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**Knowledge about vaccines and vaccination in older people: Results of a national survey
by the Italian Society for Gerontology & Geriatrics.**

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Introduction

Vaccine preventable diseases (VPDs) represent a major public health issue and a significant burden on healthcare systems, particularly among older persons. Diseases such as seasonal influenza, pneumococcal pneumonia and herpes zoster (HZ) account for considerable morbidity and mortality, and their incidence and mortality increase significantly with age [1-4]. Effective vaccines exist against all these diseases, but uptake of vaccines fails to reach target levels in many regions [1, 2, 5-8].

Vaccine uptake is a complex and multidimensional phenomenon that is the combination of the physician's propensity to offer the vaccine, and the individual's propensity to accept it. Reported physician barriers to offering vaccination include competing demands on the physician's time [9], forgetting to do so during the consultation [10], the cost to the patient [11], as well as low awareness of vaccines and of the recommended target groups [12]. Healthcare providers have been shown to be more aware of disease burden for VPDs, and have more confidence in the efficacy of vaccination, whereas patients often do not feel a need for the vaccine if they don't perceive the disease as a threat to themselves [13]. The perceived severity and incidence of herpes zoster, for example, was shown to influence the intention of general practitioners (GPs) to recommend vaccination, in a study of 732 GPs from the Netherlands [14]. Similarly, the existence of recommendations from professional societies was judged to be important in determining vaccination in an online survey of 138 physicians in the USA [11]. Conversely, it was shown in another survey of 603 primary care physicians that vaccination practices are not in compliance with existing recommendations [12], and in another survey by the same group, primary care physicians were found to inexplicably prioritize some vaccines over others, resulting in lost opportunities for vaccination [15].

Furthermore, across different groups of physicians, there are wide variations in understanding, information needs and access to information. In a self-reported questionnaire survey of 346 hospital-based specialists and 335 community GPs, Ridda et al reported that hospital-based specialists tended to consider it the GPs' responsibility to provide vaccination [9]. In a web-based cohort study of 2,506 medical residents from 18 universities in Italy, the quality of training about influenza vaccination was considered fair or poor in both pre-graduate (40.7%) and post-graduate medical training (59.6%) [16]. In this same study, the adherence of tutors and peers to influenza vaccination recommendations, as well as correct knowledge and consultation of scientific sources about the vaccine was associated with increased uptake of influenza vaccination [16]. In turn, patients' propensity to accept HZ vaccination in Italy has been shown to be positively influenced by the physician's recommendation [17].

Therefore, giving healthcare providers accurate information that is likely to influence their vaccination practices and increase their propensity to recommend immunization is crucial to achieving adequate uptake on the part of the patients. This is particularly important in view of the high burden represented by VPDs and their complications, coupled with low knowledge and vaccination uptake. In this context, we performed a web-based survey to gain insights into the level of vaccine knowledge, and current vaccination practices among qualified specialists and postgraduate medical residents, with the ultimate aim of planning interventions to enhance teaching about vaccines and vaccination in Italy.

Methods

The survey was carried out from 1 October to 30 November 2018 among qualified specialists in geriatric medicine, internal medicine and general practitioners, as well as residents training to qualify in these disciplines. Physicians and residents were recruited among the members of the

52 Italian Society of Gerontology and Geriatrics (SIGG). An email with an electronic copy of the
53 questionnaire was sent to the Directors of Internship Programs in Geriatrics (N=51) registered on
54 the membership list of the SIGG, with an invitation to participate in the survey and to distribute the
55 survey to all their colleagues and residents for participation. There were a total of 450 registered
56 residents in training at the time of survey.

57
58 *Study questionnaire*

59 The questionnaire used was specifically designed for the purposes of this study by a consensus
60 group comprising 5 geriatricians with specific expertise in the field, questionnaire design and
61 vaccination. It was reviewed by two specialists in Infectious Diseases. The English translation of
62 the questionnaire is provided in the Supplementary Appendix. The questions aimed to assess the
63 following areas: (1) demographics and type of practice; (2) information needs and sources; (3)
64 knowledge about the influenza, pneumococcal, and HZ vaccines, recommended target groups and
65 contraindications, and practices in this area, as tested through a series of questions presenting cases
66 where the respondent is invited to choose an answer from among multiple choice options. For each
67 question, there was only one correct answer among multiple choices.

68
69 *Statistical analysis*

70 Quantitative variables are presented as mean and standard deviation (SD) or median and
71 interquartile range as appropriate according to the distribution, and categorical variables are
72 expressed as number (percentage). The proportion who answered correctly was calculated for each
73 question, and separately for qualified specialists and residents. The proportion of correct responders
74 was compared between residents and qualified senior physicians for each question using the chi
75 square test. Characteristics were compared between best performers (those with a percentage of
76 correct responses in the highest quartile) and worst performers (those with a percentage of correct

77 response in the lowest quartile). No imputation was applied for missing data. All analyses were
78 performed using R software, v 3.5.3 for Linux.

79

80

81 **Results**

82 A total of 472 physicians completed the survey; 245 (52%) were females; 253 (53.6%) were
83 qualified specialists, 206 (43.6%) were residents and the remaining 13 (2.8%) failed to indicate
84 whether they were qualified or residents and were excluded from further analysis. The response rate
85 among residents was 206/450 (46%). The characteristics of the respondents by qualification status
86 are compared in Table 1 (N=459). The mean age was 40.3 (SD: 12.8, median 35, minimum 25,
87 maximum 71 years). More than half qualified as doctors within the last 10 years, and the majority
88 of respondents worked in acute care wards (almost 60%). There were significant differences
89 between specialists and residents in all characteristics, with more women, lower age and fewer
90 years of practice on average among residents.

91 Regarding respondents' knowledge of vaccination, almost half responded that they used PubMed
92 (N=216) and governmental websites/publications (N=241) as their main source of knowledge about
93 vaccination, while 186 also reported using internet as a main source of information. Fewer
94 respondents obtained their information from courses/congresses (N=127) or journals (n=126 and
95 106 for international and national journal respectively), while pharmaceutical company
96 representatives were the least popular source of information (N=57). Respondents reported that on
97 average, 33% of their patients asked them for information about vaccination (median [IQR] 30
98 [10;50]), while 29% of carers asked about vaccination (median 20 [10;50]).

99 The reported barriers to advising vaccination were primarily the patient's fear of side effects (cited
100 by 300 respondents (66.2%) and patient skepticism about efficacy (90 (19.9%)), while only 63
101 (13.9%) reported a lack of time or information as a barrier.

102 Overall, 76.5% of respondents said they propose (or intend to propose) influenza vaccination,
103 46.3% pneumococcal vaccination, and only 24.8% HZ vaccination. When asked about prescription
104 of herpes zoster vaccination for a patient aged over 60 years, 180 (41.5%) responded that they
105 would only prescribe it if the patient had multiple comorbidities and disability, 157 (36.2%) would

106 prescribe it if the patient has multiple comorbidities, while 58 (13.4%) would prescribe it after a
107 first episode of zoster, and only 39 (9%) would systematically prescribe it.

108 Regarding knowledge about vaccination, the proportion of correct answers among both qualified
109 specialists and residents is shown in Table 2. There were significant differences in the proportion of
110 correct answers on 8 out of 18 (44.5%) questions with residents having higher rates of correct
111 answers than qualified specialists in all cases, except for one question, where specialists scored
112 significantly better (albeit still with only 20.9% correct answers compared to 8.5% in
113 residents($p=0.0005$).

114 Overall, the rates of correct answers were low, with more than 50% of correct responses achieved
115 on only 5 questions out of 18 (27.8%); for two questions, less than one out of five physicians
116 responded correctly. The rates of correct responses for each question according to the type of
117 vaccination are shown in Figure 1.

118 When comparing those with the highest scores (top quartile of correct answers; best performers)
119 and those with the lowest scores (bottom quartile of correct answers; worst performers), there were
120 significantly more men among the poor performers, who also had more years of experience on
121 average, and were slightly older than the best performers. There were significantly more residents
122 among the best performers, and more qualified specialists among the poor performers (Table 3).

123

124

125 **Discussion**

126

127 Our survey study among Italian specialists and residents shows that the overall level of knowledge
128 about vaccines is quite low in both groups, although residents performed significantly better than
129 qualified specialists on 7 out of 18 questions. Significantly more residents achieved a score in the
130 top quartile of correct answers compared to qualified specialists. In terms of patients' awareness,
131 only one third of patients (and even fewer carers) were reported by the physicians to enquire about
132 vaccinations.

133

134 These findings highlight the observation that routine practices fall considerably short of
135 recommended practices. It has long-since been established that non-negligible proportions of
136 providers fail to recommend guidelines-advocated vaccines to their patients [18]. This may be
137 explained in our study by the fact that the most common care setting was acute care, where
138 management of acute events takes priority, and discussing (or administering) vaccines is of lesser
139 importance. Significant gaps in knowledge among physicians regarding specific vaccines have
140 previously been reported, notably low levels of knowledge about trivalent inactivated and high-dose
141 influenza vaccines in a study of 281 providers in an urban academic medical center [19]. Improved
142 knowledge has shown to boost the physician's own confidence, consequently affecting their
143 willingness to recommend the vaccine to their patients [20]. Indeed, healthcare providers (HCPs)
144 are often the most trusted advisor and hold sway with patients in their decisions to receive
145 vaccination. A provider recommendation is a strong predictor of patient uptake [17, 21, 22].
146 Therefore, if the HCP is well-informed and confident, uptake may increase among patients [20],
147 whereas there will be many lost opportunities for vaccination if the HCP is misinformed or non-
148 knowledgeable. A further downside with greater potential for harm is that poor knowledge could
149 even result in incorrect administration of vaccines to ineligible patients. In this regard, in an
150 electronic questionnaire survey of primary care physicians in the USA, it was reported that up to

151 23% would incorrectly recommend a live vaccine to immunocompromised patients with
152 inflammatory bowel disease [23]. This underscores the importance of ensuring that HCPs are
153 properly informed with adequate knowledge of target groups and contraindications, and
154 recommendations for the vaccine. Indeed, for reasons that remain unclear, some providers have
155 been found to prioritize some vaccines over others, and to give lower priority to vaccines as
156 compared to other preventive interventions [15].

157

158 In our study, respondents reported that only one third of patients asked about the need for
159 vaccination. This indicates that there is great potential for proactive intervention on the physicians'
160 part to reach out systematically to those who do not spontaneously enquire about immunization.
161 Among patients, common reasons for not receiving vaccines are that the patient did not know it was
162 necessary, or believed it was not necessary because they were currently healthy [24]. In this context,
163 physicians clearly have a major role to play in alerting patients to the need for vaccination, since, as
164 mentioned previously, provider recommendations have concrete repercussions in terms of uptake.

165

166 In terms of the different vaccines for which knowledge was examined, residents performed better
167 than specialists on all questions pertaining to pneumococcal vaccine and influenza vaccine, but
168 specialists performed better on 2/5 questions involving herpes zoster, and the single question on
169 measles. However, although trainees showed higher levels of knowledge, the overall correct
170 response rates were still low, especially for HZV, where all the questions had correct response rates
171 below 50% (i.e. less than one physician in two could answer them correctly – no better than
172 guessing). This is in line with reports that herpes zoster vaccine lags behind influenza and
173 pneumococcal vaccines in terms of recommendations by HCPs, even though all three vaccines are
174 provided free of charge for all persons aged over 65 years in Italy. Despite the fact that providers
175 generally agree that herpes zoster vaccination is important, they nonetheless report that more of
176 their patients get influenza and pneumococcal vaccines [11]. In a cross-sectional internet-based

177 survey administered to 266 general internal medicine physicians, 95% and 92% respectively
178 reported that influenza and pneumococcal vaccines were important, compared to only 66% for
179 herpes zoster [25]. Among patients, Lu et al reported from an internet panel survey of a nationally
180 representative sample of U.S. adults, that herpes zoster vaccine was the least well known among
181 American adults, while influenza was the most well known vaccine [26]. Similarly, in a survey of
182 4,023 Canadian adults, 77.4% reported that they were offered influenza vaccine, but only 17.8 and
183 7.9% respectively were offered pneumococcal and herpes zoster vaccines [13]. Clearly, there is a
184 mismatch between the providers' assertion that vaccination is important, and how these attitudes
185 translate into their practices in recommending it. This could be at least partially explained by the
186 fact that the herpes zoster vaccine is the most recent of the three, and could therefore be less well
187 known to both patients and HCPs. In this regard, there is a dearth of studies investigating provider
188 prescribing behavior as an outcome [27], making it difficult to assess exactly how knowledge
189 affects prescription practices.

190

191 Our findings that residents performed better than qualified specialists on most questions pertaining
192 to vaccine knowledge are in line with previous findings. Medical students were shown to have
193 higher levels of knowledge of influenza vaccines than nursing students, and generally, healthcare
194 students tended to be pro-vaccination in a survey of medical, pharmacy and nursing students in
195 Canada [28]. Conversely, in a study of 256 qualified nurses and 292 physicians in British Columbia,
196 nurses appeared to have higher overall immunization knowledge than physicians and were more
197 likely to receive training outside of the academic setting [29]. Educational initiatives can surely
198 improve provider knowledge, whether among trainees or qualified specialists. Educational
199 initiatives have previously been shown to translate into improved pneumococcal vaccination rates in
200 a pharmacy-driven education campaign in the state of Rhode Island [30]. Similarly, among Italian
201 students of medicine at Palermo university, educational interventions significantly improved
202 knowledge through extracurricular seminars [31]. By their own admission, trainees themselves may

203 perceive a need for further training. In a study of 385 pediatric residents in the USA, 96% reported
204 that they would benefit from receiving more information [32]. Clearly, increased emphasis on
205 vaccination in undergraduate medical education and during clinical residency is essential and
206 should be integrated into the usual curriculum to prepare future generations of HCPs to promote
207 vaccination once they become professionally active. This is particularly important in ensuring they
208 have the skills to address such challenging situations as vaccine hesitancy, for example [33].
209

210 **Study limitations**

211 This study has some limitations that need to be taken into account. A first limitation concerns the
212 sample, which was a convenience sample selected due to the ease of access through the SIGG. In
213 addition, the survey was sent only to the Directors of Internship programs, and we relied on their
214 good will to forward the survey to specialists and residents in their entourage. We therefore cannot
215 rule out the possibility that potentially eligible participants were not reached. However, after
216 sending the survey to 51 program directors, a total of 472 completed questionnaires were returned,
217 which attests to the active collaboration of these directors in forwarding the survey to relevant
218 respondents. A second limitation concerns the experimental nature of the questionnaire. Indeed, the
219 questionnaire was developed *ad hoc* for the purposes of this survey, and its psychometric properties
220 were not evaluated. There may be determinant domains that could influence practice but that were
221 not explored by this questionnaire. However, irrespective of the type of practice or profile of
222 patients treated, the questions judging the level of knowledge remain relevant, and thus, examining
223 knowledge is pertinent to uncover information needs amenable to educational interventions in this
224 population. Finally, an alternative explanation of our results is that different practice settings may be
225 driving the difference between qualified specialists and trainees, rather than the level of training.
226 Further studies are warranted to investigate variations in levels of knowledge between practice
227 settings.
228

229 **Conclusion**

230 In conclusion, our study shows that residents in geriatric and internal medicine have a higher level
231 of vaccine knowledge than qualified specialists in these disciplines, even though overall levels of
232 knowledge were low in both groups. Both specialists and residents appeared to achieve higher rates
233 of correct responses on questions pertaining to influenza and pneumococcal vaccines than on
234 questions relating to HZV vaccine. Increased focus on vaccines and immunization in the education
235 of future generations of healthcare providers, and targeted interventions to improve knowledge
236 among qualified specialists in practice are avenues to explore as one path to increased vaccine
237 uptake among the general population.

238

239

240 **Figure Legend**

241 **Figure 1:** Range (minimum to maximum) of correct response rates achieved on each question by
242 qualified specialists and residents, according to the vaccine mentioned in the question.

243 (Note: the single question about measles is not included)

244

245

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250 **References**

251

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348

349

350 **Table 1:** Characteristics of the respondents to the survey about vaccination knowledge and practices
351 (N=472) comparing qualified specialists and residents in training.

352

	All	Specialists (N=253)	Residents (n=206)	P
Women [N (%)]	239 (52.2)	109 (43.3)	130 (63.1)	< 0.001
Age [mean (SD)]	40.3 (12.8)	48.5 (11.6)	30.1 (3.2)	< 0.001
Years of practice [mean, (SD)]	13.4 (12.8)	21.9 (11.7)	3.2 (1.8)	< 0.001
Type of practice				< 0.001
Acute care	264 (60.7)	124 (49.8)	140 (75.3)	
Outpatients	63 (14.5)	47 (18.9)	16 (8.6)	
Nursing home	23 (5.3)	18 (7.2)	5 (2.7)	
Post-acute care	20 (4.6)	11 (4.4)	9 (4.8)	
Other	65 (14.9)	49 (19.7)	16 (8.6)	
Area				<0.001
North	80 (18.0)	28 (11.5)	52 (25.9)	
Center	81 (18.2)	44 (18.0)	37 (18.4)	
South	284 (63.8)	172 (70.5)	112 (55.7)	

353

354

Table 2: Comparison of the rate of correct answers among qualified specialists and among residents in training

Question	Correct answers among qualified specialists, N (%)	Correct answers among residents, N (%)	p-value
1 - 71 year old man, good general condition, with hypertension, atrial fibrillation, hypertrophic prostate and hypothyroidism, received the pneumococcal vaccine at age 66. Correct answer: strongly indicated	30.0	36.6	0.167
2 - Irrespective of the strength and accuracy of the indication, to consolidate the effect of this vaccine, it would now be necessary to... Correct answer: take no further action	23.3	38.8	0.0004
3 - If we wanted to increase vaccine coverage, should we use the 23-valent pneumococcal vaccine? Correct answer: Yes, because the sequence “PCV13 then PPSV23” is optimal	59.3	71.0	0.0170
4 - In the presence of chronic corticosteroid therapy, pneumococcal vaccination is.... Correct answer: Efficacious, regardless of therapy	65.2	70.6	0.263

5 – In a patient with systemic lupus erythematosus, the addition of belimumab on top of an alkylating agent... Correct answer: would not reduce the response to influenza vaccination	32.5	35.5	0.584
6 – Concomitant presence of COPD, renal insufficiency and diabetes mellitus. Correct answer: clear indications for both influenza and pneumococcal vaccines.	5.5	15.0	0.0011
7 - The 23-valent polysaccharide pneumococcal vaccine.... Correct answer: includes PCV13	73.0	82.5	0.023
8 - In a 77 year old man in good general condition, herpes zoster vaccination is indicated... Correct answer: always	30.8	49.3	0.0001
9 – Persisting symptoms one month after onset of herpes zoster.... Correct answer: is not a contraindication to vaccination	41.6	35.3	0.207
10 – What form of bacterial pneumonia is predominantly prevented by influenza vaccination? Correct answer: Staphylococcus	7.2	12.8	0.0651
11 - Simultaneous administration of influenza and pneumococcal vaccines is... Correct answer: possible	62.7	67.3	0.350
12 - With respect to measles, a subject born in 1945 should be considered... Correct answer: immune	20.9	8.5	0.0005
13 - The simultaneous administration of herpes zoster and 23-valent pneumococcal	19.1	35.3	0.0003

vaccines... Correct answer: Could reduce the immunogenic potential of the herpes zoster vaccine			
14 - In an immunosuppressed individual.... Correct answer: Both herpes zoster and live attenuated influenza vaccines are contra-indicated	45.3	49.0	0.491
15 - In the presence of an allergy to egg protein.... Correct answer: influenza vaccination is contra-indicated	43.6	46.5	0.610
16 - According to the national vaccine schedule, the minimal influenza vaccine coverage should be.... Correct answer: >75% all of the time	39.9	43.6	0.484
17 - Pneumococcal vaccination for the elderly can be proposed.... Correct answer: At any time of year, and together with influenza vaccine	62.4	76.7	0.0014
18 – Regarding herpes zoster vaccination, the statement that “coverage does not decline with increasing age of the vaccinated subjects” is untrue, and therefore, the correct answer	31.3	28.9	0.657

Questions with significant differences in the proportion of correct answers between specialists and residents are highlighted in bold.

Table 3: Comparison of characteristics between worst performers (lowest quartile of correct answers) and best performers (highest quartile of correct answers)

Variable	Worst performers (N=115)	Best performers (N=114)	p-value
Women	46 (40%)	69 (60.5%)	<0.0001
Age (years)	41.9±13.1	37.6±11.2	<0.001
Number of years of experience	14.1±13	10.8±11.4	0.015
Type of practice setting			<0.0001
Acute care	60 (54.1%)	75 (70.8%)	
Ambulatory	26 (23.4%)	9 (8.5%)	
Post-acute care	3 (2.7%)	8 (7.5%)	
Other	12 (10.8%)	10 (9.4%)	
Qualification			<0.0001
Qualified specialists	73 (63.5%)	46 (40.4%)	
Residents in training	42 (36.5%)	68 (59.6%)	
Geographical location			0.001
Southern Italy	75 (68.6%)	53 (48.2%)	
Central Italy	20 (18.3%)	20 (18.2%)	
Northern Italy	14 (12.8%)	37 (33.6%)	

