

Capturing the chance for pneumococcal vaccination in the hospital setting

Francesco Di Nardo¹, Giovanna Elisa Calabrò¹, Carolina Ianuale¹, Andrea Poscia¹, Elena Azzolini¹, Massimo Volpe² and Chiara de Waure¹

¹Istituto di Sanità Pubblica, Università Cattolica del Sacro Cuore di Roma, Rome, Italy

²Fondazione Policlinico Universitario "A. Gemelli", Rome, Italy

Abstract

Introduction. Because of the relevant burden of pneumococcal diseases, newborns, people at risk and elderly are recommended vaccination but coverage is still low for problems in catching them. This study evaluates the proportion of eligible patients seen at hospital level in the view of assessing its potential role in vaccination campaigns.

Methods. This is a retrospective analysis of discharge data of all patients over 49 years of age admitted between 2011 and 2013 to "A. Gemelli" teaching hospital. Eligibility for pneumococcal vaccination was evaluated based on ICD-9 codes.

Results. Among 65 047 unique patients, 53.2% were eligible for pneumococcal vaccination. Most common eligibility criteria were chronic heart diseases, cancer and diabetes. Considering also age ≥ 65 as an indication to vaccination, the proportion of eligible patients reached 76.8%. The highest number of eligible patients was seen in medical sciences, general surgery, cardiovascular medicine and neurosciences departments.

Conclusions. Hospital might play an important role in catching patients eligible for pneumococcal vaccination because their proportion in the hospital setting is high.

Key words

- *Streptococcus pneumoniae*
- vaccination
- hospital medicine

INTRODUCTION

Streptococcus pneumoniae (Sp) is responsible for different diseases: upper and lower respiratory infections – i.e. community-acquired pneumonia (CAP) – particularly in elderly, as well as otitis and invasive pneumococcal diseases (IPD), e.g. meningitis and bacteremia, especially in children. Sp is a leading cause of infection worldwide and in all age groups with elderly and people with one or more risk factors showing the highest incidence rates and burden of disease [1]. Chronic medical conditions, such as chronic liver disease, chronic heart or lung disease, diabetes, asthma, neuromuscular disorders as well as alcohol abuse, smoking, asplenia and immunocompromising conditions are the main risk factors for Sp [2, 3]. Furthermore, accumulation of concurrent at-risk conditions significantly increases the risk, independently of age [4-6]. Alongside an increased incidence of pneumococcal diseases, patients at risk occur also higher costs if affected [7].

Sp is responsible of around 30% of all CAP [8, 9]. Annual incidence rates of CAP are estimated to range from 1.6 to 11.6 per 1000 [10, 11]. Nevertheless, the incidence rate is four-times higher in elderly and at risk people as compared to younger people [7, 12, 13]. Furthermore, elderly and patients at risk for Sp have also a higher mortality [14].

According to the data from the European Centre for

Disease Prevention and Control, the incidence of IPD varies from 0.2 to 13.4 cases per 100 000 population across EU/EEA countries [15] with a lethality of 3-35% [16, 17]. Italy has reported an incidence rate of confirmed cases of 2.41 per 100 000 in 2016. Nevertheless, looking only at Regions that pay more attention to notification, the incidence increases to 4.58 per 100 000 [18].

Three vaccines are available in order to protect against pneumococcal diseases, namely the 13-valent and the 10-valent pneumococcal conjugate vaccine (PCV10 and PCV13) and the 23-valent polysaccharide (PPV23). They are directed towards different Sp serotypes allowing protection against a part of pneumococcal diseases. Currently the PCV13 is included in the National Immunization Program (NIP) of some European countries for vaccination of newborns. The vaccine has been also licensed for the use in all age groups for the prevention of CAP and IPD. PCV13 provides elderly and patients at risk with a new weapon against pneumococcal diseases. In fact, the other vaccine used in this target population, i.e. the PPV23, has shown some limits [19]. PCV13 has been shown to reduce vaccine-type CAP by 45% and vaccine-type IPD by 75% [20]. Consequently, the current Italian NIP recommends vaccinating elderly and people at risk [3].

Although the herd effect of the infant vaccination programme is meant to indirectly protect unvaccinated

people, the burden of preventable pneumococcal diseases remains high, in particular in elderly and people at risk [21]. Eventually, vaccinating all groups at risk for Sp would have a relevant public health impact [22]. In Italy, both the previous (2012-2014) and the current (2017-2019) NIP recommends vaccination in newborns but also in people at risk for Sp, including elderly [3, 23]; the last one recommends a sequential administration of PCV13 and PPV23 at 65 years. Following the approval of the 2012-2014 NIP, each Region has delivered its own Immunization Program enclosing details on patients at risk for Sp and on vaccination strategies to catch them. Lazio Region, at the end of 2012, delivered the list of conditions at risk for Sp [24]. Nevertheless, from 2012 onward, no specific vaccination campaigns were implemented to reach people at risk. Only at the end of 2015, the Region has set an age based vaccination campaign targeting elderly, which was not uniformly implemented. Vaccination coverage among elderly is very low with regional estimates ranging from 0.7% to 50% [25]. Even though data for people at risk are not known, it may be expected that vaccination coverage is low also among them. In fact, also international evidence shows that, albeit the most of patients with pneumococcal diseases have two or more risk factors, vaccination coverage in population at risk for Sp is quite low, 25-30% overall [26-27].

In the light of this context, the Università Cattolica del Sacro Cuore has performed a pilot project together with the Fondazione Policlinico Universitario "A. Gemelli" aimed at identifying and vaccinating patients at risk for Sp in the hospital setting. Within the project, a retrospective assessment of the amount of people likely eligible to receive pneumococcal vaccination was carried out to characterize their distribution across hospital wards and departments. This analysis, together with the results of the prospective phase of the project on vaccination of people at risk in the hospital, which will be the objective of a further paper, could be helpful in order to inform decision makers about the more suitable setting and ways to offer people at risk for Sp with the vaccination.

MATERIALS AND METHODS

A retrospective analysis was performed to identify patients eligible to receive pneumococcal vaccination among all people aged 50 years or older admitted in a three-year period between January 1st 2011 and December 31st 2013 to any of the departments of the Fondazione Policlinico Universitario "A. Gemelli". The hospital is located in Lazio, a Region housing, in the three-year study period, a mean of 5,520,061 people (9.3% of the Italian population) [28]. According to 2013 mission report, the Fondazione Policlinico Universitario "A. Gemelli", in the three-year study period, had a mean of 1610 hospital beds for acute patients representing 8% of all regional hospital beds and 13% of the hospital beds belonging to the local health authorities in Rome [29]. The analysis was carried out on hospital discharge records including ordinary admissions, but also inpatient rehabilitation, day hospital and day surgery admissions. For each patient, only the first admission to the

hospital in the study period was considered, while the following admissions were excluded from the analysis. Demographic data (gender, date of birth, place of residence) were used to identify and subsequently exclude following admissions. Eligibility criteria were defined according to vaccination recommendations proposed by the Lazio Region for pneumococcal vaccination [24]. These recommendations overlap with national ones included in the previous and in the current NIP. The following conditions were considered increasing the risk for pneumococcal disease: chronic heart, lung or liver diseases; alcoholism; diabetes mellitus; cerebrospinal fluid fistulas; sickle cell disease and thalassemia; congenital or acquired immunodeficiency; anatomic or functional asplenia; leukemia, lymphoma or multiple myeloma; disseminated cancers; organ or bone marrow transplant; clinically significant iatrogenic immunosuppression; chronic renal failure, nephrotic syndrome; HIV; presence of a cochlear implant. Eligibility criteria for pneumococcal vaccination were identified using the ICD-9-CM codes that were in force during the study period in Italy [30]. For each patient, data reported in both primary and secondary diagnoses and in procedures fields were taken into account. Eligible patients were defined as those who showed at least one of the aforementioned criteria in any of the fields described. Since the WHO and the current 2017-2019 NIP recommend vaccinating against pneumococcal disease all subjects aged 65 or older [3, 31], we also stratified the results for age class focusing the attention to the age group 50-64. Furthermore, a secondary analysis was performed considering eligible both people with one of the abovementioned criteria and those ≥ 65 years of age. In order to assess the potential role of the hospital as a setting for catching people at risk for Sp, the overall proportion of patients eligible for pneumococcal vaccination was calculated. The analysis was also stratified by type of hospitalization (ordinary, day hospital or day surgery, rehabilitation), department and unit of admission. The distribution of patients eligible for pneumococcal vaccination by eligibility criteria was also analyzed. The statistical analysis was performed using the IBM SPSS 22.0 software for Windows.

RESULTS

Between January 1st 2011 and December 31st 2013, a total of 120 010 hospital admissions were recorded at the Fondazione Policlinico Universitario "A. Gemelli". These admissions corresponded to 65 046 unique patients (54.2% of the admissions in the study period were first admissions). Females were 33 497 (51.5% of the sample); median age was 68 (interquartile range: 17), and 38 879 (59.8%) patients were aged 65 or above. Of the 65 046 unique patients, 46 785 (71.9%) underwent an ordinary admission, 18 076 (27.8%) a day hospital or a day surgery and 185 (0.3%) were admitted to rehabilitation units.

Overall, 34 575 unique patients were eligible for pneumococcal vaccination (53.2% of the sample), with 10 970 patients showing more than one criteria (16.9% of the sample, 31.7% of the eligible subjects). Most commonly observed eligibility criteria were chronic heart dis-

eases (28.3% of the admitted patients), cancer (21.3%), diabetes (8.5%) and chronic lung disease (5.0%) (Table 1). When considering also the age (≥ 65 years of age or above) as a criterion for vaccination, the proportion of eligible patients raised to 76.8%. In particular, 15 380 patients (23.6% of the whole sample) showed no other vaccination criteria than age. Table 2 reports the figures of patients eligible for pneumococcal vaccination because either ≥ 65 years of age or affected by an at-risk condition in each department and single unit.

Of the 38 879 patients aged 65 or above, 23 499 (60.4%) showed at least one risk condition for Sp as compared to 11 076 out of 26 167 among patients under the age of 65 (42.3%) (Table 3).

Of the 46 785 patients who were seen during an ordinary admission, 27 612 were eligible for vaccination (59.0%) while of the 18 076 patients seen during a day hospital/surgery admission 6848 (37.9%) were eligible. One-hundred sixteen out of 185 patients admitted to any of the rehabilitation units (62.7%) were also eligible.

In terms of relative frequencies, the departments showing the highest proportion of eligible patients were as follows: radiology (which includes the radiotherapy unit and in which 94.8% of the patients were eligible for pneumococcal vaccination), cardiovascular medicine (85.4%) and the public health department (which includes the infectious diseases units, 77.4%). In terms of absolute numbers, most of the eligible patients were observed in the medical sciences department (8485 pa-

tients), the general surgery department (6852), the department of cardiovascular medicine (5502) and the department of neurosciences, gerontology and orthopedic surgery (4564). With respect to eligible patients aged less than 65 years, they were more commonly seen, in terms of relative frequencies, in the same departments but, as far as absolute numbers are concerned, they were highly represented in the departments of obstetrics and gynecology (which includes gynecology oncology and breast surgery), medical sciences, cardiovascular medicine and general surgery.

DISCUSSION

According to our retrospective study, the hospital seems a promising setting in order to catch and to vaccinate those at risk for pneumococcal diseases, as 53.2% of the patients aged 50 years or older are eligible for vaccination because of the presence of a chronic condition or immunodepression. Eligible patients were more frequently observed in the cardiovascular medicine department (5502 subjects overall, corresponding to 85.4% of the patients admitted to that department), the internal medicine units (3659, 81.0%) and the geriatric ward (1043, 82.1%). All these accounted for 29.5% of eligible patients observed in the over 100 wards, rehabilitations and day hospital/day surgery units of the hospital. Therefore, these departments/units could be best suited for identifying patients eligible to receive pneumococcal vaccination. Even if radiotherapy ward

Table 1

Distribution of patients eligible for pneumococcal vaccination according to the Lazio Region recommendations [24]. For each condition, the corresponding ICD-9-CM codes used to assess the prevalence are reported

Criteria	ICD-9-CM codes	N	%
Chronic heart disease	394.0-398.99; 401.0-402.91; 412; 413.0-414.9; 416.0-416.9; 423.1-426.89; 427.31-427.32; 428.0-428.9; 429.0-429.9; 440.0-440.9	18 400	28.3
Disseminated cancers	140.0-195.8; 196.0-198.8; 199.0; 199.1	13 861	21.3
Diabetes mellitus	250.00-250.93	5561	8.5
Chronic lung disease	114.4; 490-496; 500-505; 506.4; 506.9; 508.1; 514-516.9; 517.1-517.8; 518.1-518.3; 518.83-518.84	3258	5.0
Clinically significant iatrogenic immunosuppression	V58.1-V58.12; V58.65; E933.1	2191	3.4
Chronic liver disease	070.22-070.23; 070.32-070.33; 070.44; 070.54; 571; 571.2; 571.40-571.5; 571.8-571.9	1557	2.4
Chronic renal failure or nephrotic syndrome	585.1-585.9; 403.00-403.91; 404.00-404.93; 405.01; 581.0-581.9; V13.03	1341	2.1
Leukemia, lymphoma, multiple myeloma	200.0-208.91	1242	1.9
HIV	042; V08	178	0.3
Alcoholism	291.0-291.9; 292.2; 303.90-303.93; 305.00-305.03; 357.5; 425.5; 535.3; 571.0; 980.0; V11.3; V79.1	175	0.3
Anatomic or functional asplenia	41.5; 759.0	76	0.1
Organ or bone marrow transplant	33.50-33.52; 33.6; 37.51; 41.00-41.09; 41.94; 46.97; 50.51; 50.59; 52.80-52.86; 55.61; 55.69	61	0.1
Presence of a cochlear implant	20.96-20.99; 95.49	54	0.1
Congenital or acquired immunodeficiency	279.0-279.3; 279.8-279.9	33	0.1
Sickle cell disease or thalassemia	282.41-282.49; 282.60-282.69	20	< 0.1
Cerebrospinal fluid fistulas	02.12; 388.61	4	< 0.1

Table 2

Distribution of patients eligible for pneumococcal vaccination stratified by hospital department and unit

Department	Unit	N total admission	Affected by at least one risk condition		Affected by at least one risk condition or ≥ 65 years of age	
			N eligible	Eligible (%)	N eligible	Eligible (%)
Department of medical sciences	Internal and clinical medicine*	1923	1516	78.8	1819	94.6
	Internal medicine (and angiology)*	1501	1284	85.5	1439	95.9
	Internal medicine (and gastroenterology)*	1090	859	78.8	994	91.2
	Endocrinology	1057	768	72.7	935	88.5
	Pulmonology	524	485	92.6	513	97.9
	Dermatology	296	190	64.2	230	77.7
	Obesity diseases	339	265	78.2	315	92.9
	Hematology	374	318	85.0	341	91.2
	Oncology	664	648	97.6	653	98.3
	Day hospital**	4109	2152	52.4	2836	69.0
	Total	11 877	8485	71.4	10 075	84.8
Department of cardiovascular medicine	Cardiology*	2944	2655	90.2	2813	95.6
	Cardiac and vascular surgery*	1981	1814	91.6	1919	96.9
	Coronary unit	896	593	66.2	755	84.3
	Chest pain	393	295	75.1	359	91.3
	Day hospital**	228	145	63.6	196	86.0
	Total	6442	5502	85.4	6042	93.8
Department of obstetrics and gynecology	Gynecology and obstetrics*	646	37	5.7	212	32.8
	Gynecologic oncology	1620	1287	79.4	1416	87.4
	Gynecologic surgery	252	74	29.4	133	52.8
	Breast surgery	854	765	89.6	801	93.8
	Day hospital**	605	405	66.9	441	72.9
	Total	3977	2568	64.6	3003	75.5
Department of neurosciences, gerontology and orthopedic surgery	Neurology*	1668	748	44.8	1247	74.8
	Rehabilitation***	185	116	62.7	176	95.1
	Orthopedic surgery and traumatology*	3028	347	11.5	2139	70.6
	Geriatric ward	1270	1043	82.1	1243	97.9
	Stroke unit	522	322	61.7	429	82.2
	Day hospital**	3526	1988	56.4	2795	79.3
	Total	10 199	4564	44.7	8029	78.7
Department of general surgery	Digestive surgery and proctology*	1159	712	61.4	936	80.8
	General surgery (and transplants)*	1047	647	61.8	781	74.6
	General surgery (and hepatobiliary surgery)*	945	573	60.6	733	77.6
	General surgery (and endocrine surgery)*	1693	342	20.2	846	50.0
	Urology	1719	1075	62.5	1418	82.5
	Plastic surgery	287	134	46.7	181	63.1
	General surgery	904	516	57.1	715	79.1
	Thoracic surgery	856	602	70.3	731	85.4
	Digestive endoscopy	1798	551	30.6	1344	74.7
	Emergency surgery	1755	875	49.9	1395	79.5
	Day hospital**	2478	825	33.3	1546	62.4
	Total	14 641	6852	46.8	10 626	72.6
Department of diseases of the head and neck	Neurosurgery*	1380	282	20.4	851	61.7
	Ophthalmology and ocular oncology*	562	142	25.3	413	73.5
	Otolaryngology	1276	517	40.5	766	60.0
	Neuro-traumatology	513	142	27.7	359	70.0
	Day hospital**	2650	390	14.7	1721	64.9
	Total	6381	1473	23.1	4110	64.4
Department of public health	Infectious diseases*	606	448	73.9	509	84.0
	Day hospital	169	152	89.9	161	95.3
	Total	775	600	77.4	670	86.5

Continues

Table 2
Continued

Department	Unit	N total admission	Affected by at least one risk condition		Affected by at least one risk condition or ≥ 65 years of age	
			N eligible	Eligible (%)	N eligible	Eligible (%)
Emergency department	Short stay and post-operative intensive care*	2073	1658	80.0	1896	91.5
	Intensive care	577	237	41.1	435	75.4
	Total	2650	1895	71.5	2331	88.0
Radiology department	Radiotherapy*	485	449	92.6	476	98.1
	Day hospital	259	256	98.8	258	99.6
	Total	744	705	94.8	734	98.7
Interdepartmental day hospital	Day hospital	320	196	61.3	234	73.1
	Day surgery	3721	333	8.9	1707	45.9
	Total	4041	529	13.1	1941	48.0
Private practice	Medical and dental private practice*	3319	1402	42.2	2394	72.1
Total		65 046	34 575	53.2	49 955	76.8

*At least two units combined. **At least two day hospital units combined. ***Includes four units exclusively dedicated to rehabilitation admissions.

Table 3

Distribution of patients eligible for pneumococcal vaccination because affected by at least one at risk condition, stratified by hospital department and unit and age

Department	Unit	50-64 years of age		65+ years of age	
		N eligible	Eligible (%)	N eligible	Eligible (%)
Department of medical sciences	Internal and clinical medicine*	316	75.2	1037	87.0
	Internal medicine (and angiology)*	247	79.9	1200	79.8
	Internal medicine (and gastroenterology)*	241	71.5	618	82.1
	Endocrinology	240	66.3	528	76.0
	Pulmonology	94	89.5	391	93.3
	Dermatology	72	52.2	118	74.7
	Obesity diseases	113	82.5	152	75.2
	Hematology	161	83.0	157	87.2
	Oncology	246	95.7	402	98.8
	Day hospital**	1040	45.0	1112	61.9
	Total	2770	60.6	5715	78.2
Department of cardiovascular medicine	Cardiology*	794	85.8	1861	92.2
	Cardiac and vascular surgery*	445	87.8	1369	92.9
	Coronary unit	153	52.0	440	73.1
	Chest pain	75	68.8	220	77.5
	Day hospital**	33	50.8	112	68.7
	Total	1500	78.9	4002	88.1
Department of obstetrics and gynecology	Gynecology and obstetrics*	21	4.6	16	8.4
	Gynecologic oncology	681	76.9	606	82.4
	Gynecologic surgery	36	23.2	38	39.2
	Breast surgery	402	88.4	363	91.0
	Day hospital**	216	56.8	189	84.0
	Total	1356	58.2	1212	73.6
Department of neurosciences, gerontology and orthopedic surgery	Neurology*	247	37.0	501	50.1
	Rehabilitation***	11	55.0	105	63.6
	Orthopedic surgery and traumatology*	90	9.2	257	12.5
	Geriatric ward	67	71.3	976	83.0
	Stroke unit	85	47.8	237	68.9
	Day hospital**	195	21.1	1793	69.0
	Total	695	24.3	3869	52.8

Continues

Table 3
Continued

Department	Unit	50-64 years of age		65+ years of age	
		N eligible	Eligible (%)	N eligible	Eligible (%)
Department of general surgery	Digestive surgery and proctology*	262	54.0	450	66.8
	General surgery (and transplants)*	270	50.4	377	73.8
	General surgery (and hepatobiliary surgery)*	217	50.6	356	69.0
	General surgery (and endocrine surgery)*	220	20.6	122	19.5
	Urology	315	51.1	760	68.9
	Plastic surgery	29	21.5	105	69.1
	General surgery	156	45.2	360	64.4
	Thoracic surgery	192	60.6	410	76.1
	Digestive endoscopy	141	23.7	410	34.1
	Emergency surgery	215	37.4	660	55.9
	Day hospital**	302	24.5	523	42.0
	Total	2319	36.6	4533	54.6
Department of diseases of the head and neck	Neurosurgery*	117	18.1	165	22.5
	Ophthalmology and ocular oncology*	46	23.6	96	26.2
	Otolaryngology	221	30.2	296	54.3
	Neuro-traumatology	39	20.2	103	32.2
	Day hospital**	172	15.6	218	14.1
	Total	595	20.8	878	25.0
Department of public health	Infectious diseases*	241	71.3	207	77.2
	Day hospital	70	89.7	82	90.1
	Total	311	74.8	289	80.5
Emergency department	Short stay and post-operative intensive care*	414	70.1	1244	83.9
	Intensive care	61	30.0	176	47.1
	Total	475	59.8	1420	76.5
Radiology department	Radiotherapy*	211	95.9	238	89.8
	Day hospital	105	99.1	151	98.7
	Total	316	96.9	389	93.1
Interdepartmental day hospital	Day hospital	112	56.6	84	68.9
	Day surgery	111	5.2	222	13.9
	Total	223	9.6	306	17.8
Private practice	Medical and dental private practice*	516	35.8	886	47.2
Total		11 076	42.3	23 499	60.4

*At least two units combined. **At least two day hospital units combined. ***Includes four units exclusively dedicated to rehabilitation admissions

and day hospital and the oncology units only registered, respectively, 705 and 648 cases of patients eligible for pneumococcal vaccination, these represented nearly all their patients (94.8% and 97.6% respectively). Consequently, also such units could play a role in catching patients at risk.

When considering also all patients aged 65 or older eligible for vaccination even though without risk factors for pneumococcal diseases, the proportion of eligible patients considerably increased to around 77%. An age-based vaccination campaign would probably catch elderly people outside the hospital setting. However, it should be taken into consideration that, in our study, more than 40% of subjects younger than 65 years of age showed at least one of the eligibility criteria for pneumococcal vaccination. These subjects could be reached

by their general practitioners but, because of the supposed low level of vaccination coverage, we may suggest that this target could also benefit from a hospital based campaign. In fact, the check of vaccination status and the inclusion of vaccination in inpatient pathways have already been investigated as a solution to increase coverage against influenza and Sp [32-34]. The high proportion of subjects at risk among people < 65 years of age confirms that the hospital may work as a valuable setting for increasing vaccination coverage. These patients were more commonly seen in different settings as compared to the whole group of eligible subjects. In fact, they were also frequently observed, in absolute terms, in the department of obstetrics and gynecology and in the day hospital of the medical sciences department. This is probably due to the high prevalence of

relatively young women living with (or in follow-up for) breast or cervical cancer and of relatively young people living with other cancers or diabetes.

Other studies have investigated the prevalence of at risk conditions for Sp. Pelton *et al.* found that 25% of adults from 50 to 64 years of age had at least one at-risk condition and that 6% had a high-risk condition [35]. High-risk conditions, namely those determining immunodepression, were found in a similar percentage of cases also in a cross-sectional study conducted in Spain (5.1%) [36].

Our results depict the frequency of at-risk conditions for Sp in the hospital population and provide a picture of the distribution of patients eligible to receive pneumococcal vaccination among different units over a three-year period. On the other hand, the fact that the study considered only one hospital may be considered a limit. In fact, other hospitals may admit different kinds of patients, which implies that both the proportion of eligible patients itself and the distribution of eligibility criteria may be different. Furthermore, the results (and particularly the absolute numbers of patients eligible for pneumococcal vaccination) are influenced by the number of hospital beds in each ward. Another limit of the study is represented by the use of ICD-9-CM codes for detecting people eligible to be vaccinated. This approach may have led to a misclassification of people, possibly underestimating the proportion of candidates for vaccination. Another pitfall is represented by the lack of information about vaccination status of eligible people. As for the strengths, this study is, to the best of

our knowledge, the first Italian attempt to describe the distribution of eligibility for pneumococcal vaccination in hospitalized patients. The proportion of candidates for pneumococcal vaccination could be extrapolated to other tertiary hospitals and considered to inform optimal pneumococcal vaccination strategies. In fact, it is important to guarantee vaccination to people at risk for pneumococcal diseases and to take advantage of any opportunity to do it. The hospital stay or discharge can be considered one of these opportunities and this is supported by data arising from our study.

CONCLUSION

In order to increase vaccination coverage among people at risk for pneumococcal diseases, new strategies should be pursued. The hospital may play a relevant role in detecting people at risk as this study demonstrates that the prevalence of patients eligible for pneumococcal vaccination is quite high in the hospital setting. In particular, some departments/units, such as cardiovascular medicine department and internal medicine and geriatric units may be an elected place for capturing people at risk through counseling, recommendation, proposal and offer of the vaccination.

Conflicts of interest statement

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REFERENCES

1. Torres A, Blasi F, Peetermans WE, Viegi G, Welte T. The aetiology and antibiotic management of community-acquired pneumonia in adults in Europe: a literature review. *Eur J Clin Microbiol Infect Dis* 2014;33(7):1065-79. DOI: 10.1007/s10096-014-2067-1
2. Centers for Disease Control, Prevention (CDC). Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine for adults with immunocompromising conditions: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep* 2012;61:816-9.
3. Piano Nazionale Prevenzione Vaccinale 2017-2019. Available from: www.salute.gov.it/imgs/C_17_pubblicazioni_2571_allegato.pdf.
4. Pelton SI, Shea KM, Farkouh RA, Strutton DR, Braun S, Jacob C, Klok R, Gruen ES, Weycker D. Rates of pneumonia among children and adults with chronic medical conditions in Germany. *BMC Infect Dis* 2015;15:470. DOI: 10.1186/s12879-015-1162-y
5. Shea KM, Edelsberg J, Weycker D, Farkouh RA, Strutton DR, Pelton SI. Rates of pneumococcal disease in adults with chronic medical conditions. *Open Forum Infect Dis* 2014;1(1):ofu024. DOI: 10.1093/ofid/ofu024
6. Curcio D, Cané A, Isturiz R. Redefining risk categories for pneumococcal disease in adults: critical analysis of the evidence. *Int J Infect Dis* 2015;37:30-5. DOI: 10.1016/j.ijid.2015.05.003
7. Weycker D, Farkouh RA, Strutton DR, Edelsberg J, Shea KM, Pelton SI. Rates and costs of invasive pneumococcal disease and pneumonia in persons with underlying medical conditions. *BMC Health Serv Res* 2016;16(1):182. DOI: 10.1186/s12913-016-1432-4
8. Rozenbaum MH, Pechlivanoglou P, van der Werf TS, Lo-Ten-Foe JR, Postma MJ, Hak E. The role of Streptococcus pneumoniae in community-acquired pneumonia among adults in Europe: a meta-analysis. *Eur J Clin Microbiol Infect Dis* 2013;32:305-16. DOI: 10.1007/s10096-012-1778-4
9. Cilloniz C, Ewig S, Polverino E, Prina E, Sellares J, Ferrer M, Ortega M, Gabarrús A, Mensa J, Torres A. Community-acquired pneumonia in outpatients: aetiology and outcomes. *Eur Respir J* 2012;40:931-8.
10. Almirall J, Bolibar I, Vidal J, Sauca G, Coll P, Niklasson B, Bartolomé M, Balanzó X. Epidemiology of community-acquired pneumonia in adults: a population-based study. *Eur Respir J* 2000;15:757-63.
11. Jokinen C, Heiskanen L, Juvonen H, Kallinen S, Karkola K, Korppi M, Kurki S, Rönnerberg PR, Seppä A, Soimakallio S. Incidence of community-acquired pneumonia in the population of four municipalities in eastern Finland. *Am J Epidemiol* 1993;137:977-88.
12. Janssens JP, Krause KH. Pneumonia in the very old. *Lancet Infect Dis* 2004;4(2):112-24.
13. Vila-Corcoles A, Aguirre-Chavarria C, Ochoa-Gondar O, de Diego C, Rodriguez-Blanco T, Gomez F, Raga X, Barnes L, Magarolas R, Esteban L. Influence of chronic illnesses and underlying risk conditions on the incidence of pneumococcal pneumonia in older adults. *Infection*

- 2015;43(6):699-706. DOI: 10.1007/s15010-015-0801-y
14. Kothe H, Bauer T, Marre R, Suttorp N, Welte T, Dalhoff K; Competence Network for Community-Acquired Pneumonia study group. Outcome of community-acquired pneumonia: influence of age, residence status and antimicrobial treatment. *Eur Respir J* 2008;32(1):139-46. DOI: 10.1183/09031936.00092507
15. European Centre for Disease Prevention and Control. *Annual Epidemiological Report 2016. Invasive pneumococcal disease*. Stockholm: ECDC; 2016. Available from: <http://ecdc.europa.eu/en/healthtopics/invasivepneumococcal-disease/Pages/Annualedpidemiologicalreport2016.aspx>.
16. Kyaw MH, Christie P, Clarke SC, Mooney JD, Ahmed S, Jones IG, Campbell H. Invasive pneumococcal disease in Scotland, 1999-2001: use of record linkage to explore associations between patients and disease in relation to future vaccination policy. *Clin Infect Dis* 2003;37:1283-91.
17. Rock C, Sadlier C, Fitzgerald J, Kelleher M, Dowling C, Kelly S, Bergin C. Epidemiology of invasive pneumococcal disease and vaccine provision in a tertiary referral center. *Eur J Clin Microbiol Infect Dis* 2013;32(9):1135-41. DOI: 10.1007/s10096-013-1859-z
18. Istituto Superiore di Sanità. Epicentro. *Dati di sorveglianza delle malattie batteriche invasive aggiornati al 3 aprile 2017*. Available from: www.epicentro.iss.it.
19. Alicino C, Barberis I, Orsi A, Durando P. Pneumococcal vaccination strategies in adult population: perspectives with the pneumococcal 13 - valent polysaccharide conjugate vaccine. *Minerva Med* 2014;105(1):89-97.
20. Isturiz R, Webber C. Prevention of adult pneumococcal pneumonia with the 13-valent pneumococcal conjugate vaccine: CAPiTA, the community-acquired pneumonia immunization trial in adults. *Hum Vaccin Immunother* 2015;11(7):1825-7. DOI: 10.1080/21645515.2015.1043502
21. Muhammad RD, Oza-Frank R, Zell E, Link-Gelles R, Narayan KM, Schaffner W, Thomas A, Lexau C, Bennett NM, Farley MM, Harrison LH, Reingold A, Hadler J, Beall B, Klugman KP, Moore MR. Epidemiology of invasive pneumococcal disease among high-risk adults since the introduction of pneumococcal conjugate vaccine for children. *Clin Infect Dis* 2013;56:e59-e67. DOI: 10.1093/cid/cis971
22. Porchia BR, Bonanni P, Bechini A, Bonaccorsi G, Boccalini S. Evaluating the costs and benefits of pneumococcal vaccination in adults. *Expert Rev Vaccines* 2017;16(2):93-107. DOI: 10.1080/14760584.2017
23. Piano Nazionale Prevenzione Vaccinale 2012-2014. Available from: www.salute.gov.it/imgs/C_17_pubblicazioni_1721_allegato.pdf.
24. Bollettino Ufficiale della Regione Lazio, N. 63 del 13/11/2012. Available from: www.regione.lazio.it.
25. Istituto Superiore di Sanità. Centro nazionale di epidemiologia, sorveglianza e promozione della salute. *Dati e evidenze disponibili per l'utilizzo dei vaccini anti-pneumococcali nei soggetti a rischio di qualsiasi età e per l'eventuale ampliamento dell'offerta ai soggetti anziani*. Roma: ISS; 2013. Available from: www.epicentro.iss.it.
26. Richard C, Le Garlantezec P, Lamand V, Rasamijao V, Rapp C. Anti-pneumococcal vaccine coverage for hospitalized risk patients: Assessment and suggestions for improvements. *Ann Pharm Fr* 2016;74(3):244-51. DOI: 10.1016/j.pharma.2015.10.007
27. Arencibia Jiménez M, Navarro Gracia JF, Delgado de Los Reyes JA, Pérez Torregrosa G, López Parra D, López García P. Missed opportunities in antipneumococcal vaccination. Can something more be done for prevention? *Arch Bronconeumol* 2014;50(3):93-8. DOI: 10.1016/j.arbres.2013.09.016
28. Demo-Geodemo. *Demografia in cifre*. Available from: <http://demo.istat.it/>.
29. Bilancio di Missione 2013. Policlinico Universitario "A. Gemelli". Available from: http://www.policlinicogemelli.it/Policlinico_Gemelli.aspx?p=A4DC96B5-9DC7-4EF1-9497-73DA2034B3FB&n=bilancio_di_missione.
30. ICD-9-CM International Classification of Diseases (2007). Available from: http://www.salute.gov.it/portale/temi/p2_6.jsp?id=1277&area=ricoveriOspedali&menu=classificazione.
31. World Health Organization. *Pneumococcal vaccines*. Available from: <http://archives.who.int/vaccines/en/pneumococcus.shtml>.
32. Crouse BJ, Nichol K, Peterson DC, Grimm MB. Hospital-based strategies for improving influenza vaccination rates. *J Fam Pract* 1994;38(3):258-61.
33. Ovbiagele B, McNair N, Pineda S, Liebeskind DS, Ali LK, Saver JL. A Care pathway to boost influenza vaccination rates among patients with acute ischemic stroke and transient ischemic attack. *J Stroke Cerebrovasc Dis* 2009;18(1):38-40. DOI: 10.1016/j.jstrokecerebrovasdis.2008.08.002
34. Bakare M, Shrivastava R, Jeevanantham V, Navaneethan SD. Impact of two different models on influenza and pneumococcal vaccination in hospitalized patients. *South Med J* 2007;100(2):140-4.
35. Pelton SI, Shea KM, Weycker D, Farkouh RA, Strutton DR, Edelsberg J. Rethinking risk for pneumococcal disease in adults: the role of risk stacking. *Open Forum Infect Dis* 2015;2(1):ofv020. DOI: 10.1093/ofid/ofv020. eCollection 2015
36. Vila-Corcoles A, Hospital I, Ochoa-Gondar O, de Diego C, Satue E, Aragon M. Prevalence of High-Risk Underlying conditions for Pneumococcal disease among people over 50 years in Catalonia, Spain. *Primary Health Care* 2016;6:3. DOI: 10.4172/2167-1079.1000