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ARTICLE

Application of MAPO (movement and assistance of hospitalized patients) method in hospitals and nursing homes: 20 years of experience and evolution – part 1

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ABSTRACT

This article illustrates the evolution of the MAPO method for quantifying the risk of musculoskeletal disorders associated with patient handling.

The main factors that have influenced MAPO risk determinants include the rising number of disabled patients (D), growing understaffing, and the increased availability of equipment and training.

Hospital wards and especially nursing homes have been provided with lifting equipment since 2008; however, 73.8% of the workforce in nursing homes is exposed to a high level of MAPO risk versus only 8.1% of hospital workers. This study presents organisational data in hospital wards (no.=528) and nursing homes (no.=214) involving 14,246 caregivers: the D/Op ratio in nursing homes is significantly higher compared to the corresponding ratio in hospital wards (p-value < 0.001). Moreover, the number of healthcare workers involved in manual patient handling activities over the night shift in nursing homes is much lower than the corresponding number in hospital wards.

Practitioner summary: The purpose of this article is to illustrate organisational data from hospital wards and nursing homes, gathered over 20 years of implementing the MAPO method. The protocols for adapting the method to recent changes in care delivery are also presented.

Abbreviations: A: Afternoon; AF: Minor Aids Factor; CEN: European Committee for Standardisation; CICU: Cardiac Intensive Care Unit; CIIP: Italian Inter-associative Prevention Council; D: Disabled patients; EF: Environment Factor; H: Hospital wards; LF: Lifting Factor; M: Morning; MAPO: Movement and Assistance of Hospitalised Patients; MPH: Manual Patient Handling; N: Night; NC: completely non-cooperative patients; NH: Nursing Home; NR: Not Reported; Op: nurses and nurses' aides involved in manual patient handling activities over 24 hours; PC: partially cooperative patients; TF: Training Factor; WF: Wheelchair Factor; WMSDs: work-related musculoskeletal disorders.

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Introduction

It is now well known that WMSDs are more prevalent among healthcare workers than other job categories, and tend to affect the lower back, upper back, and shoulders (Stobbe et al. 1988; Hignett 1996; Ferguson and Marras 1997; Colombini et al. 1999; Marras et al. 1999; Myers, Silverstein, and Nelson 2002; Daraiseh et al. 2003; Smedley et al. 2003; Waters, Nelson, and Proctor 2007; Nelson et al. 2006; Serranheira et al. 2012; Anap, Iyer, and Rao 2013; Davis and Kotowski 2015; Choi and Brings 2016; Karstad et al. 2018).

Manual patient handling (MPH) has been recognised as a high-risk activity since the early 1990s (Gagnon, Sicard, and Sirois 1986, Gagnon et al. 1987; Nelson et al. 2006; Waters, Nelson, and Proctor 2007).

The risk associated with manual patient handling has been addressed in many countries, albeit with different approaches: confirmation comes from an analysis of ISO Technical Report 12296 (ISO TR 12296 2012) published by ISO in June 2012 and approved by CEN (European Committee for Standardisation) in August 2013.

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Essentially, this document highlights the need to consider the simultaneous presence of multiple factors in different healthcare sectors – type of patient care load, operators (that is healthcare workers involved in manual patient handling) working different shifts, availability and adequacy of patient handling aids, care environment, operator training – as well as the relationships between such factors.

The MAPO method is an accurate tool for assessing risk associated with patient handling. It is illustrated in ISO Technical Report 12296 and has been validated and used in Italy since 1996 (Menoni et al. 1999; Battevi et al. 2006, Battevi, Menoni, and Alvarez-Casado 2012; Menoni, Battevi, and Cairoli 2015; Cantarella et al. 2020). The method is currently also used in France, Spain (Nogareda, Álvarez-Casado, and Hernández-Soto 2011; Menoni et al. 2014), India, Brazil, and other countries around the world (Akbari et al. 2016).

Since 2010, the MAPO method has been amended to reflect several variables reported in the literature and observed in the various hospitals analysed.

The first variable to be considered is the substantial change in care delivery at the European level, in both hospitals and nursing homes. Healthcare provided by hospitals increasingly involves acute patients, leaving the treatment of chronic conditions to outpatient facilities. This situation has led to a reduction in the average length of stay in hospitals (from 20 to 40 days in 1999 to 8 days in 2019) and an increased number of severely disabled patients (Annuario Statistico del Servizio Sanitario Nazionale [2019] 2021).

In the last decade, growing staff shortages have changed work shift schedules, going from standard conditions[1] to a higher number of weekly shifts worked by each operator (Caruso 2014; Son, Lee, and Ko 2019).

Another organisational change that has occurred in recent years concerns patient handling. Such activities used to be carried out by nurses; nowadays, however, such tasks are mainly performed by older nurse's aides; on average their age has increased from 36 in the period 1999–2003 to 48 today, leading to a greater number of workers who are highly susceptible to biomechanical overload (CIIP Group Italian Inter-Associative Prevention Council 2017).

Most manual patient handling activities are carried out in pairs (Vinstrup et al. 2020), which leads to a higher frequency of overloading tasks per operator.

As far as nursing homes are concerned, several unique characteristics have emerged over the past few decades, mainly relating to the smaller number of operators working night shifts: often, only one operator manages multiple wards.

The current COVID-19 pandemic has further intensified the abovementioned aspects. In some Italian regions, the public health emergency has accentuated the negative impact of understaffing on workloads, on the quality of care and on operator health. Moreover, already inadequate staff numbers have been aggravated by a significant increase in operators on sick leave.

It is therefore fundamental to address the issue with the twofold objective of safeguarding workers' health and assuring quality of care for patients and the population at large.

To better define the risks associated with patient handling, it is necessary to adopt both a micro- and a macro-management approach.

Therefore, the tools used and the changes that have been made will be addressed in two separate articles, the first being this one.

This article aims to:

1. Define two support tools for assessing the risk of musculoskeletal disorders associated with MPH and ensuring that data collected during interviews are objective;
2. Illustrate organisational data concerning the quantification of risk associated with patient handling in Italian hospitals and nursing homes since 2008.

2. Materials and methods

Risk assessments conducted using MAPO method (Menoni et al. 1999, ISO TR 12296 2012, Menoni, Battevi, and Cairoli 2015) summarise the exposure level by means of the following formula:

$$(NC/Op \times LF) + (PC/Op \times AF) \times WF \times EF \times TF$$

Where NC/Op is the ratio of completely non-cooperative patients[2] to operators working the three shifts (M = morning; A = afternoon; N = night); PC/Op is the ratio of partially cooperative patients[3] to operators working the three shifts; LF is the lifting factor; AF is the minor aids factor; WF is the wheelchair factor; EF is the environment factor, and TF is the training factor. Organisational factors are crucial in identifying the exposure level as they influence the NC/Op and PC/Op ratios as well as the training factor (TF).

For some determinants (NC, PC, Op), the head nurse is asked to describe the most frequent organisational scenario in the ward over the last 12 months.

Table 1. Adequacy of MAPO risk factors control in the studies carried out from 1999 to 2020, expressed as percentages.

	Adequacy of risk factor control in hospital wards (%)				Adequacy of risk factor control in nursing homes (%)			
Study/year	4.4	2	11	11.7	7	0	38	20
1999 (no.=216 wards)	LF	AF	EF	TF	LF	AF	EF	TF
2003 (no.=191 wards)	17	2	30	20	80	0	37	15
2012 (no.=31 wards)					54	10	N.R.	32
2020 (no = 116 wards)	36.3	2.6	30	5				

The MAPO method aims at providing a parametric index representing the risk level correlated with the prevalence of low back pain (low back injuries) among nurses working in the wards under examination.

The wards were broken down into four levels of MAPO index:

- 0 = absent exposure level, no disabled patients
- 0.1–1.5 = negligible exposure level (green)
- 1.51–5 = medium exposure level (yellow)
- >5 = high exposure level (red)

In the period 1999–2019, four validation studies were carried out to investigate the correlation between the risk associated with manual patient handling and the prevalence of acute low back injuries. Such studies involved 560 hospital wards and nursing homes and 8,456 nurses (Battevi et al. 1999, 2006, Battevi, Menoni, and Alvarez-Casado 2012; Cantarella et al. 2020). Various training courses were held during each study to collect homogeneous data. The four studies carried out from 1999 to 2019 made it possible to analyse the evolution of different risk factors that have influenced the MAPO index.

Table 1 shows the adequacy of MAPO risk factors (equipment, environment and training factors) expressed as percentages. The concept of adequacy has to do with the level of risk factor control: as illustrated in the table below, the adequacy of risk factor control in different wards is increasing but not optimal.

Figure 1 illustrates the methodological flow chart for conducting studies on the association between the MAPO index and acute low back pain in the previous year, with the relative timeline.

2.1. Tools for ensuring objective data

The MAPO method involves collecting data concerning organisational factors via an interview with the head nurse and a subsequent evaluation of the relevant environment and equipment through an on-site inspection.

The interview is instrumental in gathering information on the following organisational aspects in relation to the most frequent scenario:

a. Number of beds occupied;
b. Total number of operators involved in patient handling activities, including those off duty (staff);
c. Shift duration and number of operators (nurses and nurses' aides) involved in MPH activities over 24 hours (Op);
d. Average number of disabled patients (D); in particular, number of patients to be fully lifted (NC) and number of patients to be partially lifted (PC);
e. Number of pairs of operators performing patient handling tasks per shift;
f. Type of handling tasks performed on most NC or PC patients.

Due to the drastic reduction in the average length of hospital stays and the increasingly widespread shortage of staff, very often it is difficult to define the average number of NC and PC patients routinely present as well as the number of Op involved in MPH activities over 24 hours.

Since 2008, our experience has shown that points (c) and (d) are prone to subjective responses from the interviewee. To overcome this limitation, i.e. avoid over- or underestimations and better quantify the level of risk exposure, two different tools (namely, Tool 2 and Tool 3) are used: the first tool is used in wards where the head nurse was unable to provide objective answers while the second tool is used in all wards (Table 2). Tool 2 and 3 are complementary to the MAPO method and simplify its application without changing its methodology.

Since 2014, for short stays (surgery wards) or stays in wards with high patient turnover, a protocol has been used to collect objective data on NC-PC patients (Tool 2 – a specific template for indicating the type of patients in the ward). Tool 2 allows the head nurse to collect data for at least 7 days (Menoni, Battevi, and Cairoli 2015).[4] It was used alongside the MAPO interview in 20 hospital wards, where objective data were collected on the number of disabled patients (NC and

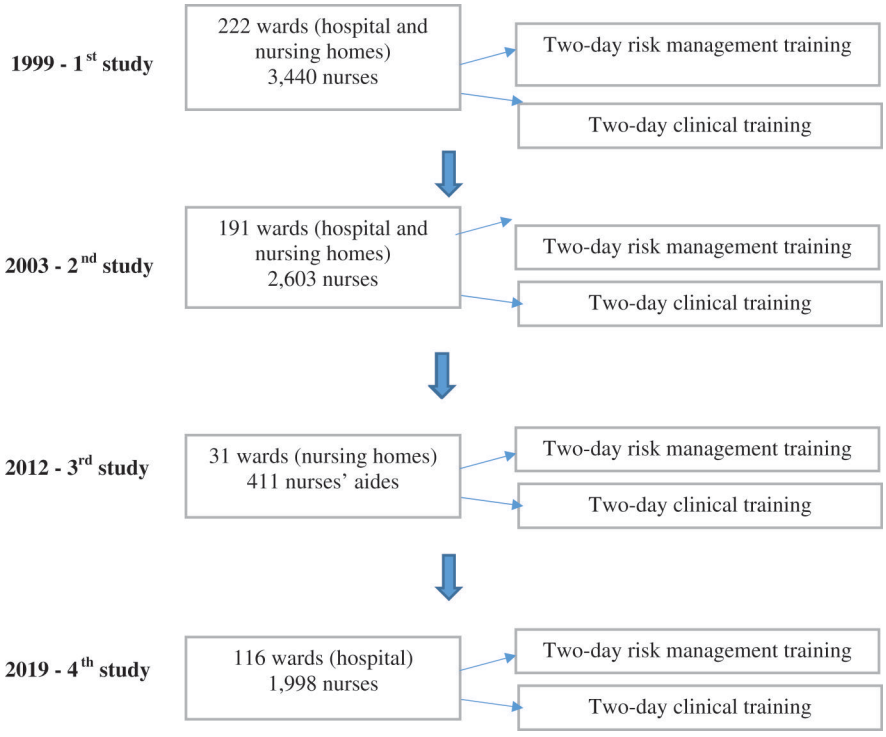

Figure 1. Validation studies on the relationship between the MAPO index and acute low back pain among exposed nurses and nurses' aides.

Table 2. Timeline of the tools developed in relation to the change in care activities.

Period	New tools	Aim of the tools
2011	Tool 1: MAPO screening checklist (Battevi, Menoni, and Alvarez-Casado 2012)	Define priorities of intervention to reduce risk
2013	Tool 2: sheet for type of patients in ward (Menoni, Battevi, and Cairoli 2015)[a]	Limit any potential overestimation or underestimation of the number of disabled patients.
2014–2019	Tool 3: monthly shift rotation (EPM International Ergonomics School – MAPO method 2002)	Limit any potential overestimation or underestimation of the number of operators by analysing the shifts actually worked.

[a]Figure 5.3.

PC) for 7 or 14 days, depending on the availability of the head nurse.

Section 3.1 below illustrates the results of the studies carried out in these wards.

Since 2014, an analysis of the shifts (Tool 3 – monthly shift rotation) worked by nurses and nurse's aides in the month leading up to the risk assessment has made it possible to determine the actual number of operators involved in patient handling activities in the different shifts, both as an average (Op) and as a range of monthly variability. Table 3 shows an example of a 14-day work schedule (M = morning; A = afternoon; N = Night) in a specific ward with 15 nurses, from which it can be assumed that the average number of operators (Op) is 8.6, with a range going from a minimum of 7 to a maximum of 10.

2.2. Analysis of organisational data related to risk quantification in hospital wards and nursing homes

From 2008 to 2019, organisational data from 528 hospital wards and 214 nursing homes were analysed to verify changes in the organisation of different wards. This process involved six Italian regions and 14,246 workers (nurses and nurse's aides) exposed to the risk of musculoskeletal disorders associated with MPH.

Table 3. Example of Tool 3 – partial monthly shift rotation.

	Days													
Nurses	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	M	A	N			M	A	N			M	A	N	
2	N				A	N			M	A	N			M
3		M	M	A	N			M	A	N			M	A
4	A	N			A	A	N		M	M		N		
5			A				A	A			M	M	M	A
6	M	M	M	M	M			M	M	A	A			M
7		M	A	N			M	A	N				M	N
8		A	A			M	M	A	A		M	M	A	
9	A	A	M		M									
10		M	M	M	A	A	M		M	M	A	A	A	
11	M		M	A	N		M	M			M	M	M	M
12	M	M	A	A		M							M	M
13				A	A	M		M	M	A	A			M
14	M	M												
15	A			M	M	A	A	M		M	M	A	A	
Total no. of Op	9	10	10	8	9	8	8	9	8	7	9	7	9	8
Average no. of Op				8.6			Range of Op					7 – 10		

In particular, the analysis concerned the following aspects:

- Number of beds;
- Number of operators involved in patient handling activities, including those off duty (staff);
- Number of operators assigned to patient handling tasks over a 24-hour period (Op);
- Number of NC patients;
- Number of PC patients;
- MAPO Index.

The results are broken down by hospital departments (medicine and surgery), hospital wards providing high-intensity care, and nursing homes. SPSS Statistics 23.0 software was used for descriptive data analysis and R software was used for quantitative analyses.

3. Results

3.1. Limiting variability of data collected during the interview

The first aspect addressed in the interview section of MAPO method concerns the number of NC and PC patients. In some wards, defining the number of patients routinely present can be very difficult

The sample that was analysed to quantify this aspect, which is subject to variability, concerns 20 different hospital wards for a total of 163 days of objective data collection.

Table 4 shows the number of beds occupied and compares the average number of disabled patients (NC and PC) reported during the interview with the corresponding average number objectively observed (Tool 2); objective data collection enables the range of variability of specific parameters to be determined. In some wards (Cardiology – Geriatrics – ENT – Medicine B) the range of variability is minimal or absent, and the average number of NC and PC patients identified on the days of the analysis is almost the same as the average number reported during the interview.

In other wards the average calculated on the basis of the objective data differs from the data gathered during the interview. In these instances, Tool 2 proved useful in determining both the average data and the range of variability in specific wards: in short, the level of risk exposure.

3.2. Quantitative data in hospital wards and nursing homes

Tables 5 and 6 summarise the main organisational data of 528 hospital wards, including 21 high-intensity intensive care units[5] and 214 nursing homes[6].

The comparison between hospital wards, intensive care units and nursing homes shows a substantially high exposure level to the risk of MPH in nursing homes (average MAPO Index equal to 6.15), medium risk in hospital wards (average MAPO Index equal to 2.6), and low risk in intensive care units (average MAPO Index equal to 1.19). These indexes are closely related to the ratio of disabled patients to operators involved in patient handling activities over 24 hours (D/Op). The mean difference in the D/Op ratios is statistically significant, reporting a p-value <0.001.

Figure 2 illustrates the trend for different MAPO exposure levels and D/Op ratios.

Table 5 shows that the D/Op ratio is 3.07 in nursing homes, significantly higher (comparison by means of D/Op ratio: p-value < 0.001) compared to corresponding ratio in hospital wards (1.32).

Table 4. Results of the objective observation of the number of disabled patients in 20 in-patient wards.

		Interview		Objective findings (Tool 2)						
		Average			Average		Min		Max	
Ward	No. of beds	NC	PC	No. observed days	NC	PC	NC	PC	NC	PC
Medicine 1	21	7	7	7	5	7	3	4	6	8
Neurology	44	12	11	7	16.7	11.6	11	5	24	17
Surgery	32	NR	NR	7	6.7	17.7	1	11	10	24
Rehabilitation 1	33	5	11	7	4	9.6	3	8	6	12
Cardiology 1	21	3	8	7	2.3	7.4	2	7	3	8
Surgery 1	26	4	6	7	4	6	2	4	6	8
ENT	14	2	3	7	2	3	2	3	2	3
Urology	21	3	4	7	2	5	1	4	3	6
Nephrology	20	4	8	7	3.8	6	2	5	6	8
Surgery 2	17	6	4	7	4.8	9	0	8	9	13
Surgery 3	24	5	4	14	4	6	2	4	6	8
Orthopedics	33	7	7	7	6	8.3	4	7	7	12
Geriatrics	19	10	5	7	10	5	10	5	10	5
Intensive care	28	4	8	9	6.1	8	2	6	9	8
Cardiology	14	5	6	7	4.5	4.7	3	3	6	7
CICU	8	1	6	14	1.8	5	0	4	3	8
Rehabilitation 2	25	5	14	14	6	14.4	5	13	8	17
Medicine B	25	19	4	7	19.4	4.4	19	4	20	5
Medicine 2	24	16	6	7	15.7	5.8	12	3	19	8
Medicine 3	22	NR	NR	7	11.2	6.3	7	5	15	13
Total observed days				163						

NR: not reported.

Table 5. Organisational data of hospital wards and nursing homes.

Hospital wards (no.=507)				Nursing home wards (no.=214)		
	Total	Average (S.D.)	Median	Total	Average (S.D.)	Median
No. beds	11,424	23 (11)	21	7,283	34 (19)	31
Staff[a]	10,066	20 (8)	18	3,679	17 (10)	15
D[b]	6,908	14 (10)	12	5,908	28 (16)	25
Op[c]	5,330	10.5 (4)	9.4	1,903	8.9 (4.5)	8.1
D/Op		1.32			3.07	
MAPO		2.6 (1.5)	2.4		6.15 (1.9)	6.28

[a]Total number of operators involved in patient handling activities, including those off duty.
[b]Disabled patients (NC + PC).
[c]Nurses and nurses' aides involved in manual patient handling activities over 24 hours.

Table 6. Organisational data of high intensity care units.

	High intensity care units (no.=21)		
	Total	Average (S.D.)	Median
No. beds	213	10 (11)	8
Staff	501	24 (14)	20
D	151	7.2 (3.4)	7
Op	283	13.5 (7.1)	12
MAPO		1.19 (0.4)	1.2

Table 7 summarises the level of MAPO exposure in the three groups of wards under examination: the data indicates high risk in 70.5% of nursing homes, compared to 7.3% in hospital wards. Consequently, 73.8% of workers in nursing homes are exposed to high risk.

Table 8 (hospital wards) and Table 9 (nursing homes) illustrate the organisational aspects (number of beds, total workforce) per shift and risk level: the significance of D/Nurses Morning (Disabled patients/nurses and nurses' aides working the morning shift), D/Nurses Afternoon (Disabled patients/nurses and nurses' aides working the afternoon shift), D/Nurses Night (Disabled patients/nurses and nurses' aides working the night shift) ratios is directly correlated with the number of patients that the individual operator cares for during each shift and can influence the frequency of patient handling tasks per operator.

In all the wards analysed, the number of operators (nurses or nurses' aides) on duty in the afternoon shift is lower than in the morning shift, although the number of patient handling tasks during the two shifts is very similar. In particular, the D/Nurses ratios in the three shifts increase proportionally with increases in the MAPO index (Tables 8 and 9).

Table 10 illustrates the D/Op (Disabled patients/Operators over 24 hours) ratios; considering that Op is the total number of operators (nurses and nurses' aides) covering three shifts and that operators usually

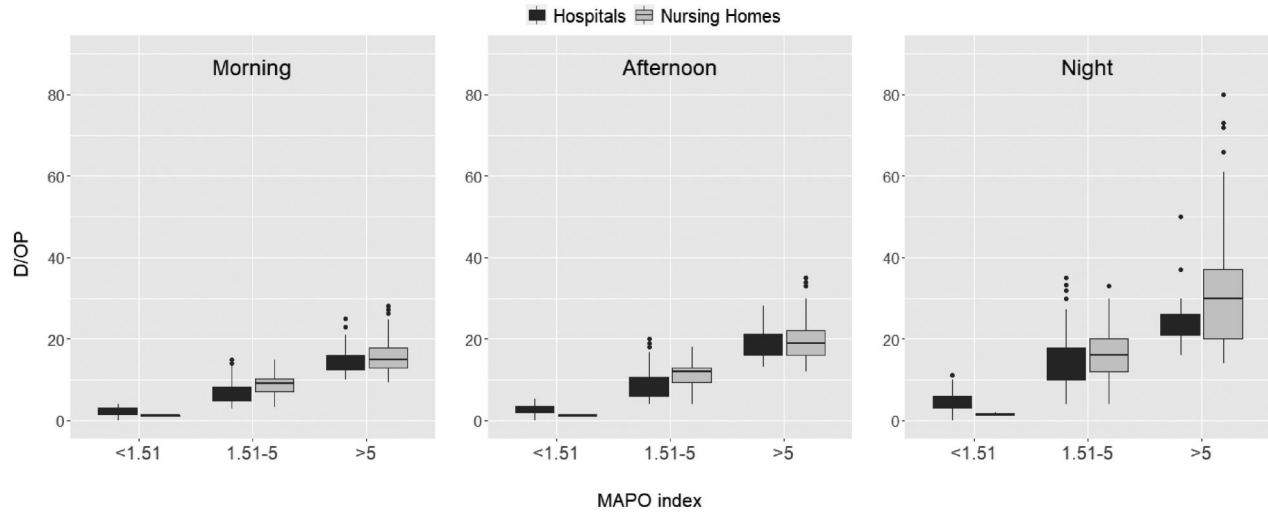

Figure 2. D/Op ratio across all three shifts in relation to the MAPO index in hospitals and nursing homes.

Table 7. Organisational data of three groups of wards in relation to the three MAPO risk levels.

	MAPO = 0–1.5		MAPO = 1.51–5		MAPO >5	
	No.	%	No.	%	No.	%
Hospital wards (507)	127	25.1	343	67.6	37	7.3
Exposed staff	2,332	23.2	6,919	68.7	815	8.1
Nursing home wards (214)	2	1	61	28.5	151	70.5
Exposed staff	15	0.4	949	25.8	2,715	73.8
Intensive care units (21)	19	90.5	2	9.5	0%	0
Exposed staff	467	93.2	34	6.8	0%	0
Total (742)	130	17.5	423	57	191	25.7

Table 8. Organisational data of hospital wards.

	MAPO = 0–1.5		MAPO = 1.51–5		MAPO >5	
Hospital wards (507)	No.	Average (S.D.)	No.	Average (S.D.)	No.	Average (S.D.)
Beds	2,149	17 (9)	8,142	24 (10)	1.133	31 (11)
Staff	2,332	18 (7)	6,919	20 (8)	815	22 (8)
D	590	5 (3)	5,399	16 (9)	919	26 (7)
D/Nurses morning		2.1 (1.1)		6.7 (2.4)		14.8 (3.2)
D/Nurses afternoon		2.7 (1.3)		8.9 (3.2)		18.6 (3.7)
D/Nurses night		4.2 (2.5)		13.7 (5.7)		24.1 (6.2)

carry out MPH activities in pairs, the frequency of overloading tasks per operator in each shift is higher.

The comparison of the D/Op ratio between nursing homes and hospital wards shows high significance (p-value < 0.001) for the medium and high exposure level (Table 10); no test was performed for the low exposure level due to the small number of nursing homes that belonged to this category.

In addition to nursing homes it is worth highlighting that in 53% of such facilities (Table 11) the number of operators working night shifts is less than or equal to 1. This means that one operator carries out patient handling activities in multiple wards.

Moreover, Table 11 shows that operators may work in pairs in 94.7% of hospital wards. On the other hand, only 44.8% of nursing homes have two operators working night shifts.

Tables 12 and 13 compare data from hospitals and nursing homes in various Italian regions.

The comparison involves hospitals located in six individual regions, while the nursing homes are located in two individual regions plus two

Table 9. Organisational data of nursing home wards.

	MAPO = 0–1.5		MAPO = 1.51–5		MAPO >5	
Nursing homes (214)	No.	Average (S.D.)	No.	Average (S.D.)	No.	Average (S.D.)
Beds	33	17 (8)	1,601	26 (12)	5,649	37 (21)
Staff	15	8 (2)	949	16 (8)	2,715	18 (11)
D	3	2 (1)	1,037	17 (9)	4,868	32 (16)
D/Nurses morning		1.2 (0.2)		8.7 (2.4)		15.5 (3.6)
D/Nurses afternoon		1.2 (0.3)		11.3 (3.2)		19.9 (4.7)
D/Nurses night		1.5 (0.7)		16.2 (6.6)		31 (12.7)

Table 10. Mean D/Op ratio in hospital wards (H) and nursing homes (NH).

	MAPO = 0–1.5			MAPO = 1.51–5			MAPO >5		
	H	NH	*p*-Value	H	NH	*p*-Value	H	NH	*p*-Value
D/Op	0.46	0.36	–	1.46	1.99	$p < 0.001$	3.02	3.54	$p < 0.001$

Table 11. Night shift workers in hospital and nursing home wards and number of wards followed.

	Hospital wards (no.=528)		Nursing homes (no.=214)	
Night shift workers	No.	(%)	No.	(%)
=<1	28	5.3	114	53.3
1< × <2	0	0	4	1.8
>=2	500	94.7	96	44.8

macro-regions (Liguria-Piedmont and Veneto-Trentino Alto Adige), with the macro-regions sharing similar mandated minimum staffing levels.

The comparison between hospitals and nursing homes highlights the unfavourable situation of nursing homes in terms of the total number of staff involved in patient handling activities versus operators.

The ratio of available staff (operators involved in patient handling activities, including those off duty) to operators working the three shifts (Op) in hospital wards is better, allowing the head nurse to organise the monthly shifts and avoid excessively burdensome workloads.

In cases where the difference between the two parameters (staff/Op) is lower than 10, it is difficult for the head nurse to organise a shift schedule that complies with the maximum number of hours per week allowed by Italian collective employments agreements. In nursing homes, the difference between the two parameters is often lower than 10, especially in the Liguria and Piedmont regions.

4. Discussion and conclusions

This article addresses the authors' experience with the MAPO method for quantifying exposure to risk of musculoskeletal disorders associated with MPH. The flow chart is crucial in understanding the development of the methodology as it illustrates four studies that have shown a positive correlation between risk of manual patient handling and low back injuries.

In contrast with the earliest MAPO research studies (Battevi et al. 1999, 2006) and analyses carried out in the period 1999–2006, today hospital wards, and especially nursing homes, have been provided with lifting equipment, constituting a significant improvement; however, 73.8% of the workforce in nursing homes is exposed to a high level of MAPO risk versus only 8.1% of hospital workers.

This aspect allowed us to pay more attention to the organisational aspects of the MAPO index, especially in nursing homes: the D/Op ratio of the three MAPO risk exposure levels shows a significant difference, (*p*-value < 0,001) especially for medium-high risk exposure levels.

This is particularly important because a large number of D patients requires a larger number of staff members who can take care of individual patients and provide a better quality of care.

Moreover, changes in the type of care delivered at the European level has made it necessary to develop two tools to support risk assessments and ensure that the data collected during interviews is as objective as possible (i.e. data regarding NC-PC patients and monthly shift rotations). The tools presented do allow for greater objectivity in quantifying the main risk determinants (namely, NC/Op and PC/Op) and accurately depict average scenarios as well as the range of variability in different wards.

The results of the objective data collected in 20 wards regarding the number of NC and PC patients did not show a substantially different average than the number reported during the interview; however,

Table 12. Organisational data of hospital wards (no.= 507) organised by regions.

Parameters	Lombardy 87 wards Average (S.D.)	Emilia-Romagna 68 wards Average (S.D.)	Liguria 76 wards Average (S.D.)	Apulia 231 wards Average (S.D.)	Piedmont 29 wards Average (S.D.)	Veneto 16 wards Average (S.D.)
No. beds	25 (10)	26 (15)	22 (10)	20 (8)	27 (13)	32 (13)
Staff	20 (8)	23 (11)	19 (7)	18 (6)	22 (8)	27 (10)
Disabled patients	13 (8)	18 (12)	13 (10)	11 (7)	20 (13)	23 (12)
Op	10.7 (3.9)	10.9 (4.8)	9.8 (4)	10 (3.2)	13 (4.6)	13.9 (6.4)
MAPO	2.5 (1.3)	3.37 (1.9)	2.7 (1.7)	2.35 (1.4)	2.96 (1.1)	3.45 (1.5)

Table 13. Organisational data of nursing home wards (no. 210) organised by regions and macro-regions.

Parameters	Lombardy 132 wards Average (S.D.)	Emilia-Romagna 14 wards Average (S.D.)	Liguria–Piedmont 18 wards Average (S.D.)	Veneto-Trentino 46 wards Average (S.D.)
No. beds	34 (19)	38 (30)	37.8 (26)	32.4 (12)
Staff	18 (11)	19 (13)	13.5 (6)	16.9 (8)
Disabled patients	28 (15)	31 (24)	30.5 (22)	26.1 (7)
Op	8.9 (4.7)	11.3 (7.5)	8.4 (3.4)	8.33 (2.9)
MAPO	6.28 (1.7)	5.37 (1.5)	6.58 (2.3)	6 (2.2)

they show a range of variability of the number of NC and PC patients that enables the minimum and maximum MAPO index of the specific ward to be calculated. Therefore, Tool 2 proved to be a useful way to better define weekly trends in the number of patients who need to be lifted.

In addition, the analysis of the actual shifts worked during the months (Tool 3) prior to the assessment of risk associated with MPH makes it possible to quantify the average number of hours worked by each worker. This number correlates with the increase in low back pain among caregivers who work additional daily hours (Shieh et al. 2016).

In some nursing homes, a computerised nursing record has been put in place for each patient, specifying the type of patient (NC or PC) and handling tasks (manual or aided) that are carried out. This proposal undoubtedly represents the most objective way to obtain data concerning specific risks, types of patients (NC or PC) and handling needs (manual or aided patient handling tasks).

Accordingly, it is worth underlining that Italy's regional regulations on the provision of staff in nursing homes ought to be revised, especially with reference to the large number of nursing homes (114, equal to 53%) in which night-shift operators cover multiple wards. This leads to a high risk associated with patient handling and low quality of care: as some operators work in different wards during the same shift, there might be an occasional lack of caregivers in some wards.

The ratios of D/Nurses Morning, Afternoon or Night define a high number of patients to be handled and, presumably, a high number of handling tasks to be performed per operator during each shift.

The next article will complete this analysis of the evolution of MAPO method by quantifying patient handling tasks in different shifts both in hospitals and nursing homes. It will also illustrate the breakdown of tasks by risk of biomechanical overload.

Notes

1. Cycles of shifts: morning-afternoon-night-2 rests
2. Patients who must be lifted entirely during handling operations.
3. Patients who need to be partially moved or lifted during handling operations.
4. Figure 5.3
5. Involving a total number of 10,567 nurses assigned to patient handling activities.
6. Involving a total number of 3,679 nurses' aides assigned to patient handling activities.

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