Prevalence of nursing diagnoses as a measure of nursing complexity in a hospital setting

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Abstract

Aims. To describe the prevalence of nursing diagnoses on admission among inpatient units and medical diagnoses and to analyse the relationship of nursing diagnoses to patient characteristics and hospital outcomes.

Background. Nursing diagnoses classify patients according to nursing dependency and can be a measure of nursing complexity. Knowledge regarding the prevalence of nursing diagnoses on admission and their relationship with hospital outcomes is lacking.

Design. Prospective observational study.

Methods. Data were collected for 6 months in 2014 in four inpatient units of an Italian hospital using a nursing information system and the hospital discharge register. Nursing diagnoses with prevalence higher or equal to 20% were considered as 'high frequency.' Nursing diagnoses with statistically significant relationships with either higher mortality or length of stay were considered as 'high risk.' The high-frequency/high-risk category of nursing diagnoses was identified.

Results. The sample included 2283 patients. A mean of 4·5 nursing diagnoses per patient was identified; this number showed a statistically significant difference among inpatient units and medical diagnoses. Six nursing diagnoses were classified as high frequency/high risk. Nursing diagnoses were not correlated with patient gender and age. A statistically significant perfect linear association (Spearman's correlation coefficient) was observed between the number of nursing diagnoses and both the length of stay and the mortality rate.

Conclusion. Nursing complexity, as described by nursing diagnoses, was shown to be associated with length of stay and mortality. These results should be confirmed after considering other variables through multivariate analyses. The concept of high-frequency/high-risk nursing diagnoses should be expanded in further studies.

Keywords: correlation, hospital outcomes, nursing complexity, nursing diagnosis, patient outcome, prevalence

Why is this research needed?

- Since nursing diagnoses represent the clinical judgement of nurses, they can be a measure of nursing dependency and nursing complexity.
- The nursing diagnoses collected at admission can provide a picture of the nursing needs in the first hours of care and, consequently, the outcomes to achieve and the interventions to perform.
- The initial diagnostic pattern may allow healthcare teams to make a prognosis regarding hospital outcomes, such as mortality and length of stay.

What are the key findings?

- The number and patterns of nursing diagnoses per patient identified on admission describe patients with broadly different nursing complexity among inpatient units and medical diagnoses.
- A perfect linear correlation exists between the number of nursing diagnoses on admission and both the length of stay and the mortality rate.
- Some diagnoses are assigned with high frequency, while others are significantly associated with the risk of death or a longer hospital stay and others are simultaneously at high frequency and high risk.

How should the findings be used to influence policy/practice/research/education?

- Understanding the epidemiology of nursing diagnoses may provide detailed information regarding relevant aspects of patient care, with a potentially relevant impact on both the organizational and the clinical aspects of care.
- The number of nursing diagnoses may influence the nursing workload: a high number of nursing diagnoses means a higher nursing complexity in terms of outcome to pursue and interventions to perform.
- The resolution or prevention of high-risk nursing diagnoses should be considered as a treatment priority, leading to personalizing the nursing process and the allocation of staffing resources.

Introduction

The quality of health care, frequently measured using clinical medical data, cannot be assessed effectively without assessing the quality of the nursing care (Maas & Delaney 2004). Unfortunately, nursing is poorly represented in healthcare records (Westra *et al.* 2015). Nursing documentation should help to enhance the efficiency of the decision-making processes in the clinical and management fields by improving the methods of data collection and storage (Juve-Udina 2013). Using nursing data from electronic documentation identifies professional practice and the provision of patient care (Mitchell *et al.* 2009). Electronic health record systems can also increase patient safety, decrease medical errors, improve efficiency and reduce costs (Rosenbloom *et al.* 2006).

Realizing this potential requires a transformation of non-standardized, non-uniform and invisible nursing information into visible, standardized and uniform data (Maas & Delaney 2004). Werley and Lang (1988) proposed the Nursing Minimum Data Set (NMDS) to achieve this aim. The NMDS represents a systematic record of essential standardized nursing data documenting all steps of the nursing process (Sermeus *et al.* 1994, Ranegger *et al.* 2015).

Standardized terms and definitions are required to describe clinical nursing findings and procedures and to ensure appropriate outcomes. Furthermore, a standardized language allows clear, consistent and precise clinical communication (Müller-Staub 2009). Unfortunately, the use of standardized nursing terminologies and information systems is still lacking and not yet the standard method of identifying and measuring the practice of nurses (Thoroddsen *et al.* 2012). The dissemination of electronic information systems does not appear to coincide with the larger amount of data available for research and many clinical information systems do not provide reports on clinical data stored in electronic health records (Head *et al.* 2011, O'Brien *et al.* 2015).

Background

As part of the nursing process, the nursing diagnosis (ND) represents the 'clinical judgement concerning a human response to health conditions/life processes, or a vulnerability for that response, by an individual, family, group or community'; nurses can identify 'problem-focused,' 'health promotion', and 'risk' diagnoses (Herdman 2014). NDs classify patients according to their level of nursing dependency (Halloran & Kiley 1987) and reflect a holistic assessment of patient care needs that affect the amount of nursing interventions, being predictive also for the nursing workload (Halloran 1985, O'Brien-Pallas *et al.* 1997). Dependency observed in basic patient care needs (e.g. feeding and hydration, hygiene, mobility) with related nursing interventions quantify the nursing complexity, which is defined as all dimensions of care expressed as intensity, engagement and nursing work (Galimberti *et al.* 2012). The systematic use of NDs in conjunction with nursing interventions can provide a better measure of nursing complexity because NDs cover wide domains of nursing care (e.g. nutrition, self-care, coping, safety, comfort); they are the current standard terms and are based on the ongoing patient assessment.

A shortage of solid knowledge exists regarding the prevalence and distribution of patient needs among clinical settings and diseases. Only a few studies have been based on large hospital databases that included nursing diagnostic data (Halloran & Kiley 1987, Rosenthal *et al.* 1995, Welton & Halloran 2005, Park *et al.* 2006, O'Brien-Pallas *et al.* 2010, Feng & Chang 2015). Nonetheless, studies such as these are central to improving the knowledge on the epidemiology of NDs. For example, considering the NDs collected at admission after the initial nursing assessment can provide a picture of the most frequent nursing needs in the first hours of care and, consequently, the outcome to achieve and the interventions to perform for a certain category of patients or in a particular care unit. Unfortunately, only a few large studies have analysed the NDs on hospital admission (Rosenthal *et al.* 1992, 1995).

Since several studies have shown that NDs could be associated with key hospital outcomes, such as mortality and length of stay (LOS), the interest regarding the analysis of NDs could be significantly greater (Halloran 1985, Rosenthal *et al.* 1995, O'Brien-Pallas *et al.* 1997, Welton & Halloran 2005). Nursing diagnosis patterns and trends may allow healthcare teams (not just nurses) to make a prognosis and identify the trajectory of care compared with similar patients. The relationship between nursing diagnoses and these outcomes remains uncertain (Maas & Delaney 2004, Müller-Staub *et al.* 2006, Urquhart *et al.* 2009).

Aims

The aims of this study were: 1) to describe the prevalence and distribution of NDs on admission among inpatient units (IUs) and medical diagnoses and 2) to analyse the relationship between the NDs on admission, the patient characteristics and the hospital outcomes.

Research questions

- How many NDs were identified on average for each patient?
- Which NDs were more frequent?
- What were the differences and similarities between the IUs and the medical diagnoses in terms of the prevalence of NDs?
- What is the relationship between the total number of NDs, the patient characteristics (age and sex) and the hospital outcomes (LOS and mortality)?
- What NDs with a higher prevalence are associated with higher mortality or longer LOS?

Methods

Design and setting

This was a prospective observational study carried out in a 1547-bed university hospital in Rome, Italy. The hospital had eight departments and 55 IUs.

Sample/participants

Four IUs were selected for this study. The nursing information system described below was implemented in them all. All patients admitted in a period of 6 months in two medical (Internal Medicine, 54 beds, 3200 admission/year; and Oncology, 21 beds, 1080 admission/year) and two surgical (General Surgery, 26 beds, 1500 admission/year; and Thoracic Surgery, 28 beds, 1800 admission/year) IUs were enrolled in the study. The exclusion criteria were: a hospital LOS lower than 2 days, unless the patient deceased; patient transferred to a different IU instead of being discharged; nursing assessment not filled out; patients with V64.x ICD9-CM coding at discharge (patients admitted in hospital for a specific procedure or treatment not carried out because of unexpected circumstances). The LOS was considered ended when the patients died or were discharged.

Data collection

Patients were enrolled from 1 July - 31 December 2014. Data were prospectively collected using a dedicated study database, including data from a clinical nursing information system (professional assessment instrument, PAI) (D'Agostino *et al.* 2012, 2013) and from the hospital discharge register.

PAI system

The PAI is an electronic health record for documenting nursing care according to the structure of the nursing process. The PAI collected data on patient demographics (e.g. age, sex, profession), modality of admission [scheduled, from the emergency department (ED)], date of admission and discharge and nursing care (nursing assessment, nursing diagnoses, nursing interventions and evaluation scales).

Each patient assessment was conducted within 24 hours of admission, in the context of clinical practice, through interviews and clinical examinations. The problems identified during this assessment were described using ND labels based on the NANDA-International Taxonomy. After the nursing assessment, nurses identified the appropriate NDs and recorded them in the PAI system, where a set of 44 NDs was available, in addition to the option of inserting 'other' NDs not present in this set. The 44 NDs in the PAI were selected based on a literature review examining the prevalence of certain NDs in different hospital care settings (D'Agostino *et al.* 2012).

Criteria for identifying NDs

Nurses were supported in the diagnostic reasoning for identifying NDs using a structured and validated Nursing Assessment Form (NAF) (Zega *et al.* 2014). The NAF is a clinical decision support system linked through specific items to the 44 NDs available in the PAI system. These items represent the signs, symptoms and risk factors of the 44 NDs. The input of these data allows the NAF to suggest possible NDs.

Hospital discharge register

Additional data were obtained from the hospital discharge register. The main medical diagnoses were categorized according to the major diagnostic category (MDC), based on the Centers for Medicare and Medicaid Services-Diagnosis Related Groups (CMS-DRG) v.24, in 25 mutually exclusive groups of diseases or disorders (DDs). Based on the DRGs, each patient was classified as 'medical' or 'surgical.' Patients were considered surgical if they underwent a procedure performed in an operating room. Data on the condition at discharge (deceased, transferred to other healthcare facilities or discharged home) were also collected.

Database linkages

Data from the PAI and the hospital discharge register were linked. First, the variables of study interest were selected. Two key variables (health code and medical record number) were used to link the two databases in the one dedicated study database. Then, the Hospital Management Control Department performed a probabilistic matching process (Bradley *et al.* 2010), using a dedicated software, to match the two databases in the study database.

Ethical considerations

The local ethics committee of the hospital approved the study. Data from the patient records were de-identified and assigned to a progressive numerical code before being entered into the study database. The researchers could not identify individual patients after the data were stored in the database.

Data analysis

Statistical analyses were performed using the IBM SPSS Statistics for Windows, Version 22·0 (Armonk, NY, USA: IBM Corp.) software. Continuous variables such as age, LOS and total number of NDs were described as mean and standard deviation (SD) and range; the median was calculated in the variables that were not normally distributed. Nominal variables such as gender, diagnostic categories, frequency of NDs and mortality were described as a number and a percentage.

The NDs were grouped by their domains (Herdman 2014) and were classified by clinical prevalence. The NDs with a prevalence higher or equal to 20% were considered as 'high-frequency (HF) NDs' (Jomar & de Souza Bispo 2014). The NDs significantly related to either higher mortality or LOS were considered as 'high-risk (HR) NDs.' An HF/HR category of NDs was also identified.

To compare the different number/pattern of NDs among the different MDCs, for this analysis, we selected the MDCs that accounted for at least 80% of the study population. The comparisons of the proportions between two or more groups (e.g. frequency of NDs between IUs or diagnostic categories) were analysed using chi-squared test, as appropriate. The differences between the means in the two groups (e.g. mean number of NDs between the surviving or the dead patients) were analysed via unpaired Student's *t*-test, after considering whether the subgroups had equal variance via Levene's test or not. The comparisons of the means between more than two groups (e.g. mean number of NDs among diagnostic categories or IUs) were analysed using one-way ANOVA and *post hoc* Tukey–Kramer test.

Six categories of patients (with 0; 1; 2–3; 4–6; 7–13; and ≥ 14 NDs) were created using the 5, 25, 50, 75 and 95th percentiles of the total number of NDs as a cut-off. For each category, the mortality rate and the mean LOS (after excluding the dead patients) were determined. The Spearman's rank correlation coefficient (ρ) was used to investigate the bivariate associations between the number of NDs and the age and between the ND categories and the respective mean LOS and the mortality rate. Given the high number of statistical comparisons performed for each variable, an alpha level of $P = 0{\cdot}01$ was set for the statistical significance for all tests to reduce the type I error rate.

Results

General data

During the study period, 3191 patients were included. After applying the exclusion criteria, 2283 (71·5%) patients constituted the final study population. The main characteristics of the enrolled patients are described in Table 1. Most patients were aged over 60 (1,373; 60·1%). The male and female ages were comparable [males: 62·6 (SD 15·7) years, range: 6–97; females: 62·0 (SD 17·3) years, range: 10–98; $t = -0{\cdot}817$, $P = 0{\cdot}414$]. The patient age varied significantly among the four considered IUs [Internal Medicine: 64·4 (SD 17·5); Oncology: 59·5 (SD 13·5); General Surgery: 60·8 (SD 14·9); Thoracic Surgery: 62·0 (SD 17·7); $F = 10{\cdot}094$, $P < 0{\cdot}001$]; *post hoc* analysis revealed that the patients admitted to the Internal Medicine were significantly older than those in the other IUs, whereas no significant difference was shown for the other comparisons.

The mean hospital LOS was 7·6 (SD 6·2) days (median: 6; range: 1–68). No significant differences were found among the IUs in terms of LOS [Internal Medicine: 7·5 (SD 6·1) days; Oncology: 7·8 (SD 6·3) days; General Surgery: 7·9 (SD 6·4) days; Thoracic Surgery: 7·3 (SD 6·1) days; $F = 0{\cdot}909$, $P = 0{\cdot}436$]. The mortality rate was 4·1% with significant differences among the IUs (Internal Medicine: 5·2%; Oncology: 6·0%; General Surgery: 0%; Thoracic Surgery: 3·3%; $\chi^2 = 23{\cdot}357$, $P < 0{\cdot}001$).

Nursing diagnosis prevalence and distribution among inpatient units and medical diagnoses

Overall, the nurses identified 10,202 NDs, corresponding to a mean of 4·5 (SD 4·5) NDs per patient (median: 3·0; range: 0–32). All 44 NDs available in the PAI data set were selected at least once. Eighty-four per cent of the NDs belonged to the safety/protection, activity/rest, elimination and exchange and nutrition domains (Table 1).

The mean number of NDs was significantly higher for patients admitted from the ED [scheduled admission: 3·9 (SD 3·7); from the ED: 5·4 (SD 5·4); $t = -7{\cdot}371$, $P < 0{\cdot}001$]. The average number of NDs per patient differed significantly among the IUs [Internal Medicine: 3·0 (SD 3·0); Oncology: 5·7 (SD 3·7); General Surgery: 3·6 (SD 3·8); Thoracic Surgery: 6·6 (SD 6·1); $F = 103{\cdot}314$, $P < 0{\cdot}001$]; *post hoc* analysis revealed significant differences in all comparisons except between internal medicine and general surgery.

Table 1 Main characteristics of the study population ($N = 2283$).

Variables	Descriptive statistics
Age (years) (mean (SD); range)	62·3 (16·5); 6–98
Gender (*n*; %)	
Male/female	1105/1178; 48·4%/52·6%
Modality of admission (*n*; %)	
Scheduled admission	1417; 62·1%
From emergency department	866; 37·9%
Inpatient unit (*n*; %)	
Internal medicine	939; 41·1%
Thoracic surgery	549; 24·0%
Oncology	435; 19·1%
General surgery	360; 15·8%
Major diagnostic category (*n*; %)	
Hepatobiliary and pancreatic DDs	602; 26·4%
Digestive system DDs	487; 21·3%
Respiratory system DDs	431; 18·9%
Myeloproliferative DDs	205; 9·0%
Nervous system DDs	170; 7·4%
Infectious and parasitic DDs	55; 2·4%
Endocrine, nutritional and metabolic system DDs	54; 2·4%
Cardiocirculatory system DDs	52; 2·3%
Kidney and urinary tract DDs	49; 2·1%
Skin, subcutaneous tissue and breast DDs	47; 2·1%
Others	131; 5·7%
Nursing diagnoses into NANDA-international domains (*n*; %)	
Safety/protection	3474; 34·1%
Activity/rest	2748; 26·9%
Elimination and exchange	1221; 12·0%
Nutrition	1110; 10·9%
Coping/stress tolerance	717; 7·0%
Comfort	678; 6·7%
Perception/cognition	155; 1·5%
Life principles	54; 0·5%
Self-perception	32; 0·3%
Role relationships	13; 0·1%
Modality of discharge (*n*; %)	
Home	2165; 94·8%
Transferred to other healthcare facilities	25; 1·1%
Died	93; 4·1%

SD, standard deviation; DDs: diseases and disorders.

The most frequent ND was *Risk for infection*, both in general and when the single IUs were considered. The frequency distribution of the NDs among the four IUs was significantly different for almost all NDs. 'Other' NDs, which were not included in the set of 44 NDs, were selected rarely (< 1%). Eight NDs were classified as HF-NDs in the overall population; the number of NDs classified as HF varied among the IUs, with 3 for Internal Medicine, 10 for

Oncology, 5 for General Surgery and 14 for Thoracic Surgery (Table 2).

A total of 1895 patients corresponding to 83·0% of the study population, were included in five MDCs (Table 1). The mean number of NDs per patient according to MDC was higher for Respiratory DDs [7·0 (SD 6·2)] and lower for Hepatobiliary-Pancreatic DDs [3·1 (SD 3·0)]. The number of NDs was significantly different ($F = 68{\cdot}358$, $P < 0{\cdot}001$) among the MDC subgroups; *post hoc* analysis revealed that NDs were significantly higher for the Nervous System, the Respiratory System and Myeloproliferative DDs. The number of NDs was higher for medical [4·7 (SD 4·7)] as compared with surgical situations [3·9 (SD 3·8)]; the MDC subgroup analysis confirmed this difference only for Respiratory DDs (Table 3).

The prevalence of HF-NDs in the five MDCs was analysed (Table 4). Several HF-NDs, including between 3 and 16, was shown, for a total of 17 HF-NDs (11 problem-focused and 6 risk NDs); only the ND *Risk for infection* was present in all of the five considered MCDs.

Given that Respiratory DDs was the MDC with the higher number of HF-NDs and the only one with a statistically significant difference in the number of NDs between the medical and the surgical subgroups, we compared the prevalence of the 16 HF-NDs between these subgroups. The prevalence of 11 HF-NDs was significantly different between the subgroups; in 10 cases, the prevalence was higher in the medical subgroup (Table 5).

Relationship between NDs, patient characteristics and hospital outcomes

The number of NDs categorized by gender was similar [females: 4·5 (SD 4·4); males: 4·5 (SD 4·5); $t = 0{\cdot}076$, $P = 0{\cdot}939$]. An absence of correlation was shown between the number of NDs and the patients' age ($\rho = 0{\cdot}08$; $P < 0{\cdot}001$).

The number of NDs was significantly higher in patients who died compared with those who survived to hospital discharge [survived: 4·3 (SD 4·2); died: 8·5 (SD 7·4); $t = -5{\cdot}413$, $P < 0{\cdot}001$]. Considering the six categories of patients defined in the methods, a perfect linear correlation between the number of NDs and both the mean LOS and the mortality rate was observed ($\rho = 1{\cdot}00$; $P < 0{\cdot}001$) (Figure 1).

Thirty NDs (68·2%) were significantly related with higher mortality, 25 (56·8%) to longer LOS and 23 (52·3%) to both outcomes (Table 6). Three problem-focused (Disturbed sleep pattern, Imbalanced nutrition: less than body requirement and Impaired physical mobility) and three risk (Risk for constipation, Risk for impaired skin integrity and Risk for infection) diagnoses were classified as HF/HR.

Discussion

Synthesis of main results

In a sample of 2283 patients admitted in four IUs of a university hospital, on admission, nurses identified a mean of 4·5 NDs per patient. The most frequent ND was *Risk for infection*. A significantly different prevalence and ND pattern was shown among the four IUs. Compared with surgical MDCs, patients with medical MDCs had a higher number of NDs. A strong direct relationship between the number of NDs and both LOS and mortality was identified. Based on their prevalence and relationship with the explored outcomes, six NDs were classified as HF/HR.

Nursing diagnosis prevalence and distribution among inpatient units and medical diagnoses

A mean of 4·5 NDs was present on admission. Only one previous large study (14,183 patients) analysed the prevalence of admission NDs in medical and surgical hospital populations, reporting a mean of 9·4 NDs per patient (range, 0–39) (Rosenthal *et al.* 1992). A partial explanation for this difference may be that the study was performed almost 30 years ago and considered a list of 50 NANDA-I NDs together with 11 NDs developed by the authors.

Overall, the most frequent NDs were in the safety/protection, activity/rest, elimination and exchange and nutrition domains. These domains are relatively common in an acute care setting because they cover areas of safety from risks such as infections, falls and skin integrity; energy resources such as sleep/rest, activity/exercise, cardiovascular/pulmonary responses and self-care; urinary, gastrointestinal and respiratory functions; and nutrient or fluid intake. No other large study has investigated the prevalence of admission NDs by domain.

The number of NDs was higher for patients admitted from the ED. This result may be explained by a higher severity of the patients' clinical conditions, which could be additionally related to an increased number of human responses and the choice of considering NDs only on admission. The prevalence of NDs differed significantly among the four studied IUs, revealing a different pattern of care needs consistent with the different clinical characteristics of these patients; even in cases where the average number of NDs was similar (e.g. Internal Medicine and General

Table 2 Frequency distribution of the NDs (N = 10,202) among the four inpatient units.

Diagnosis	Total *n*	Total %	Total Rank	Internal medicine *n*	Internal medicine %	Internal medicine Rank	Oncology *n*	Oncology %	Oncology Rank	General surgery *n*	General surgery %	General surgery Rank	Thoracic surgery *n*	Thoracic surgery %	Thoracic surgery Rank	P value*
Risk for infection	**1474**	**64·6**	1	**545**	**58·0**	1	**359**	**82·5**	1	**268**	**74·4**	1	**302**	**55·0**	1	< 0·001
Risk for impaired skin integrity	**582**	**25·5**	2	85	9·1	8	**183**	**42·1**	2	70	19·4	6	**244**	**44·4**	2	< 0·001
Imbalanced nutrition: less…**	**575**	**25·2**	3	180	19·2	4	**161**	**37·0**	4	70	19·4	7	**164**	**29·9**	8	< 0·001
Acute pain	**554**	**24·3**	4	**221**	**23·5**	3	**100**	**23·0**	8	50	13·9	8	**183**	**33·3**	5	< 0·001
Risk for constipation	**544**	**23·8**	5	100	10·6	7	**159**	**36·6**	5	**80**	**22·2**	4	**205**	**37·3**	4	< 0·001
Disturbed sleep pattern	**532**	**23·3**	6	**249**	**26·5**	2	**167**	**38·4**	3	44	12·2	10	72	13·1	20	0·021
Anxiety	**477**	**20·9**	7	114	12·1	6	**114**	**26·2**	6	**86**	**23·9**	3	**163**	**29·7**	9	0·004
Impaired physical mobility	**476**	**20·8**	8	178	19·0	5	**98**	**22·5**	9	**74**	**20·6**	5	**126**	**23·0**	10	< 0·001
Risk for falls	409	17·9	9	77	8·2	9	84	19·3	11	39	10·8	11	**209**	**38·1**	3	< 0·001
Risk for activity intolerance	322	14·1	10	57	6·1	14	**98**	**22·5**	10	46	12·8	9	**121**	**22·0**	12	0·002
Activity intolerance	306	13·4	11	69	7·3	10	**101**	**23·2**	7	21	5·8	16	**115**	**20·9**	13	< 0·001
Bathing self-care deficit	288	12·6	12	49	5·2	18	82	18·9	12	32	8·9	13	**125**	**22·8**	11	< 0·001
Imbalanced nutrition: more…**	262	11·5	13	17	1·8		58	13·3	16	13	3·6		**174**	**31·7**	7	< 0·001
Impaired urinary elimination	242	10·6	14	64	6·8	12	39	9·0		27	7·5	15	**112**	**20·4**	14	< 0·001
Dressing self-care deficit	239	10·5	15	45	4·8	19	63	14·5	14	30	8·3	14	101	18·4	16	< 0·001
Ineffective breathing pattern	238	10·4	16	20	2·1		36	8·3		6	1·7		**176**	**32·1**	6	< 0·001
Impaired walking	229	10·0	17	69	7·3	11	57	13·1	17	21	5·8	17	82	14·9	19	< 0·001
Fear	227	9·9	18	24	2·6		20	4·6		**115**	**31·9**	2	68	12·4		0·001
Risk for injury	213	9·3	19	38	4·0		52	12·0	18	18	5·0	19	105	19·1	15	< 0·001
Ineffective peripheral tissue perfusion	204	8·9	20	39	4·2	20	61	14·0	15	12	3·3		92	16·8	17	< 0·001
Constipation	198	8·7		50	5·3	16	77	17·7	13	15	4·2	20	56	10·2		< 0·001
Deficient fluid volume	189	8·3		54	5·8	15	38	8·7		38	10·6	12	59	10·7		0·234
Toileting self-care deficit	180	7·9		27	2·9		45	10·3	19	21	5·8	18	87	15·8	18	0·001
Feeding self-care deficit	132	5·8		37	3·9		14	3·2		14	3·9		67	12·2		0·130
Chronic pain	124	5·4		64	6·8	13	40	9·2	20	1	0·3		19	3·5		0·014
Risk for aspiration	117	5·1		29	3·1		12	2·8		6	1·7		70	12·8		< 0·001
Diarrhea	112	4·9		49	5·2	17	32	7·4		3	0·8		28	5·1		< 0·001
Fatigue	104	4·6		38	4·0		10	2·3		7	1·9		49	8·9		< 0·001
Impaired skin integrity	88	3·9		26	2·8		20	4·6		7	1·9		35	6·4		< 0·001
Impaired swallowing	84	3·7		36	3·8		20	4·6		3	0·8		25	4·6		0·012
Bowel incontinence	68	3·0		20	2·1		22	5·1		8	2·2		18	3·3		< 0·001
Acute confusion	65	2·8		38	4·0		2	0·5		4	1·1		21	3·8		< 0·001
Impaired memory	57	2·5		38	4·0		3	0·7		1	0·3		15	2·7		0·027
Ineffective airway clearance	55	2·4		11	1·2		1	0·2		4	1·1		39	7·1		< 0·001
Non-compliance	54	2·4		14	1·5		2	0·5		8	2·2		30	5·5		< 0·001
Perceived constipation	36	1·6		8	0·9		9	2·1		4	1·1		15	2·7		< 0·001
Chronic confusion	33	1·4		13	1·4		2	0·5		2	0·6		16	2·9		< 0·001
Disturbed body image	32	1·4		2	0·2		7	1·6		13	3·6		10	1·8		< 0·001
Reflex urinary incontinence	21	0·9		1	0·1		3	0·7		0	0·0		17	3·1		< 0·001
Other (not coded)	17	0·7		15	1·6		2	0·5		0	0·0		0	0·0		< 0·001
Impaired social interaction	13	0·6		9	1·0		1	0·2		0	0·0		3	0·5		< 0·001

Table 2 (*Continued*).

	Total			Internal medicine			Oncology			General surgery			Thoracic surgery			
Diagnosis	*n*	%	Rank	*n*	%	Rank	*n*	%	Rank	*n*	%	Rank	*n*	%	Rank	P value*
Ineffective coping	13	0·6		0	0·0		4	0·9		5	1·4		4	0·7		< 0·001
Functional urinary incontinence	10	0·4		2	0·2		0	0·0		0	0·0		8	1·5		0·645
Urge urinary incontinence	5	0·2		0	0·0		2	0·5		1	0·3		2	0·4		< 0·001
Stress urinary incontinence	2	0·1		1	0·1		0	0·0		1	0·3		0	0·0		0·307

*chi-squared test.
**. . .than body requirements.
In bold: high-frequency (HF) diagnoses.

Table 3 Mean number of nursing diagnoses per patient assigned according to the most represented major diagnostic categories.

Major diagnostic category	Total *n*; mean (SD); range	Medical *n*; mean (SD); range	Surgical *n*; mean (SD); range	Medical vs. surgical *P* value*
Hepatobiliary-pancreatic DDs	602; 3·1 (3·0); 0–18	487; 3·0 (2·9); 0–18	115; 3·1 (3·4); 0–17	0·813
Digestive system DDs	487; 3·3 (3·2); 0–21	267; 3·3 (3·3); 0–21	220; 3·3 (3·1); 0–16	0·944
Respiratory system DDs	431; 7·0 (6·2); 0–32	286; 7·9 (6·7); 0–32	145; 5·1 (4·6); 0–20	< 0·001
Myeloproliferative DDs	205; 4·9 (3·0); 0–17	186; 5·0 (2·9); 1–17	19; 4·4 (3·8); 0–13	0·437
Nervous system DDs	170; 5·6 (5·2); 0–22	162; 5·6 (5·3); 0–22	8; 5·3 (3·9); 0–13	0·863
Total	1,895; 4·4 (4·5); 0–32	1,388; 4·7 (4·7); 0–32	507; 3·9 (3·8); 0–20	< 0·001

*Student's *t*-test.
DDs: diseases and disorders; SD: standard deviation.

Surgery), the analysis of the prevalence described a different pattern of NDs. Therefore, the total number of NDs as well as their range of distribution described patients with broadly different nursing complexity.

Based on our results, the nurses working in Oncology and Thoracic Surgery cared for patients with a higher nursing complexity. Indeed, in these IUs, the number of NDs per patient, as well as the number of HF-NDs and problem-focused HF/HR-NDs, were all higher than that of the other IUs. We noted that in these IUs, the HF-ND patterns were similar, but surprisingly, in Oncology, despite the presence of NDs such as Impaired physical mobility and Activity intolerance, the NDs related to self-care deficits were found only in a reduced proportion of the patients. This finding described different characteristics of the surgical patients, potentially contributing to an influence on the nursing workload, since in this population, it was more frequently necessary to apply a supportive or compensatory nursing strategy towards deficits in the activities of daily living.

Ten NDs were classified as HF-NDs in the oncologic patients. Although a literature review (Jomar & de Souza Bispo 2014) identified 10 HF-NDs in hospitalized oncologic adults, only 4 HF-NDs (*Risk for infection*, *Disturbed sleep pattern*, *Anxiety* and *Acute pain*) corresponded to our findings. Several reasons could explain such differences; for example, the heterogeneity and methodological quality of the considered studies, such as small samples, limited subgroups of NDs considered (e.g. only emotional, psychosocial or spiritual NDs) and the NDs being identified in different hospital phases (admission, pre- or postoperative or discharge).

This is the first study to provide a picture of nursing complexity among different MDCs based on the NDs on admission. According to the total number of NDs, higher nursing complexity was shown for Respiratory DDs and lower for Hepatobiliary-Pancreatic DDs. The prevalence and distribution of the HF-NDs was very different for all medical categories except Digestive and Hepato-Bilio-Pancreatic DDs. As expected, the analysis of ND prevalence described extremely relevant aspects of patient care that are not intercepted by medical diagnoses.

The most frequent ND among most of the MDCs was *Risk for infection*; this result is consistent with previous studies in similar settings (Hao *et al.* 2013, Dias de

Table 4 Distribution of the high-frequency nursing diagnoses (HF-NDs) among medical diagnostic categories (MDC).

	Nervous system DDs			Respiratory system DDs			Digestive system DDs			Hepato-bilio-pancreatic DDs			Myeloproliferative DDs		
Nursing diagnosis	N;	%	Rank	N;	%	Rank	N;	%	Rank	N;	%	Rank	N;	%	Rank
Activity intolerance	41;	24·1%	8	116;	26·9%	9		§			§		41;	20·0%	8
Acute pain		§		134;	31·1%	6	100;	20·5%	3	150;	24·9%	3		§	
Anxiety		§		113;	26·2%	10		§			§		54;	26·3%	5
Bathing self-care deficit		§		106;	24·6%	12		§			§			§	
Disturbed sleep pattern	52;	30·6%	3	91;	21·1%	15		§		134;	22·3%	4	67;	32·7%	4
Dressing self-care deficit		§		101;	23·4%	13		§			§			§	
Imbalanced nutrition: less…*		§		108;	25·1%	11	130;	26·7%	2	153;	25·4%	2	51;	24·9%	6
Imbalanced nutrition: more…*		§		122;	28·3%	8		§			§			§	
Impaired physical mobility	*87;*	*51·2%*	*1*	130;	30·2%	7		§			§		41;	20·0%	7
Impaired walking	51;	30·0%	4		§			§			§			§	
Ineffective breathing pattern		§		164;	38·1%	4		§			§			§	
Risk for activity intolerance	34;	20·0%	9	98;	22·7%	14		§			§			§	
Risk for constipation	47;	27·6%	6	160;	37·1%	5		§			§		91;	44·4%	3
Risk for falls	51;	30·0%	5	166;	38·5%	3		§			§			§	
Risk for impaired skin integrity	44;	25·9%	7	197;	45·7%	2		§			§		93;	45·4%	2
Risk for infection	**68;**	**40·0%**	**2**	***260;***	***60·3%***	***1***	***330;***	***67·8%***	***1***	***399;***	***66·3%***	***1***	***180;***	***87·8%***	***1***
Risk for injury		§		91;	21·1%	16		§			§			§	

In bold: nursing diagnoses present in all MDCs.
In italic: most selected ND for each MDC.
*…than body requirements.
§: Prevalence < 20%.
DDs: diseases and disorders.

Araujo *et al.* 2014, Jomar & de Souza Bispo 2014, Alves dos Santos *et al.* 2015). This fact is not surprising, since this ND is transversal to different sites of care and is related to situations such as loss of skin integrity, invasive procedures, weakness of immune system and nutritional deficiencies.

Analyses of ND prevalence play a relevant role from both an organizational and a clinical perspective. For example, patients with Nervous System DDs had a higher prevalence of HF-NDs related to ability in moving (Impaired physical mobility, Impaired walking, Risk for falls, Activity intolerance, Risk for impaired skin integrity). This finding is consistent with the literature (Lima *et al.* 2016); in addition to the effects on nursing workload, it describes well the strong impact of neurological diseases on patients' independence and quality of life. A further example resulted from the analysis of HF-NDs in the Respiratory DDs subgroup. Where differences were shown, all of the NDs except *Anxiety* had a higher prevalence in the medical MDCs; this finding may be related to the fact that *Anxiety* was observed more frequently on admission in patients who had to be subjected to surgery. These results strengthen the assumption that nursing is an independent component inside the complexity of the care project of a person. Human needs (namely ND patterns) are different among diseases (Onori 2013).

Relationships between NDs, patient characteristics and hospital outcomes

The number of NDs was related to neither the patients' gender nor their age. No study on medical-surgical populations similar to the present research has reported a correlation analysis between age and the number of NDs.

Table 5 Prevalence of high-frequency nursing diagnoses (HF-NDs) in medical and surgical subgroups of Respiratory diseases and disorders medical diagnostic category (MDC).

Nursing diagnosis	Total *n*	Total %	Medical MDC *n*	Medical MDC %		Surgical MDC *n*	Surgical MDC %	Medical vs. surgical *P* value*
Risk for infection	260	60·3	189	66·1	>	71	49·0	0·001
Risk for impaired skin integrity	197	45·7	145	50·7	>	52	35·9	0·003
Risk for falls	166	38·5	120	42·0		46	31·7	0·039
Ineffective breathing pattern	164	38·1	126	44·1	>	38	26·2	< 0·001
Risk for constipation	160	37·1	120	42·0	>	40	27·6	0·004
Acute pain	134	31·1	84	29·4		50	34·5	0·279
Impaired physical mobility	130	30·2	105	36·7	>	25	17·2	< 0·001
Imbalanced nutrition: more…**	122	28·3	77	26·9		45	31·0	0·371
Activity intolerance	116	26·9	99	34·6	>	17	11·7	< 0·001
Anxiety	113	26·2	61	21·3	<	52	35·9	0·001
Imbalanced nutrition: less…**	108	25·1	78	27·3		30	20·7	0·136
Bathing self-care deficit	106	24·6	81	28·3		25	17·2	0·012
Dressing self-care deficit	101	23·4	87	30·4	>	14	9·7	< 0·001
Risk for activity intolerance	98	22·7	78	27·3	>	20	13·8	0·002
Disturbed sleep pattern	91	21·1	72	25·2	>	19	13·1	0·004
Risk for injury	91	21·1	76	26·6	>	15	10·3	< 0·001

*chi-squared test.
**…than body requirements.

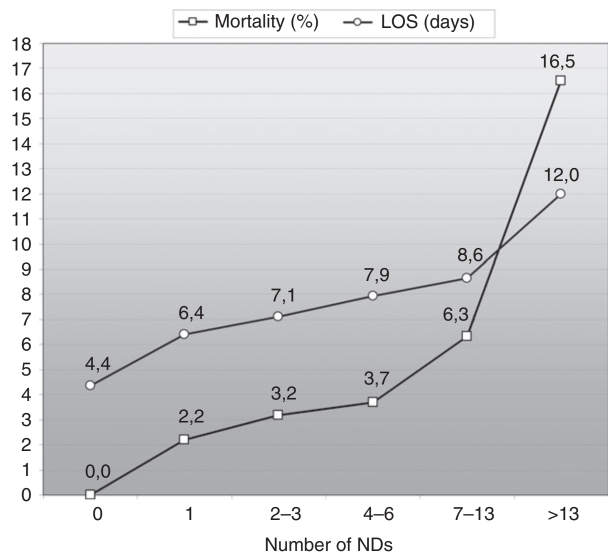

Figure 1 Relationship between the number of nursing diagnoses (NDs), the mortality rate and the mean hospital length of stay (LOS).

A clear scenario appears to emerge from the analysis of the NDs, showing a higher number of NDs on admission is strongly and linearly related to a longer LOS and higher mortality. This finding concurs with the results of previous studies that report a predictive power for the number of NDs towards the in-hospital risk of death and LOS in different populations (Halloran & Kiley 1987, Rosenthal *et al.* 1992, 1995, Smith 1995, Welton & Halloran 2005, O'Brien-Pallas *et al.* 2010, Onori 2013, Castellan *et al.* 2016).

Since NDs deal with the human response to actual or potential health conditions and life processes, it is imperative to emphasize that these results do not mean that patients with more NDs are more seriously ill: a high number of NDs means a higher nursing complexity in terms of outcome to pursue and interventions to perform. This leads to an additional interesting reflection. It is known that the number of NDs influences the time that nurses spend with the patient and thus the nursing workload (Halloran 1985, Halloran & Kiley 1987, O'Brien-Pallas *et al.* 1997, Bakken *et al.* 2005). The poor outcomes that we documented could be related to suboptimal care delivered to patients with higher nursing complexity, due, for example, to the presence of an inadequate nursing staff. Indeed, it has been well documented that both the presence of a patient-to-nurse ratio below the target levels and missed nursing care are associated with increased mortality and other adverse outcomes (Needleman *et al.* 2011, Aiken *et al.* 2014, Kalisch *et al.* 2014).

We also showed that the number as well as the kind of ND could be associated with both the mortality and the LOS. We classified these diagnoses as HR-NDs. It might be considered surprising that NDs such as those indicating self-care deficits (e.g. bathing, feeding, incontinence) or identifying situations not yet present (NDs of risk) can be related to adverse outcomes, such as other NDs clearly

Table 6 Nursing diagnoses significantly related with hospital length of stay (LOS) or mortality.

Diagnosis	LOS (days) Pts without NDs n; mean (SD)	Pts with NDs n; mean (SD)	P value†	Mortality Survived with NDs n	%	Dead with NDs n	%	P value*
Activity intolerance	1977; 7·2 (5·8)	306; 9·8 (7·9)	< 0·001	279	12·7	27	29·0	< 0·001
Acute confusion	2218; 7·5 (6·1)	65; 10·6 (6·8)	< 0·001	54	2·5	11	11·8	< 0·001
Bathing self-care deficit	1995; 7·2 (5·9)	288; 9·9 (7·6)	< 0·001	254	11·6	34	36·6	< 0·001
Bowel incontinence	/			59	2·7	9	9·7	0·001
Chronic confusion	/			27	1·2	6	6·5	0·002
Chronic pain	/			110	5·0	14	15·1	< 0·001
Constipation	2085; 7·4 (5·8)	198; 9·3 (9·1)	0·004	/				
Deficient fluid volume	2094; 7·4 (5·9)	189; 10·0 (8·7)	< 0·001	168	7·7	21	22·6	< 0·001
Disturbed sleep pattern	1751; 7·3 (6·0)	532; 8·5 (6·5)	< 0·001	/				
Dressing self-care deficit	2044; 7·2 (5·8)	239; 10·5 (8·2)	< 0·001	214	9·8	25	26·9	< 0·001
Fatigue	2179; 7·5 (6·1)	104; 9·6 (7·7)	0·008	91	4·2	13	14·0	< 0·001
Feeding self-care deficit	2151; 7·5 (6·1)	132; 9·4 (7·1)	0·002	114	5·2	18	19·4	< 0·001
Imbalanced nutrition: less…**	1708; 7·1 (5·4)	575; 8·9 (8·0)	< 0·001	539	24·6	36	38·7	0·003
Impaired memory	2226; 7·5 (6·1)	57; 9·9 (7·6)	0·004	50	2·3	7	7·5	0·007
Impaired physical mobility	1807; 6·9 (5·2)	476; 10·2 (8·6)	< 0·001	428	19·5	48	51·6	< 0·001
Impaired skin integrity	2195; 7·4 (6·0)	88; 10·8 (9·5)	0·002	72	3·3	16	17·2	< 0·001
Impaired swallowing	2199; 7·5 (6·1)	84; 10·1 (8·1)	< 0·001	72	3·3	12	12·9	< 0·001
Impaired urinary elimination	2041; 7·4 (6·0)	242; 9·3 (7·3)	< 0·001	215	9·8	27	29·0	< 0·001
Impaired walking	/			206	9·4	23	24·7	< 0·001
Ineffective airway clearance	/			48	2·2	7	7·5	0·006
Ineffective breathing pattern	2045; 7·3 (6·0)	238; 9·6 (7·3)	< 0·001	209	9·5	29	31·2	< 0·001
Ineff. periph. tissue perfusion	2079; 7·4 (5·9)	204; 9·8 (8·6)	< 0·001	180	8·2	24	25·8	< 0·001
Non-compliance	/			43	2·0	11	11·8	< 0·001
Reflex urinary incontinence	/			15	0·7	6	6·5	< 0·001
Risk for activity intolerance	1961; 7·2 (5·7)	322; 9·5 (8·3)	< 0·001	298	13·6	24	25·8	0·002
Risk for aspiration	2166; 7·4 (6·0)	117; 9·9 (8·2)	0·002	103	4·7	14	15·1	< 0·001
Risk for constipation	1739; 7·2 (5·8)	544; 8·6 (7·2)	< 0·001	509	23·2	35	37·6	0·003
Risk for falls	1874; 7·2 (5·8)	409; 9·3 (7·6)	< 0·001	380	17·4	29	31·2	0·001
Risk for impaired skin integrity	1701; 7·2 (5·8)	582; 8·8 (7·1)	< 0·001	543	24·8	39	41·9	< 0·001
Risk for infection	809; 7·0 (5·2)	1474; 7·9 (6·6)	< 0·001	1401	64·0	73	78·5	0·004
Risk for injury	2070; 7·4 (6·0)	213; 9·5 (7·4)	< 0·001	194	8·9	19	20·4	0·001
Toileting self-care deficit	2103; 7·3 (6·0)	180; 10·4 (7·6)	< 0·001	162	7·4	18	19·4	< 0·001

*chi-squared test.
**…than body requirements.
†Student's t- test.
Pts, patients; SD, standard deviation.

suggestive of acute and potentially critical conditions (e.g. Deficient fluid volume, Imbalanced nutrition: less than body requirements, Ineffective airway clearance, Ineffective peripheral tissue perfusion). This finding could be consistent with our discussion above. Some NDs clearly suggest a high dependency level or a high need for nursing care. At the same time, risk diagnoses might become 'actual' without effective prevention interventions. This again draws attention to the potential inadequacy of the care provided and to the need to collect accurate data on this issue after stratifying the nursing complexity on the basis of the NDs. Regrettably, for this study, we did not consider data regarding nurse staffing characteristics and nursing workload, therefore, we could not analyse this aspect.

An additional noteworthy finding was identifying six NDs classified as HF/HR. A previous study identified high-frequency treatment priority NDs in critical care patients by collecting the opinions of 678 nurses (Gordon & Hiltunen 1995). However, in contrast to that study, we measured the 'high-frequency' criterion starting with data collected in actual clinical situations and linked to the concept of 'high risk' by the occurrence of an unfavourable outcome. We considered it extremely important for daily clinical practice to know the epidemiology of the NDs in a certain IU and in particular, to identify the HR-NDs that occur with a prevalence exceeding the threshold of attention of 20%. We reason that the presence of such NDs should be a signal to the nurses for significant attention, therefore, their resolution or prevention should be considered as a treatment priority and lead to a tangible personalization of the nursing process, as well as in terms of choices regarding how to allocate the staffing resources. For example, patients identified on admission to be at higher complexity and greater risk of adverse outcome could be allocated to a particular area of the unit, ensuring them a more favourable patient-to-nurse ratio as compared with the low-risk patients, which is in addition to the 24-hour-a-day presence of an experienced nurse in the staff.

Limitations

This study presented some limitations. The 44 NDs included in the PAI system represented 19% of the 235 diagnoses available in the NANDA-I Taxonomy; this fact may have limited the ability to record additional NDs.

We did not evaluate the nurses' agreement in making NDs; a poor diagnostic reliability between nurses could represent a bias. However, in this study, the nurses used a standard assessment tool (NAF) to identify the NDs through the same diagnostic criteria.

Finally, in our study, an observational design with descriptive and correlational aims was used. Therefore, a causative or predictive relationship between NDs and outcomes was not explored.

Conclusions

Electronic clinical nursing databases have significant potential for increasing nursing knowledge and quality of care. The systematic collection of data on NDs provides the opportunity to have precise information about the nursing complexity and allows the ability to make comparisons between different care settings. Improving the knowledge regarding the epidemiology of NDs and correctly comparing different populations is essential to standardizing the method of gathering data, establishing wider lists of NDs in electronic health records and the timing where NDs are identified (e.g. on admission and/or during the entire stay).

The nursing complexity, as described by the NDs, appears to be associated with hospital LOS and mortality. We reason that such relevant outcomes are related to an overlapping of issues related to the patient (e.g. nursing and medical clinical condition), efficacy of the care provided (e.g. competency of the nurses and physicians) and the organization (e.g. nursing staffing and skill mix, patient-to-nurse ratio). Therefore, to evaluate the independent prognostic power of NDs, it is essential to confirm our results after considering other variables through multivariate analyses. Notwithstanding, it is clear even now that it would be a mistake to continue to ignore the contribution of nursing data in explaining the outcome of the patients' care.

Based on our results, we suggest that the concept of highly prevalent and risk (HF/HR) NDs be expanded in further large studies and in different populations. We believe that these issues are central to improving future research on the potential employment of NDs in clinical nursing.

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Conflict of Interest

No conflict of interest has been declared by the authors.

Author contributions

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (http://www.icmje.org/recommendations/)]:

- substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

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