.47 and the average threshold is exceeded in about 52% of cases (SD: 0.36).

V7: Lastly, the variable measuring OU internal quality shows an average value which gives some cause for concern (2.379). About 60% of NICU have an average score under 2.5 and only one NICU has a score higher than 3.

In general, the variables show that NICU vary widely in all aspects of organization investigated (See the last three lines of Table 2). There is clearly a great deal of room for improvement, especially in the areas indicated by V3, V5 and V7.

#### *Correlations between variables*

The correlations between the seven variables were identified, quantified and evaluated. Table 3 shows the correlation matrix, and the statistically significant correlations ( $*\alpha < 10\%$ ;  $**\alpha < 5\%$ ) are highlighted.

[Table 3 here]

The first important observation is that there is no link between V1 and the other variables. The complexity of clinical cases does not impact on the organization; in other words it does not entail professional collaboration (V2), it does not entail performance measurement systems (V3), it does not affect job motivation levels (V4; V5) and does not lead to learning and quality processes in the OU (V6; V7).

More robust performance measurement tools (V3), on the other hand, raise levels of motivation among both physicians and nursing staff, and promote learning and quality processes. V3 is the factor which proves to be most closely linked to the other variables.

High levels of professional collaboration (V2) impacts positively on physician motivation, but not on motivation among nurses. This finding is consistent with previous literature; collaboration between physicians and nurses gives more satisfaction to physicians than to nurses.<sup>49</sup> But even though it is weak, the correlation between motivation in the two professional categories indicates that when one category is satisfied, so is the other.

Lastly, the closest correlations are found between the last three variables. This is predictable, given that the construction of V7 and V8 involves items that are also used to construct V6. It is however interesting to note that quality orientation of the OU impacts more on nursing motivation than do learning opportunities.

#### *Correlations with “structural” elements*

Lastly, correlations between variables and structural characteristics of geographical location, size of the OU and endowment of staff per bed were investigated.

No correlation with variables was found for size of the NICU (number of beds), and no significant correlations were found with the endowment of staff (number of physicians, nurses and other healthcare staff). Size does not therefore impact on the other variables.

There was however a weak correlation between the number of physicians and nursing staff per bed with V1 and with V4. NICU dealing with more serious cases on average show a higher number of physicians (Pearson coefficient: 0.263) and nurses (0.265) per bed. NICU have more highly motivated physicians

where they have a higher number of physicians (-0.259) and nurses (-0.273) per bed; but further statistical analysis shows that this is true only for the NICU in north of Italy (-0.294).

There are however clearer correlations between geographical location and the seven variables.

Table 4 shows that hospitals in the north have higher values for almost all variables than hospitals in the south (\* $\alpha < 10\%$ ; \*\* $\alpha < 5\%$ ).

[Table 4 here]

NICU in northern Italian hospitals thus show more structured performance evaluation systems (V3), more highly motivated physicians and nursing staff (V4; V5), greater learning opportunities for nursing staff (V6) and a higher orientation to quality (V7). The two variables for complexity of cases treated (V1) and levels of collaboration formalised (V2) do not on the other hand reflect geographical location.

There are also big differences between NICU in the north and south in terms of the endowment of staff per bed. NICU in the south show a higher on average number of healthcare staff per bed (+19.1% physicians; +7.4% nursing staff). No differences were found regarding size or number of beds between NICU in the north and south.

### **Discussion and implications for management**

This paper describes NICU in Italy using an assessment model consisting of a set of organizational and management variables. The findings have several important implications for three categories of management. The first category are hospital management (CEOs) responsible for allocation of resources (staff, investments, incentives, etc.), which impact on all departments including NICU. CEO and their assistants in fact specify organizational policy for all clinicians and other hospital personnel. The second category are senior physicians who are NICU team leaders and are in charge of NICU organization. These people have important influence on staff management, staff motivation and often decide on the level of care. The last category of management for whom our findings are of interest are regional health system



managers responsible for resource allocation and assessment, as well as overall policy such as deciding on the number of NICU in an area and the number of beds, etc.

Four of our findings are extremely important. The first is that the complexity of cases, which is determined by the need for services, does not affect organizational processes. The second is that human resource policies are not linked to NICU size. The third is that performance assessment is a critical variable for change. The fourth finding is that there are differences in organizational models between the north and south of Italy, which means that change is necessary.

Regarding the first finding, each NICU has its own organizational characteristics, which may be strongly differentiated, and are consolidated over time. Each NICU has its own “history”, which determines a specific organizational system and is not linked to the characteristics of services delivered. Size and case-mix of the NICU do not in fact impact on the organizational variables we examined. So for management, the implication is that supply and demand for services does not directly impact on organizational variables. And the complexity of cases, which is linked to the hospital user base rather than the organizational variables, allows for hospital management and clinicians to make different organizational choices. Each NICU organizes in a way that reflects its history as well as the strategic vision of management and senior clinicians.

In terms of human resource policies, NICU personnel endowment is not currently directly linked to size or activities. Differences in staff levels need to be taken into account in improving resource allocation. Specific local factors such as personnel allocation problems or lack of specialist ability among personnel can influence the allocation of staff to NICU, but comparison with staff in other neonatology departments could be useful in drawing up policy for lowering costs without compromising quality. In other words, management can use benchmarking for better allocation of staff to NICU, and to justify it to clinical professionals. There appears to be room for maneuver for management and clinicians to intervene in specifying staffing levels and competencies. In terms of personnel allocation policy, the use of comparison

data for care and services delivered is a key element of assessment for management. In Italy, allocation of personnel is the responsibility of the 21 regional authorities and the hospitals themselves. Regional authorities could use the accreditation system and hospitals could use personnel requirement plans for purposes of comparison in order to improve the way personnel and their skills are employed.

The third finding is that quality performance is a key element of organizational processes. Performance assessment is linked to important organizational variables such as physician and nurse motivation and organizational learning. Assessment is thus a key tool for management and senior clinicians, and the following actions are all ways of introducing or strengthening performance systems. Performance evaluation systems themselves need to be of high quality, staff need to focus on quality through organizational systems, and formal evaluation systems involving the team as a whole need to be planned. Hospital management in short needs to set up systems of performance quality evaluation on both processes and outcomes, working in a systematic and continuous manner, and it needs to orient all professionals towards quality improvement in various ways including assessment by third parties. Senior clinicians should encourage systematic assessment of group performance within NICU, involving professionals in evaluation of clinical processes and outcomes, and identifying objectives for future improvement. This should raise motivation among health professionals and increase levels of collaboration between professionals.

Lastly, the differences between NICU over Italy is a particularly important point. The differences concern nearly all variables in performance measuring systems, clinical and nursing staff motivation, nurse learning and orientation to quality. The only variables which do not show geographical difference are those relating to complexity of cases treated and formal levels of collaboration. But the complexity of cases treated depends on the demand, which does not vary significantly between north and south, and collaboration on the other hand probably reflects the professional culture<sup>50</sup>. In the south, there is on one hand higher

absorption of human resources, and on the other, lower scores for variables concerning organization, such as motivation, quality, and performance evaluation than the north.

These differences are probably due to various underlying causes, often referred to in Italy as the “problem of the South”. Differences between the north and the south are longstanding and have been identified in numerous academic contributions.<sup>51,52</sup> Finding the same unevenness in NICU as there is in many fields, this study however makes it possible to identify strategies for improvement in terms of possible managerial intervention.

It appears that far-reaching re-organization of NICU is necessary in the south of Italy. This implies that a policy of organizational change is required, in other words that there is need for restructuring of clinical and care processes possibly based on the experiences of other NICU. Our findings show that national and regional policy could play a key role in policy-making which could impact on overall organizational variables, rather than on structural NICU variables such as the number of beds. A potential policy of organizational change at hospital and NICU level could raise the level of responsibility given to management and senior clinicians through planning ad hoc interventions in organizational initiatives. This could be supported by incentive-disincentive schemes to align motivation towards achieving objectives.

### **Limitations and further research**

This study defines seven variables relating to activities, organization processes and behaviour models to assess NICU. The variables are linked to areas in the assessment model described in Øvretveit’s WHO study. Two observations are necessary.

Firstly, the areas in Øvretveit’s model were not investigated using the same number of variables. Just one variable was used for Area A (Performance and results review), for Area B (Benchmarking) and for Area D (Clinical guidelines, protocols and procedures). Two variables were used for Area C (Leadership) and for Area E (Patient and staff satisfaction).

Secondly, note that there are other variables which could have been used in addition to the variables used here. For example, for variable V1 (complexity of cases treated), some neonatology studies use British Association of Perinatal Medicine standards<sup>53</sup> or guidelines indicated by Rogowski.<sup>1</sup>

In assessing the degree of collaboration between healthcare professionals (V2), only formal meetings were taken into account. Clearly it would be of interest to assess informal interpersonal relationships, which are frequent and impact on organizational behaviour.

There are also various ways of measuring performance (V3), which can be subdivided into quality of care, efficiency, and patient satisfaction.<sup>54</sup> In this study however our focus was on quality performance which is considered the key dimension of health organization performance.<sup>55</sup>

Our study measured satisfaction for healthcare professionals in NICU for physicians (V4) and for nurses (V5). The satisfaction of patients is of course equally important, and in the case of NICU needs to focus on parents of patients rather than newborns themselves.

Our investigations of Opportunities for learning (V6) and Orientation to quality (V7) used PES-NWI items; but here too other indicators of organization culture could have been.<sup>56</sup>

Taking account of the above limitations, there are two main avenues for future research. The first is to define homogenous organizational and managerial models for NICU on the bases of the variables used above. The second is to link newborn outcomes, such as rates of mortality, chronic lung disease, infections, neurological problems to types of structure and organizational variables. This will provide further and more precise important indications for the three levels of healthcare management; hospital management, senior physicians, and regional health system managers.

## References

1. Rogowski JA, Staiger D, Patrick T, et al. Nurse Staffing and NICU Infection Rates. *JAMA Pediatr* 2013; 167: 444–450.
2. World Health Organization. *Born too soon. The global action report on preterm birth*. Geneva: World Health Organization (WHO), 2012.
3. Meyer JA, Silow-Carroll S, Kutyla TMLA, et al. *Hospital quality: ingredients for success; overview and lessons learned*. New York, NY: The Commonwealth Fund, 2004.
4. Secanell M, Groene O, Arah OA, et al. Deepening our understanding of quality improvement in Europe (DUQuE): overview of a study of hospital quality management in seven countries. *Int J Qual Health Care* 2014; 26: 5–15.
5. Øvretveit J. *What are the best strategies to ensure quality in hospitals?* Copenhagen: WHO Regional Office for Europe's Health Evidence Network (HEN), 2003.
6. Profit J, Gould JB, Bennett M, et al. The association of level of care with NICU quality. *Pediatrics* 2016; 137: e20144210.
7. Montirosso R, Del Prete A, Bellù R, et al. Level of NICU quality of developmental care and neurobehavioral performance in very preterm infants. *Pediatrics* 2012; 129: 1129–1137.
8. Speer ME. Challenges in the NICU: questions or answers? *J Perinatol* 1998; 18: S1–S5.
9. Cheldelin LV, Dunham S and Stewart V. NICU patient satisfaction: how you measure counts. *J Perinatol* 2013; 33: 324–326.
10. Brennan SE, Bosch M, Buchan H, et al. Measuring organizational and individual factors thought to influence the success of quality improvement in primary care: a systematic review of instruments. *Implement Sci* 2012; 7: 1–19.

11. Groene O, Klazinga, N, Kazandjian V, et al. The World Health Organization Performance Assessment Tool for Quality Improvement in Hospitals (PATH): an analysis of the pilot implementation in 37 hospitals. *Int J Qual Health Care* 2008; 20: 155–161.
12. Dückers ML, Wagner C and Groenewegen PP. Developing and testing an instrument to measure the presence of conditions for successful implementation of quality improvement collaboratives. *BMC Health Serv Res* 2008; 8: 1–9.
13. Withanachchi N, Handa Y, Karandagoda KKW, et al. TQM emphasizing 5-S principles: a breakthrough for chronic managerial constraints at public hospitals in developing countries. *Int J Pub Sec Manage* 2007; 20: 168–177.
14. Hansen J. Health services research in Europe: evaluating and improving its contribution to health care policy. *J Health Serv Res Policy* 2011; 16: 1–5.
15. Øvretveit J. Understanding the conditions for improvement: research to discover which context influences affect improvement success. *BMJ Qual Saf* 2011; 20: i18–i23.
16. Walshe K and Freeman T. Effectiveness of quality improvement: learning from evaluations. *Qual Saf Health Care* 2002; 11: 85–87.
17. Ballard DJ. Indicators to improve clinical quality across an integrated health care system. *Int J Qual Health Care* 2003; 15: i13–i23.
18. Rangachari P. The strategic management of organizational knowledge exchange related to hospital quality measurement and reporting. *Qual Manag Health Care* 2008; 17: 252–269.
19. Pink GH, Slifkin RT, Coburn AF, et al. Comparative performance data for critical access hospitals. *J Rural Health* 2004; 20: 374–382.
20. Strech D and Danis M. How can bedside rationing be justified despite coexisting inefficiency? The need for benchmarks of efficiency. *J Med Ethics* 2014; 40: 89–93.

21. McAlearney AS. Using leadership development programs to improve quality and efficiency in healthcare. *J Healthc Manag* 2008; 53: 319–331.
22. Frich JC, Brewster AL, Cherlin EJ, et al. Leadership development programs for physicians: a systematic review. *J Gen Intern Med* 2014; 30: 656–674.
23. Jones GR. *Organizational theory, design, and change*. 7th ed. New York, NY: Pearson Publishing, 2012.
24. Lowman LB, Stone LL and Cole JG. Using developmental assessments in the NICU to empower families. *Neonatal Netw* 2006; 25: 177–186.
25. Watson J, DeLand M, Gibbins S, et al. Improvements in staff quality of work life and family satisfaction following the move to single-family room NICU design. *Adv Neonatal Care* 2014; 14: 129–136.
26. Lavender T, Richens Y, Milan SJ, et al. Telephone support for women during pregnancy and the first six weeks postpartum. *Cochrane Database Syst Rev* 2013; 7: 1–107.
27. Horbar JD, Plsek PE, Schriefer J, et al. Introduction to evidence-based quality improvement in neonatal and perinatal medicine: the NIC/Q 2002 experience. *Pediatrics* 2006; 118: S57–S64.
28. Lucey JF. Fetal Infants: the fate of 4172 Infants with birth weights of 401 to 500 grams - the Vermont Oxford Network experience (1996–2000). *Pediatrics* 2004; 113: 1559–1566.
29. Miles MS, Carlson J and Brunssen S. The nurse parent support tool. *J Pediatr Nurs* 1999; 20: 236–241.
30. Lake ET. Development of the practice environment scale of the Nursing Work Index. *Res Nurs Health* 2002; 25: 176–188.
31. Tucker J and UK Neonatal Staffing Study Group. Patient volume, staffing and workload in relation to risk-adjusted outcomes in a random stratified sample of UK neonatal intensive care units: a prospective evaluation. *Lancet* 2002; 359: 99–107.

32. Ingram H and Desombre T. Teamwork in health care. Lessons from the literature and from good practice around the world. *J Gen Intern Med* 1999; 13: 51–58.
33. Stein-Parbury J and Liaschenko J. Understanding collaboration between nurses and physicians as knowledge at work. *Am J Crit Care* 2007; 16: 470–477.
34. Shaw CD. External quality mechanisms for health care: summary of the ExPeRT project on visitatie, accreditation, EFQM and ISO assessment in European Union countries. *Int J Qual Health Care* 2000; 12: 169–175.
35. West E. Management matters: the link between hospital organisation and quality of patient care. *Qual in Health Care* 2001; 10: 40–48.
36. Fung CH, Lim YW, Mattke S, et al. Systematic review: the evidence that publishing patient care performance data improves quality of care. *Ann Intern Med* 2008; 148: 111–123.
37. Petter S, DeLone W and McLean E. Measuring information systems success: models, dimensions, measures, and interrelationships. *Eur J Inform Syst* 2008; 17: 236–263.
38. Samson D and Terziovski M. The relationship between total quality management practices and operational performance. *J Oper Manag* 1999; 17: 393–409.
39. Loeb JM. The current state of performance measurement in health care. *Int J Qual Health Care* 2004; 16: i5–i9.
40. Paleologou V, Kontodimopoulos N, Stamouli A, et al. Developing and testing an instrument for identifying performance incentives in the Greek health care sector. *BMC Health Serv Res* 2006; 118: 1–10.
41. Holtom B and O’Neill B. Job embeddedness: a theoretical foundation for developing a comprehensive plan for retaining health care employees. *J Nurs Adm*, 2004; 34: 216–227.
42. Joseph J and Deshpande SP. The impact of ethical climate on job satisfaction of nurses. *Health Care Manage Rev* 1997; 22: 76–78.



43. Liu K, You LM, Chen SX, et al. The relationship between hospital work environment and nurse outcomes in Guangdong, China: a nurse questionnaire survey. *J Clin Nurs* 2012; 21: 1476–1485.
44. Terzic–Supic Z, Bjegovic–Mikanovic V, Vukovic D, et al. Training hospital managers for strategic planning and management: a prospective study. *BMC Med Educ* 2015; 15: 25–34.
45. Micek ST and Kollef MH. Using protocols to improve the outcomes of critically ill patients with infection: focus on ventilator–associated pneumonia and severe sepsis. In Rello J, Kollef M, Diaz E and Rodriguez A, *Infectious Diseases in Critical Care*. Berlin: Springer–Verlag, 2007; pp. 78–89.
46. Powell AE, Davies HTO and Thomson RG. Using routine comparative data to assess the quality of health care: understanding and avoiding common pitfalls. *Qual Saf Health Care* 2002; 12: 122–128.
47. Lindley DV and Scott W. *New Cambridge Statistical tables*. Cambridge: Cambridge University Press, 1984.
48. Dancey C and Reidy J. *Statistics without maths for psychology: using SPSS for windows*. London: Prentice Hall, 2004.
49. Krogstad U, Hofoss D and Hjortdahl P. Doctor and nurse perception of inter–professional co–operation in hospitals. *Int J Qual Health Care* 2004; 16: 491–497.
50. San Martín-Rodríguez L, Beaulieu MD, D’Amour D, et al. The determinants of successful collaboration: a review of theoretical and empirical studies. *J Interprof Care* 2005; 19: 132–147.
51. Clough SB and Livi C. Economic growth in Italy: an analysis of the uneven development of north and south. *J Econ Hist* 1956; 16: 334–349.
52. Toth F. How health care regionalisation in Italy is widening the north–south gap. *Health Econ Policy Law* 2014; 9: 231–249.
53. British Association of Perinatal Medicine. *Standards for hospitals providing neonatal intensive and high dependency care*. London: BAPM, 2001.

54. Veillard J, Champagne F, Klazinga N, et al. A performance assessment framework for hospitals: the WHO regional office for Europe PATH project. *Int J Qual Health Care* 2005; 17: 487–496.
55. Fanelli S, Lanza G and Zangrandi A. Management tools for quality performance improvement in Italian hospitals. *Int J Public Adm* 2017; 40: 1–12.
56. Davies HT, Nutley SM and Mannion R. Organisational culture and quality of health care. *Qual in Health Care* 2000; 9: 111–119.

**Table 1. Method of performance measurement**

<b>Item</b>	<b>Score</b>
The individual evaluates his/her own performance systematically using information made available by the hospital	2
Regular meetings between colleagues to discuss clinical cases	3
We jointly evaluate all cases not following defined procedures	4
Periodical evaluations on quality indicators by external parties	5
Quality measurement is sporadic	1

**Table 2. Descriptive statistics for NICU analysis variables**

	<b>V1</b>	<b>V2</b>	<b>V3</b>	<b>V4</b>	<b>V5</b>	<b>V6</b>	<b>V7</b>
Mean	2.647	7.405	2.555	1.913	2.428	2.470	2.379
Median	2.241	5.553	2.650	1.905	2.413	2.522	2.333
SD	1.259	5.325	0.600	0.403	0.224	0.368	0.338
Minimum	0.897	1.222	1.25	1.00	1.805	1.416	1.505
Maximum	6.999	23.010	4.00	3.00	2.928	3.162	3.037

**Table 3. Correlation matrix**

		V1	V2	V3	V4	V5	V6	V7
<b>V1</b>	Pearson's correlation	1						
	Sig. (2-tail)							
<b>V2</b>	Pearson's correlation	-0.026	1					
	Sig. (2-tail)	0.852						
<b>V3</b>	Pearson's correlation	-0.044	0.173	1				
	Sig. (2-tail)	0.750	0.210					
<b>V4</b>	Pearson's correlation	0.013	-0.255*	-0.519**	1			
	Sig. (2-tail)	0.926	0.063	0.000				
<b>V5</b>	Pearson's correlation	-0.034	0.074	0.230*	-0.263*	1		
	Sig. (2-tail)	0.805	0.595	0.095	0.055			
<b>V6</b>	Pearson's correlation	0.146	0.096	0.267*	-0.273**	0.847**	1	
	Sig. (2-tail)	0.294	0.489	0.051	0.046	0.000		
<b>V7</b>	Pearson's correlation	0.070	0.121	0.294**	-0.95	0.893**	0.816**	1
	Sig. (2-tail)	0.614	0.384	0.031	0.157	0.000	0.000	

**Table 4. Difference between hospitals in the north and south of Italy**

	<b>North vs South</b>	<b>Mean</b>	<b>Standard deviation</b>	<b>Std. Error of the Mean</b>
<b>V1</b>	North	2.776	1.338	0.232
	South	2.446	1.124	0.245
<b>V2</b>	North	7.377	5.524	0.961
	South	7.448	5.128	1.119
<b>V3</b>	North	2.695**	0.640	0.111
	South	2.334**	0.463	0.101
<b>V4</b>	North	1.837*	0.388	0.067
	South	2.032*	0.407	0.088
<b>V5</b>	North	2.496**	0.205	0.035
	South	2.320**	0.214	0.046
<b>V6</b>	North	2.639**	0.253	0.044
	South	2.204**	0.368	0.080
<b>V7</b>	North	2.487**	0.295	0.051
	South	2.210**	0.337	0.073