



Health worker recommended vaccination rates among medical students in Brazil



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ABSTRACT

Health workers are a risk population for many infectious diseases, which leads to a number of vaccines being routinely recommended for health care staff. Medical students are also prone to such hazards. This study accesses undergraduate medicine students' compliance to recommended health-staff vaccination, and their reasons for noncompliance.

Method: An online questionnaire was sent to all undergraduates in a major public medical school in Brazil, asking about vaccination status to Hepatitis B, Measle-mumps-rubella, Varicella, Pertussis and Influenza, and reasons in case of noncompliance

Results: 146 students answered the questionnaire, (response rate 14,6%). Overall vaccination status showed 74,7% of students with incomplete vaccination in some way, with an increase in vaccination status toward the end of the course. The highest noncompliance rates were Pertussis (49,3%), Varicella (47,3%) and Influenza (30,1%) vaccines. The vaccine with the lowest noncompliance rate was measles (9,6%). During the course, the greatest increases in adequate vaccination status were Hepatitis B, from 53,2% in first-years to 93,2% by the end sixth year (chi-sq 21, $p < 0,0001$), and Influenza, from 48,9% to 91,5% (chi-sq 22,5, $p < 0,00009$). Main reasons given not to vaccinate were vaccination hesitancy for influenza and varicella (respectively 61% and 46%), and lack of awareness of the need to vaccinate for pertussis (53%).

Conclusions: Overall vaccine coverage in medical students in Brazil is still far from optimal. There is a markedly high level of vaccine hesitancy and unawareness of need to vaccinate for some diseases, particularly pertussis and influenza.

Clinical trial registry (Brazilian regulation boards): 24159119.3.0000.0065.

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1. Introduction

Health workers are a high-risk population for many infectious diseases, due to their great exposition to many ill individuals, as well as to higher concentrations of microorganisms [1]. Medical students are also prone to such hazards, especially during internship in the last two years of medical school [2,15]. Surgical rotations carry the risk of blood-infected equipment injuries; moreover, in Brazil, medical students are often required to draw blood themselves from their patients when a blood test is necessary.

As well as becoming ill, medical students, like other healthcare workers, can be a source of transmission of infectious diseases

among at-risk patients in healthcare facilities [3], which is an additional reason to include them in healthcare staff vaccination programs.

Many vaccines are available and recommended for health care staff. Brazilian main recommended immunizations include Varicella, Pertussis, Influenza, Hepatitis B and Measles, which are also the main recommended vaccines by Mayo Clinic for United States Medical Center Occupational Health programs [1]. These vaccines should preferably be administered during medical school, before the start of practical rotations.

There is an increasing noncompliance with vaccination programs, especially since last decade, which can also have affected medical students' immunization status and personal beliefs about this theme [2,18]. Few studies have gauged student awareness of these programs and their effect in vaccination status along the medical course.

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In this study, we give an overview of immunization status for vaccines recommended for healthcare workers among undergraduates of an important public medical school in Brazil, and the main reasons given in cases of noncompliance.

2. Methods

This is a transversal, observational study. From September 3rd to December 3rd, 2020, students from University of São Paulo Medical School were asked to anonymously complete a questionnaire prepared in the Google Forms platform.

An invitation was sent by email to every student, with a short explanatory text and a link to the form. Also, messages with the same link were sent through a social media platform (WhatsApp™) to the class representatives of each year of Medical School, to be sent to their classmates. The form was set so that only one answer could be submitted per email address.

Each questionnaire consisted of an explanatory text which also served as informed consent, followed by the year of the student in med school (the only personal information asked), and then a series of multiple-choice questions about the following vaccines: Hepatitis B, Measle-mumps-rubella, Varicella, Pertussis (cellular or acellular) and Influenza. For each vaccine, it was questioned if the student vaccination status was up to date, not up to date, not vaccinated at all or unknown. Also, for each vaccine there was a multiple-choice question about the student's reasons in case of not up-to-date vaccination. The whole form took about five minutes to complete. No immunization records were solicited to confirm the answers. The study was approved by the hospital ethical committee (Reg. 24159119.3.0000.0065).

2.1. Statistical analysis

Student's answers were divided in three groups, according to a traditional division in Brazilian medical schools: 1st and 2nd years (pre-clinical years), 3rd and 4th years (clinical years) and 5th and 6th years (internship). Answers for vaccination status, overall and for each individual vaccine, were reported as percentages in the respective group, and the groups were compared through Pearson's chi-square test. As vaccine knowledge was considered to increase cumulatively during medical school, we used the Cochran–Armitage test for trend, with an exposition of 2, 4 and 6, respectively, for each group. A p value $< 0,05$ was considered significant. The software used was Epi Info™ version 7.1.5.2.

Reasons for noncompliance with vaccination programs were divided into 3 categories (vaccine allegedly not available, unawareness of need to vaccinate and vaccination hesitancy). When considered per year of medical school, these were also compared between years by Pearson's chi-square test with the Cochran–Armitage test for trend. When considered as reasons per vaccine type, as the same student could give more than one reason for each vaccine, these were reported by descriptive analysis.

3. Results

University of São Paulo Medical School enrolls around 180 new students each year, which makes for a student body of about 1,000 students at any given time.

When the form submission was closed on December 3rd, there had been a total of 146 answers (response rate 14,6%); of these, 29 (19,9%) were first years, 18 (12,3%) second years, 22 (15,1%) third years, 18 (12,3%) fourth years, 21 (14,4%) fifth years and 38 (26%) sixth years.

Overall vaccination status among medical students showed an appalling 74,7% of students with incomplete vaccination in some

way, with an increase in vaccination status toward the end of the course. When considered by year of course, adequate vaccination was reported by 6,9% of first years, reaching 44,7% in last year's (chi-sq 9,8, $p = 0,001$). (Table 1)

When each vaccine was analyzed individually, the greatest increases in adequate vaccination status were Hepatitis B, which increased from 53,2% during the first two years to 93,2% by the end of the course (chi-sq 21, $p < 0,0001$), and Influenza, which increased from 48,9% to 91,5% (chi-sq 22,5, $p < 0,00009$). Pertussis vaccination also had a significant increase from 40,4% to 66,1% (chi-sq 7,1, $p = 0,008$), and measles vaccination had a near-significant increase from 85,1% to 96,6% (chi-sq 3,7, $p = 0,05$). Varicella vaccination status had a non-significant increase throughout the course, from 40,4% to 64,4% (chi-sq 5,8, $p = 0,02$). (Table 2)

Reasons given for noncompliance with vaccination programs were vaccine allegedly not available (27,3% of reasons given), unawareness of need to vaccinate (25,0%) and a series of other reasons grouped together as "vaccination hesitancy" (47,7%). When analyzed per year in medical course, only claims of non-availability of vaccines showed a significant decrease during the course, from 25,5% to 5,1% (chi-sq 8,7, $p = 0,003$). Unawareness of need to vaccinate had a non-significant decrease from 14,9% to 6,8% (chi-sq 1,9, $p = 0,17$), and vaccination hesitancy was markedly high throughout the course, ranging from 17,5% to 35,6% (chi-sq 0,5, $p = 0,48$). (Table 3)

When considered per type of vaccine, the highest noncompliance rates were found to be Pertussis (49,3%), Varicella (47,3%) and Influenza (30,1%) vaccines. The vaccine with the lowest non-compliance rate was measles (9,6%). Influenza vaccine had the highest proportion of reasons given not to vaccinate (37,5%), followed by Varicella (27,3%) and Pertussis (21,6%).

When each vaccine was analyzed separately for the main reasons given not to vaccinate, we found vaccination hesitancy for influenza and varicella (respectively 61% and 46% of each pool of reasons), and lack of awareness of the need to vaccinate for pertussis (53%).

4. Discussion

The first main result from this study is the meagre 25,3% of overall complete vaccination status among all respondent students, which is comparable with existing studies [2,14]. There was a significant increase throughout medical course, which could be explained by an increase in knowledge about the importance and availability of vaccines for health workers in our service, as well as increased motivation to be vaccinated following more intense interaction with patients at the end of the course [3,13]. Besides being potentially causes of disease spreading¹, non-vaccinated health workers, particularly physicians, are less prone to encouraging their own patients to get vaccinated [3,4]. Interestingly, nonetheless, self-protection tends to be a stronger motivation than patient protection [5].

Most available studies contemplate a single vaccine, usually influenza [3,4,5,16,18], hepatitis B [6,15,17] and human papillomavirus [20] (HPV). We chose not to include HPV in our study, as it is not a healthcare related hazard¹. To our knowledge, only one study from Mexico² took on all vaccines recommended for healthcare personnel at the same time.

Hepatitis B and Influenza vaccines had the greatest improvements, which was similar to other studies [5,6,13,15,17]. There may be a rise in awareness of their importance as students get nearer the end of the course and are progressively more exposed to risk situations [3,13,15]; also, despite its being available for children in the national calendar for general population since 1998 [19], all students can be vaccinated for hepatitis B in our facility,

Table 1
Overall vaccination status among medical students per year of course.

Year of course	Complete	Incomplete	Total	
1st	2 (6,9%)	27 (93,1%)	29	
2nd	4 (22,2%)	14 (77,8%)	18	
3rd	4 (18,2%)	18 (81,8%)	22	
4th	4 (22,2%)	14 (77,8%)	18	
5th	6 (28,6%)	15 (71,4%)	21	
6th	17 (44,7%)	21 (55,3%)	38	
Total	37 (25,3%)	109 (74,7%)	146	chi-sq 9,8 (p = 0,001)

Table 2
Increase in vaccination coverage per vaccine throughout the medical course

	Years	1st and 2nd	3rd and 4th	5th and 6th	
Vaccine					
Hepatitis B	Complete	25 (53,2%)	26 (65%)	55 (93,2%)	chi-sq 21 (p < 0,0001)
	Incomplete	22 (46,8%)	14 (35%)	4 (6,8%)	
Measles	Complete	40 (85,1%)	35 (87,5%)	57 (96,6%)	chi-sq 3,7 (p = 0,05)
	Incomplete	7 (14,9%)	5 (12,5%)	2 (3,4%)	
Varicella	Complete	19 (40,4%)	20 (50%)	38 (64,4%)	chi-sq 5,8 (p = 0,02)
	Incomplete	28 (59,6%)	20 (50%)	21 (35,6%)	
Pertussis	Complete	19 (40,4%)	16 (40%)	39 (66,1%)	chi-sq 7,1 (p = 0,008)
	Incomplete	28 (59,6%)	24 (60%)	20 (33,9%)	
Influenza	Complete	23 (48,9%)	25 (62,5%)	54 (91,5%)	chi-sq 22,5 (p < 0,00009)
	Incomplete	24 (51,1%)	15 (37,5%)	5 (8,5%)	

free of cost, if they are not up-to-date, which could account for a greater-than-average increase in comparison with other Latin American² and Mid-Eastern [7] countries, although serological verification of response to vaccination still seems to be low [15,17]. Influenza campaigns in our service also usually include medical students currently rotating in the hospital as a priority population to be vaccinated. Indeed, the strongest motivational factor among students worldwide seems to be free and easy access to vaccination [8,16,18].

Measles vaccination had an already high compliance rate, which non significantly increased during med school. As in other countries², most people in Brazil are vaccinated for measles during their infancy. A higher awareness of the disease importance, as well as recent outbreaks in many regions, which led to a massive vaccination campaign in Brazil, may account for this increase to nearly complete coverage.

Pertussis vaccination had a less pronounced increase, with only 66,1% of students vaccinated in their final years, which is comparable to a similar study conducted among German and Hungarian students [9], and suggests a lack of awareness of the importance of the disease. There has been an increase in the number of cases, even in countries with a high vaccination coverage [9], so that efforts should be made to increase awareness of students and health staff alike to prevent the spread of the disease, especially to young infants.

Varicella vaccination had noticeably the worst results, with a non-significant increase during the course. Despite being available since 1984 in private immunization clinics, it was only recently included, since 2013, free of charge, in Brazilian public vaccination programs for the general population. As a common childhood dis-

ease, it is likely that many students found it unnecessary to get vaccinated if they had already been infected in the past. Current guidelines for immunization allow for the possibility of not vaccinating for varicella, provided that natural immunity be proven by positive serology tests [1]. As a highly transmissible disease, varicella can cause outbreaks in pediatric wards and immunosuppressed patients, with possible serious complications [2]. Even so, information on the importance of vaccination for varicella for medical students is conspicuously lacking.

Despite a decrease in claims of lack of availability of vaccination, it is noteworthy that lack of awareness of vaccine importance and need to vaccinate did not change noticeably. Also, a high percentage of vaccination hesitancy was noted throughout the course, which is similar to what is found in other Brazilian [16,18] and foreign studies [2,5]. In particular, a low risk perception was found in this study, as well as in others [10]. A recent Brazilian study found that 64.2% of students and 38.5% of physicians were unaware of the vaccine-preventable infectious diseases in the basic immunization schedule [13], which calls for urgent and continuous measures to provide students with fuller and more reliable information, as well as to address the main anti-vaccination arguments at all stages of the medical curriculum [13]. Indeed, in a French national survey, nearly one third of students in their last year of medical school in France felt inadequately prepared to deal with vaccination-related questions [4]. Education strategies perceived as most efficient were case-based methods, clinical placements, personal work, and research for class presentations [3,4].

We obtained a response rate of 14,6%, which, albeit low, is comparable to similar studies. In a large French survey from 2017 [4], more than 90% of French medical students received a question-

Table 3
Reasons given for non-vaccination throughout the medical course

	Years	1st and 2nd	3rd and 4th	5th and 6th	
Reason	Total students (n)	47	40	59	n = 146
Vaccine allegedly not available		12 (25,5%)	9 (22,5%)	3 (5,1%)	chi-sq 8,7 (p = 0,003)
Unawareness of need to vaccinate		7 (14,9%)	11 (27,5%)	4 (6,8%)	chi-sq 1,9 (p = 0,17)
Vaccination hesitancy		14 (29,8%)	7 (17,5%)	21 (35,6%)	chi-sq 0,5 (p = 0,48)

naire, with an overall response rate of 32%, ranging from 8% to 62% between different medical schools. A Serbian study of the same year [11], with a recruiting method similar to ours, had a response rate of 5%. Some studies took the questionnaire simultaneously with other academic activities, which highly increased the response rate [2,3]. However, we wanted to keep our participation voluntary to avoid over-reporting bias.

Our study has some limitations. As it was conducted in only one medical school, results may not be generalized for others. Also, it was not possible to ascertain if there was an increase in individual students' vaccination status, nor the efficacy of any interventions which could have altered students' approach to vaccination. Our answers were spontaneous and based on self-reports alone, not confirmed by checking individual vaccination charts, which was not considered feasible, as these records are kept individually by students as physical charts, and checking them would preclude the anonymity of answers. Like other studies [5], this makes our questionnaire prone to selection bias, as students who have an interest in vaccination might be more likely to respond, which might have resulted in overestimates of vaccine-favorable responses. That possibility, however, would only make curricular interventions more urgent, if possible.

Moreover, this study was completed during the global SARS-Cov 2 pandemic; that may have caused a response bias, which was, unfortunately, unavoidable and impossible to quantify. Similar biases were found in studies during the 2010 Influenza pandemic [18]. A recent Italian study suggests that intention to vaccinate among students has increased during the last year-and-a-half, particularly among medical students [12].

5. Conclusions

This study shows that overall vaccine coverage in medical students in Brazil is still far from optimal. There is a markedly high level of vaccine hesitancy and unawareness of need to vaccinate for some diseases, particularly pertussis and influenza.

Efforts should be made during med school to address these issues, through more extensive information to undergraduates about vaccine importance and safety, as well as strategies to increase availability of these vaccines to medical students for free or for the lowest possible cost, in order to increase compliance and reduce risk for them and their patients.

All authors attest they meet the ICMJE criteria for authorship.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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