

O. Thonon^{1,2}, D. Gillain¹, W. Sermeus⁵, K. Van den Heede⁵, P. Van Herck⁵, J. Petermans³, P. Kolh¹, P. Gillet⁴

¹ Medico-Economic Informations Department (Simé), University Hospital (CHU) of Liege – Belgium ; ² Nursing Department, University Hospital (CHU) of Liege - Belgium ; ³ Geriatric department, University Hospital (CHU) of Liege - Belgium ; ⁴ University of Liege - Belgium ; ⁵ Centrum voor Ziekenhuis- en Verplegingswetenschap, KU Leuven - Belgium

OBJECTIVES

Belgium is one of the rare countries where *the activities of nurses contribute to determine the financing of the hospital*. The level of these activities is measured by means of a Belgian adaptation of the Nursing Interventions Classification (NIC) instrument, the *Belgian Nursing Minimum Data Set (B-NMDS)*. Firstly, it consists of six main Domains, which are subdivided in Classes. 78 items of these Classes are grouped in a clinically logical way. Secondly, many items show different options in specific care modalities. But only one modality can be registered per item and per patient day. And thirdly, some items are frequency based. In the interpretation of Nurse Time Weights (NTW) of these items, it is important to know that these weights have to be multiplied first with their item frequency to make them comparable with the others.

To improve the current financing system, a study was led at the request of federal authorities. A *two-step nursing cost model* is actually proposed : (1) a list of nursing interventions and their relative weights that contribute to nursing time needs as a proxy for costs, (2) a model will be build in linking and explaining nursing costs with Diagnosis Related Groups (DRGs) and other related variables.

Nursing time interventions was assessed by a Delphi study on *two measuring levels* : nursing intervention level and patient case level.

METHODS

Time validation

First, on patient case level, each real patient case describes the whole of nursing care delivered for a specific patient, during one day of stay (24 hours). Secondly, for activity based level, all B-NMDS interventions were rated separately, independently of any patient case. The sum of a patient's required nursing activity times should supply the total time required to care for that patient in that shift or day. To make both comparable nursing intervention ratings were aggregated based on B-NMDS of the patient cases. There is a *very high correlation* ($r = 0.902$, $p < 0.001$) between the ratings of patient cases as a whole on a 24 hours basis and the summation of ratings of separate nursing interventions based on B-NMDS.

Effect of age

We studied the *effect of patients' age on nursing workload*. We tested the model of the nursing interventions times on a database of more than 5.500 inpatients, aged 65 and over, in 66 Belgian hospitals, on voluntary base, and in specific wards. A balanced sample was obtained for the following specialties: geriatrics, intensive care, revalidation, general internal medicine and general surgical procedures. The sum of time for all nursing interventions is transformed in Full Time Equivalent (FTE) by patient, by 24 hours.

Given the not-Gaussian character of the variable, statistical tests are performed after logarithmic transformation.

RESULTS

Effect of age

In table I, we see that there is *no difference in nursing workload according to age*. ANOVA gives, indeed, a non-significant F test. If we choose a binary cutoff of 75 years old, the two groups are also equivalent (for < 75 y. : M 1.01, $\sigma \pm 0.79$; for $\geq 75+$ y. : M 0.98, $\sigma \pm 0.66$).

Table I : Nursing workload according to age

Age	N	Mean	Std. Deviation	Minimum	Maximum
65-69	866	1.00	0.79	0.10	4.65
70-74	1,127	1.03	0.79	0.16	4.87
75-79	1,294	1.01	0.74	0.14	4.90
80-84	1,231	0.97	0.65	0.12	4.32
85+	1,008	0.96	0.55	0.17	5.44
Total	5,526	0.99	0.71	0.10	5.44

On the other hand, it is noted that *the nursing workload varies significantly according to care programs*. In the table below, we give the mean nursing FTE by care program in the ascending order.

Table II : Mean nursing FTE by care program

Care programs	N	Mean	Std. Deviation	Minimum	Maximum
One-day clinic	84	0.66	0.28	0.15	1.97
Cardiology	1772	0.73	0.42	0.10	4.16
Oncology	981	0.77	0.32	0.16	2.49
Geriatry	1389	0.85	0.33	0.16	2.41
Rehabilitation	617	0.89	0.38	0.12	2.25
ICU	682	2.41	0.89	0.24	5.44
Total	5525	0.99	0.71	0.10	5.44

The two-way ANOVA (age & care program) shows, with an adjusted R Squared of 0.424, and contrary to age, *that only the care program (CareProg) effect is detected* ($p < 0.001$).

We realized a Waller-Duncan post-hoc test that gives 4 homogenous subsets: (1) {One-day clinic ; Cardiology}, (2) {Oncology}, (3) {Geriatry ; Rehabilitation}, and finally (4) {ICU}. *Interaction between age and care program is near the limit of significance with $p = 0.07$* .

At last, *the effect of age on nursing time inside each care program shows a significant level of $p < 0.001$ but only for geriatric ward*.

Comorbidity

The analysis of severity of illness as indicator of comorbidity shows a *heavy influence on nursing FTE* (see graph I). If we add Severity of Illness (SOI) in the ANOVA table (see table III), SOI and interaction between SOI and the care program have significant effects and grow R square to 0.49. It is also important to notice that age does not further interact with SOI.

Graph I : Relationship SOI * Nursing FTE / 24h00

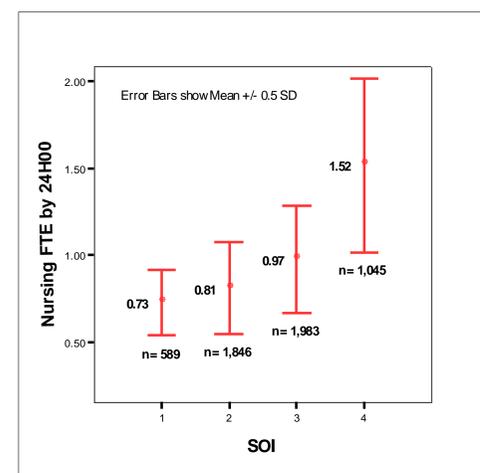


Table III : Two-way ANOVA (care program, age and SOI)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	932.66	114	8.18	44.82	< 0.001
Intercept	28.89	1	28.89	158.24	< 0.001
CareProg	215.01	5	43.00	235.58	< 0.001
Age	0.71	4	0.18	0.97	0.42427
SOI	7.81	3	2.60	14.27	< 0.001
CareProg * Age	4.99	20	0.25	1.37	0.12689
CareProg * SOI	10.25	15	0.68	3.74	< 0.001
Age * SOI	2.29	12	0.19	1.04	0.40380
CareProg * Age * SOI	11.37	55	0.21	1.13	0.23425
Error	976.04	5,347	0.18		
Total	2111.04	5,462			
Corrected Total	1908.71	5,461			

CONCLUSIONS

The summation of separate intervention nursing time estimated needs is consistently higher than estimated time for a patient case as a whole. But the *correlation between both methods is strikingly high and unexpected*. Both ratings were performed independently by other nurses not knowing anything of the alternative rating, and were also aimed at a very different level of nursing care, giving clinical nursing information in a very different format.

Unlike comorbidity, age does not influence the time of nursing activities throughout the analyzed care programs, except in geriatrics wards where the time of healthcare grows with the age of the patients.

These findings should be interpreted in relation to demographic changes in Western societies, and also according the quality of care for old hospitalized patients.