Vaccination coverage in healthcare workers: a multicenter cross-sectional study in Italy

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Introduction. In recent years, a phenomenon known as “vaccine hesitancy” has spread throughout the world, even among healthcare workers, determining a reduction in vaccination coverage (VC). A study aimed at evaluating VC among healthcare workers (HCWs) in 10 Italian cities (L’Aquila, Genoa, Milan, Palermo, Sassari, Catanzaoro, Ferrara, Catanzaoro, Naples, Messina) was performed.

Materials and methods. Annex 3 of the Presidential Decree n. 445 of 28 December 2000 was used to collect information on the vaccination status of HCWs. The mean and standard deviation (SD) were calculated with regard to the quantitative variable (age), while absolute and relative frequencies were obtained for categorical data (sex, professional profile, working sector, vaccination status). The connection between VC and the categorical variables was evaluated by chi-square method (statistical significance at p < 0.05). The statistical analyses were performed by SPSS and Stata software.

Results. A total of 3,454 HCWs participated in the project: 1,236 males and 2,218 females. The sample comprised: physicians (26.9%), trainee physicians (16.1%), nurses (17.2%) and other professional categories (9.8%). Low VC was generally recorded. Higher VC was found with regard to polio, hepatitis B, tetanus and diphtheria, while coverage was very low for measles, mumps, rubella, pertussis, chickenpox and influenza (20-30%).

Conclusions. This study revealed low VC rates among HCWs for all the vaccinations. Measures to increase VC are therefore necessary in order to prevent HCWs from becoming a source of transmission of infections with high morbidity and/or mortality both within hospitals and outside.

Introduction

Although vaccination is widely considered to be an efficacious and cost-effective health technology, the phenomenon known as ‘vaccine hesitancy’ is spreading, not only among citizens, but also among healthcare workers (HCWs), with a consequent steady reduction in vaccine coverage (VC) [1-8]. This is a serious health problem, as HCWs may spread infections to patients, colleagues and relatives. Indeed, low VC among HCWs can lead to dangerous outbreaks of disease, reduce productivity and increase absenteeism [9-11]. HCWs are therefore a priority target group for vaccinations [12-14].

Inadequate vaccination coverage among HCWs is a major concern for all national healthcare organizations. The World Health Organization (WHO) estimates that approximately 59 million HCWs worldwide are potentially exposed to hazardous biological agents daily [13]. In Europe, the average VC among HCWs is very low [3]. As recommended by the WHO Strategic Advisory Group of Experts (SAGE), vaccine hesitancy, and thus VC, need to be evaluated both globally and locally [1, 2].

The 2017-2019 Italian National Immunization Prevention Plan (INIPP) strongly recommends that HCWs be vaccinated [14]. However, although data are not systematically available, VC among HCWs is estimated to be very low. Indeed, only few studies have been conducted on this issue, and these have concerned a limited number of hospitals and are clearly not representative of the national scenario in Italy. One systematic review regarding Italy revealed suboptimal VC for hepatitis B and measles, and very low VC for varicella (3.6%) and influ-
The aim of our study was to investigate the VC of HCWs at several academic hospitals in Italy.

Materials and methods

A multicenter cross-sectional study was conducted from March to September 2018 in the following 10 cities: L’Aquila, Genoa, Milan, Palermo, Sassari, Catanzaro, Ferrara, Catania, Naples and Messina. Ethical approval was obtained from the Ethics Committee of the University Hospital “AOU G. Martino di Messina”. Written informed consent was obtained from all subjects before participation in the study. Annex 3 of Presidential Decree n. 445 28 December 2000 was used to collect information on the vaccination status of workers in schools, healthcare and social care. Indeed, as required by Presidential Decree 445 of 28 December 2000, teachers, social workers and HCWs must submit a report of their vaccination status to the institutions for which they work. However, despite these legal measures, vaccinations have not become mandatory for HCWs. Hence, healthcare professionals are under no legal obligation to be vaccinated [20-22].

The evaluation of replies regarding immunization status revealed inadequate VC, i.e. below 95% for all vaccinations examined. Higher VC was found with regard to polio, hepatitis B, tetanus and diphtheria, while coverage was very low for measles, mumps, rubella, pertussis, chickenpox and influenza (20-30%); lower VC rates were found for vaccinations not specifically recommended for HCWs (i.e. herpes zoster, meningococcus). Many HCWs could not remember or did not report their immunization status (Tab. I).

The vaccinations that are not specifically recommended for HCWs were excluded from the next statistical analysis (H. influenzae, Meningococcus C, Meningococcus B, Pneumococcus, Hepatitis A, Papilloma virus, Herpes zoster, Tuberculosis). Differences of coverage rates considering sex, age, working area and professional category were analyzed. For these analyses the category “not reported or not remember” was excluded.

Regarding sex we did not find significant differences except to rubella, chickenpox and mumps. Men HCWs showed higher vaccine coverage than women. Concerning age, we evaluated the difference of coverage rates for the following vaccines: polio, diphtheria, tetanus, hepatitis B, pertussis, measles, rubella, mumps, influenza considering five age-groups. Vaccination coverage by age is shown in Table II. Significant differences were found for poliomyelitis, tetanus, pertussis and influenza. 51-60 age-class showed higher VC for poliomyelitis, diphtheria and tetanus, while higher VC for influenza was detect in ≥ 61 years subjects. Excluding HCWs who did not report their working sector, we evaluated the vaccination coverage for the following vaccines: polio, diphtheria, tetanus, hepatitis B, pertussis, measles, rubella, mumps, chickenpox and influenza (Tab. III). Significant differences were found only for hepatitis B vaccine.

Excluding HCWs who did not report their professional profile, we evaluated the vaccination coverage for the following vaccines: polio, diphtheria, tetanus, hepatitis

Results

A total of 3,454 HCWs participated in the study: 1,236 males and 2,218 females.
B, pertussis, measles, rubella, mumps, chickenpox and influenza (Tab. IV). Significant differences were found for polio, diphtheria, hepatitis B, rubella and chickenpox. Physicians showed significantly higher coverage than nurses and other healthcare workers for hepatitis B and rubella.

Regarding to influenza vaccination the highest coverage was found in other professional categories respect to physicians and nurses.

**Discussion and conclusions**

This study revealed low VC rates among HCWs for all the vaccinations. Such coverage rates are totally inadequate in terms of preventing not only disease transmission by susceptible HCWs, but also nosocomial outbreaks, an example being the recent outbreaks of measles in Italy [23, 24] confirming data from previous studies at the national and international levels [3, 7, 8, 12, 16, 17, 25, 26].
Higher coverage was observed among men than women; this is in contrast with the literature data, where the higher rates in women are due to the prevention of risks related to some infections in pregnant women [27, 28, 29]. Our finding may be linked to the high percentage of HCWs who filled “not remember” or did not report their vaccination status.

As regards age, the youngest showed higher rates of vaccination against hepatitis B although no significance difference was found. The seasonal influenza vaccination coverage was higher in ≥ 61 years subjects (p < 0.001) although VC was very far from the minimum recommended level. These findings are in line with the literature [8, 9, 17, 30-40]. The international literature reports higher VC rates of physicians than other healthcare workers [33-35, 41, 42], however we find this only for hepatitis B and rubella. This result could be explained on the hand with high percentage of physicians who did not declare their vaccination status, on the hand with the high percentage of HCWs who did not report their professional profile. The highest coverage rates were found in pediatric workers (data not shown) but the differences between these and other clinical groups were not statistically significant. Although international literature data on vaccination coverage among pediatricians are limited, higher coverage rates and more positive attitudes towards vaccination has been reported [7, 12, 36, 43].

Limited differences were found based on the working sector, higher rates of VC were found among staff working in services than among workers in either surgical or medical departments only for hepatitis B. The low vaccination coverage for all vaccines could be explained by the fear of adverse effects, despite the fact that many scientific studies, systematic reviews and meta-analyses of the literature have shown such fears to be groundless [44-47]. In order to combat “vaccine hesitancy” among HCWs, it is essential to promote clear and effective communication regarding vaccinations and to adopt innovative strategies (e.g. promoting vaccination via social networks and the mass media, training HCWs, providing vaccination in the workplace) [48, 49].

Vaccine-hesitant HCWs might also deter patients’ vaccination uptake [49]. Another issue detected in our study was the high percentage of HCWs who declared not remembering what vaccinations they had received; this probably reflects a lack attitude and a lack of confidence in vaccination. HCWs should understand that all vaccines are safe and useful; they should regard vaccination both as a right and as a duty, in order to protect themselves and their patients [37].

A major strength of the present study is that it was a multicenter study involving several centers located in northern, central and southern regions of Italy and used an official form to collect data on vaccination status. By contrast, the fact that the data were self-reported constitutes a limitation. Indeed, many HCWs, especially in the older age-groups, may not have recalled which vaccinations they had received or might have declared that they did not remember, in order to avoid incurring legal action. Further, it was not possible evaluating the differences on propensity to vaccines between HCWs residing in North Centre and South Italy as about 30% of HCWs did not report their residence and about 40% were residents in the major islands of Italy (Sicily and Sardinia). In conclusion, the question of vaccination among HCWs is challenging and fraught with ethical issues. Mandatory measures may be needed in order to achieve better coverage, such as those implemented by the regional Laws of Emilia Romagna, Marche and Puglia [50-52]. Mandatory policies are currently under debate in several countries, and high-quality studies would help policymakers and stake-holders to shape evidence-based initiatives and programs to improve VC and the control of infectious diseases through the correct application of guidelines on prevention [53, 54].

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### Conflict of interest statement

None declared.
Authors’ contributions

GC and RS conceived the study. GT verified the analytical methods. All authors contributed to data acquisition. GC, RS, RS, GI, DP, IA and MP contributed to the interpretation of the results. GC and RS wrote the manuscript, with input from all authors.

References

[1] World Health Organization (WHO). Addressing vaccine hesitancy. Available at: http://www.who.int/immunization/programmes_systems/vaccine_hesitancy/en/ [Accessed on 15 December 2018].

[2] World Health Organization (WHO). Report of the sage working group on vaccine hesitancy, 12 November 2014. Available at: www.who.int/immunization/sage/meetings/2014/october/SAGE_working_group_revised_report_vaccine_hesitancy.pdf?ua=1 [Accessed on 15 December 2018].

[3] Karafillakis E, Dinca I, Apfel F, Cecconi S, Würz A, Takacs J, Suk J, Celentano LP, Kramarz P, Larson JH. Vaccine hesitancy among healthcare workers in Europe: A qualitative study. Vaccine 2016;34(41):5013-5020. doi: 10.1016/j.vaccine.2016.08.029.

[4] Dubé E, Laberge C, Guay M, Bramadat P, Roy R, Bettinger JA. Vaccine hesitancy: An overview. Hum Vaccin Immunother 2013;9(8):1763-73. doi: 10.4161/hv.24657.

[5] Feldstein LR, Mariat S, Gacic-Dobo M, Diablo MS, Konklin LM, Wallace AS. Global routine vaccination coverage, 2016. MMWR Morb Mortal Wkly Rep 2017;66(45):1252-5. doi: 10.15585/mmwr.mmr6645a3.

[6] Signorelli C, Odone A, Cella P, Iannazzo S, D’Ancona F, Guerra R. Infant immunization coverage in Italy (2000-2016). Ann Ist Super Sanita 2017;53(3):231-7. doi: 10.4415/ANN_17_03_09.

[7] Squeri R, Genovese C, Trimarchi G, Palamara MAR, La Fauci V. An evaluation of attitude toward vaccines among healthcare workers of a University Hospital in Southern Italy R. Ann Ig Super Sanità 2017;9(8):595-606. doi: 10.7416/ai.2017.2188.

[8] Di Gregori V, Franchino G, Marcantoni C, Simone B, Costantino C. Logistic regression of attitudes and coverage for influenza vaccination among Italian Public Health medical residents. J Prev Med Hyg 2014;55(4):152-7.

[9] Mareckie J. European Centre for Disease Prevention and Control. Seasonal influenza vaccination in Europe: Overview of vaccination recommendations and coverage rates in the EU Member States for the 2012-13 influenza season. Available at: https://ecdc.europa.eu/sites/default/files/documents/Seasonal-influenza-vaccination-Europe-2012-13.pdf.

[10] Ahmed F, Lindley MC, Allred N, Weinbaum CM, Grohskopf L. Effect of influenza vaccination of healthcare personnel on morbidity and mortality among patients: systematic review and grading of evidence. Clin Infect Dis 2014;58(1):50-7. doi: 10.1093/cid/cit580.

[11] Gianino MM, Politano G, Scarvazzino A, Charlier L, Testa M, Giacomelli S, Benso A, Zotti CM. Estimation of sickness absenteeism among Italian healthcare workers during seasonal influenza epidemics. PLoS One 2017;12(8):e0182510.

[12] Haviari S, Bénet T, Saadatian-Eliah M, André P, Loulergue P, Vanhems P. Vaccination of healthcare workers: a review. Hum Vaccin Immunother 2015;11(11):2522-37. doi: 10.1080/21645515.2015.1082014.

[13] World Health Organization (WHO). Occupational health. Health workers. Health worker occupational health. Available at: http://www.who.int/occupational_health/topics/hcworkers/en/. [Accessed on 15 December 2018].

[14] Piano Nazionale Prevenzione Vaccinale (PNPV) 2017-2019. Available at: http://www.salute.gov.it/imgs/C_17_pubblicazioni_2571_allegato. [Accessed on 15 December 2018].

[15] Maggiore LRU, Scala C, Toletone A, Debarbieri N, Perris M, D’Amico B, Montecucco A, Martiní M, Dini G, Durando P. Susceptibility to vaccine-preventable diseases and vaccination adherence among healthcare workers in Italy: A cross-sectional survey at a regional acute-care university hospital and a systematic review. Hum Vaccin Immunother 2017;13(2):470-476. doi: 10.1080/21645515.2017.1264746.

[16] Fortunato F, Tafurí S, Cozza V, Martinelli D, Prato R, Low vaccination coverage among Italian healthcare workers in 2013. Contributing to the voluntary vs. mandatory vaccination debate. Hum Vaccin Immunother 2015;11(1):133-9. doi: 10.4161/hv.34415.

[17] Alicino C, Iudici R, Barberis I, Paganino C, Cacciani R, Zacconi M, Battistini A, Bellina D, Di Bella AM, Talamini A, Sticchi L, Morando A, Ansaldi F, Durando P. Influenza vaccination among healthcare workers in Italy. Hum Vaccin Immunother 2015;11(1):95-100. doi: 10.4161/hv.34362.

[18] Gruppo di Studio Conferenza Nazionale “Medice cura te ipsum”. La Carta di Pisa delle vaccinazioni negli operatori sanitari. GmPLOS 2017;7(4):155-7.

[19] L. 31 luglio 2017, n. 119. Conversione in legge, con modificazioni, del decreto-legge 7 giugno 2017, n. 73, recante disposizioni urgenti in materia di prevenzione vaccinale. (G.U. 5 agosto 2017, n. 182). http://www.gazzettaufficiale.it/eli/id/2017/08/05/17G00132/sg.

[20] Law 81/2008. Testo unico sulla salute e sicurezza sul lavoro. Available at http://www.gazzettaufficiale.it/eli/id/2008/04/30/008G0104/sg.

[21] Law 8 March 2017, n. 24. Disposizioni in materia di sicurezza delle cure e della persona assistita, nonché in materia di responsabilità professionale degli esercenti le professioni sanitarie (GU Serie Generale n.64 del 17-03-2017). Available at: http://www.gazzettaufficiale.it/eli/id/2017/03/07/17G00041/sg.

[22] Law Decree 28 December 2000, No. 445, published in the Official Gazette No. 42 of 20 February 2001.

[23] Palamara MA, Visalli G, Picerno I, Di Pietro A, Puglisi G, Marrano F, D’Andrea G, Facciolla. Measles outbreak from February to August 2017 in Messina, Italy. J Prev Med Hyg 2018;59(1):E8-E13. doi: 10.15167/2421-4248/pnph2018.59.1.853.

[24] Report n° 37 January 2018. Available on: http://www.epicentro.iss.it/problemi/morbillo/. Last access: 30 October 2018.

[25] La Fucci V, Riso R, Facciolla C, Ceccio C, Lo Giudice D, Calimeri S, Squeri R. Response to anti-HBV vaccine and 10-year follow-up of antibody levels in healthcare workers. Public Health 2016;139:198-202. doi: 10.1016/j.puhe.2016.08.007.

[26] Gabutti G, Bergamini M, Bonanni P, Guido M, Fenoglio D, Giannamanco A, Sindoni L, Zotti C, Boddi V, Bamti F, Severini R, Becchini A, Boccalini S, Crovari P; Collaborative Group for the Study of Pertussis. Assessment of humoral and cell-mediated immunity against Bordetella pertussis in adolescent, adult, and senior subjects in Italy. Epidemiol Infect 2008;136(6):1576-84. doi: 10.1017/S0950268807000192.

[27] Swamy GK, Heine RP. Vaccinations for pregnant women. Obstet Gynecol 2015;125(1):212-26. doi: 10.1097/ AOG.0000000000000581.

[28] Lo Giudice D, Cannavò G, Capua A, Grillo OC, La Fucci V, Puliafito A, Sindoni D, Squeri R, Calimeri S. Eliminating congenital rubella: a seroepidemiological study on women of childbearing age and MMR vaccine coverage in newborns. J Prev Med Hyg 2009;50(4):236-40.

[29] Ferrera G, Squeri R, Genovese C. The evolution of vaccines for early childhood: the MMRV. Ann Ig 2018;30(4 Suppl 1):33-7. doi: 10.7416/ai.2018.2232.

[30] Restivo V, Costantino C, Mammina C, Vitale F. Influenza like illness among Medical Residents Anticipates Influenza Diffusion in General Population: Data from a National Survey among
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Italian Medical Residents. PLoS One 2016;11(12):e0168546. doi: 10.1371/journal.pone.0168546.

Costantino C, Amadio E, Calamusa G, Vitale F, Mazzucco W. Could university training and a proactive attitude of coworkers be associated with influenza vaccination compliance? A multicentre survey among Italian medical residents. BMC Med Educ 2016;16:38. doi: 10.1186/s12909-016-0558-8.

Costantino C, Amadio E, Vitale F, Maida C, Maringhini G, Asciutto R, Tramuto F, Calamusa G. Attitudes, behaviours and perceptions of Italian General Practitioner trainees towards influenza vaccination in Western Sicily (Italy). Ital J Public Health 2012;9:33-9.

Riphagen-Dalhuisen J, Gennaite G, Hak E. Predictors of seasonal influenza vaccination among healthcare workers in hospitals: a descriptive meta-analysis. Occup Environ Med (2012);69:230-5. PMID: 22172951. http://dx.doi.org/10.1136/oemed-2011-100134.

Castilla J, Martínez-Bar J, Godoy P, Toledo D, Astry J, García S, Mayoral JM, Martín V, González-Candelas F, Guevara M, et al., CIBERESP Working Group for the Survey on Influenza Vaccination in Primary Healthcare Professionals. Trends in influenza vaccine coverage among primary healthcare workers in Spain:2008-2015. Prev Med 2017;57:206-11.

Bonaccorsi G, Loriani C, Santamaura F, Guarucci S, Pellegrino E, Puggelli F, Balli M, Bonanni P. Predictive factors associated with the acceptance of pandemic and seasonal influenza vaccination in health care workers and students in Tuscany, Central Italy. Hum Vaccin Immunother 2013;9:2603-12.

Gilardi F, Castelli Gattinara G, Vinci MR, Cioffi Degli Atti M, Santilli V, Brugalla R, Santoro A, Montanaro R, Lavorato L, Raponi M, Zaffina S. Seasonal influenza vaccination in health care workers. A pre-post intervention study in an Italian paediatric hospital. Int J Environ Res Public Health 2018;15(5). pii: E841. doi: 10.3390/ijerph15050841.

Orr P. Influenza vaccination for health care workers: a duty of care. Can J Infect Dis 2000;11(5):225-6.

Squeri R, Riso R, Facciola R, Genovese C, Palamara MA, Ceccio C, La Fauci V. Management of two influenza vaccination campaign in health care workers of a university hospital in the south Italy. Ann Ig 2017;29(3):223-31. doi: 10.7416/ai.2017.2150.

Costantino C, Vitale F. Influenza vaccination in high-risk groups: a revision of existing guidelines and rationale for an evidence-based preventive strategy. J Prev Med Hyg 2016;57(1):E13-8.

Restivo V, Costantino C, Bono S, Maniglia M, Manorese V, Ventura G, Casuccio A, Tramuto F, Vitale F. Influenza vaccine effectiveness among high-risk groups: a systematic literature review and meta-analysis of case-control and cohort studies. Hum Vaccin Immunother 2018;14(5):724-35.

Guthmann JP, Fonteneau L, Ciotti C, Bouvet E, Pellissier G, Lévy-Bruhl D, Abiteboul D. Vaccination coverage of health care personnel working in health care facilities in France: results of a national survey, 2009. Vaccine 2012;30:4648-54. http://dx.doi.org/10.1016/j.vaccine.2012.04.098.

Aarón D, Nagu TJ, Rwegaša J, Komba E. Hepatitis B vaccination coverage among healthcare workers at national hospital in Tanzania: how much, who and why? BMC Infect Dis 2017;17(1):786. doi: 10.1186/s12879-017-2893-8.

La Torre G, Scalini S, Garutto V, Siclari M, Chiarini M, Manocci A. Knowledge, Attitude and Behaviours towards Recommended Vaccinations among Healthcare Workers. Healthcare (Basel) 2017;5(1). pii: E13. doi: 10.3390/healthcare5010013.

Gasparini R, Panatto D, Lai PL, Amicizia D. The “urban myth” of the association between neurological disorders and vaccinations. J Prev Med Hyg 2015;56(1):E1-8.

Genovese C, La Fauci V, Squeri A, Tramarchi G, Squeri R. HPV vaccine and autoimmune diseases: systematic review and meta-analysis of the literature. J Prev Med Hyg 2018;59: E194-E199.

Gasparini R, Amicizia D, Lai PL, Panatto D. Influenza vaccination: from epidemiological aspects and advances in research to dissent and vaccination policies. J Prev Med Hyg 2016;57(1):E1-4.

Yaqub O, Castle-Clarke S, Sevdalis N, Chatkavar J. Attitudes to vaccination: a critical review. Soc Sci Med 2014;112:1-11. doi: 10.1016/j.socscimed.2014.04.018.

Stahl JP, Cohen R, Denis F, Gaudelus J, Martinot A, Leroy T, Lepeti H. The impact of the web and social networks on vaccination. New challenges and opportunities offered to fight against vaccine hesitancy. Med Mal Infect 2016;46(3):117-22. doi: 10.1016/j.medmal.2016.02.002. Epub 2016 Mar 14.

Signorelli C, Odone A, Ceppa P, Iannazzo S, D’Ancona F, Guerra R. Infant immunization coverage in Italy (2000-2016). Ann Ist Super Sanita 2017;53(3):231-7. doi: 10.4415/ANN_17_03_09.

Legge regionale “Disposizioni per l’esecuzione degli obblighi di vaccinazione degli operatori sanitari”. Available at: https://www.vaccinarsinpuglia.org/assets/uploads/files/213/legge-puglia-obbligo-op-san.pdf.

Delibera G.R. Emilia Romagna 351 del 12/3/2018.

DDG 613 del 26/10/17 Regione Marche. Availabe on: https://www.ospedalesicuro.eu/attachments/article/542/ASUR-Marche-61DDG.pdf.

Gualano MR, Bert F, Voglino G, Buttlinelli E, D’Errico MM, De Waure C, Di Giovanni P, Fantini MP, Giuliani AR, Marranzano M, Masanotti G, Massimi A, Nante N, Pennino F, Squeri R, Stefani A, Signorelli C, Siliquini R, Collaborating Group. Attitudes towards compulsory vaccination in Italy: results from the NAVIDAD multicentre study. Vaccine 2018;36(23):3368-74. doi: 10.1016/j.vaccine.2018.04.029.

Montagna MT, Mascipinto S, Pousis C, Bianchi FP, Caggiano G, Carpanzano LF, De Giglio O, Barbuti G, Auxilia F, Destrebecq A, Castaldi S, Baldwin T, Bargellini A, Righi E, Boccia G, Santoro E, Casini B, Baggiani A, Novati R, Oriani R, Odone A, Mezzouso AG, Orsi GB, Napoli C, Pasqualetta C, Veronesi L, Ripabelli G, Sammarco ML, Rossini A, Squeri R, Laganà P, Antonuccio OM, Genovese C, Tardivo S, Torre I, Alfano R, Pennino F, Torregrossa MV, Barchitta M, Agodi A, Knowledge, experiences, and attitudes toward Mantoux test among medical and health professional students in Italy: a cross-sectional study. Ann Ig 2018;50(Suppl 2):86-98. doi: 10.7416/ai.2018.2253.