Measles and rubella in Italy, e-learning course for health care workers

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Abstract
Introduction. Since 2003, strategic plans for the elimination of measles and congenital rubella have been adopted in the World Health Organization European Region. In Italy, a network of reference laboratories for measles and rubella (MoRoNet) has been recently implemented to ensure high-quality laboratory investigation for the confirmation of cases and outbreaks. Training among health care workers (HCWs) is one of the tasks of MoRoNet and an e-learning course was produced to improve the knowledge on international and national elimination plans and laboratory surveillance for measles and rubella.
Methods. The course, based on the problem based learning methodology, was offered free of charge. Data about all participants and those who completed the course have been collected and analysed.
Results. 5822 participants enrolled and 3995 (69%) completed the course; comparison between pre- and post-test shows a significant improvement in knowledge. The average score obtained from the satisfaction questionnaire is 4.5 out of 5.
Discussion and conclusions. Course's results are satisfactory, and data show a significant improvement in knowledge among participants. Most of them were satisfied with content, learning methodology and platform. Moreover, this course represents one of the possible strategies to overcome resistance and mistrust about vaccinations among HCWs.

INTRODUCTION

Since 2003, Member States of the World Health Organization European Region (WHO/Europe), including Italy, adopted strategic plans for the elimination of measles and congenital rubella in the European region [1].

Beside the importance of monitoring the effectiveness of vaccination programs, these plans needed to be joined by dedicated surveillance systems able to promptly detect cases, with a good degree of sensitivity and specificity. In this context, laboratory activities represent one of the key elements for the confirmation of cases and epidemic outbreaks caused by measles and rubella viruses.

Surveillance objectives for these infectious diseases from WHO European plans were first receipt in Italy with the document "Piano Nazionale per l'Eliminazione del Morbillo e della Rosolia congenital" (PNEMoRc) 2003-2007 [2], and the National Reference Laboratory for measles and rubella has been established at the National Institute of Health (Istituto Superiore di Sanità – ISS) in Rome for the confirmation of the clini-

cal measles and rubella diagnosis. The Italian strategic plan, which regulated the surveillance of measles and rubella, was updated in 2007 and 2010 [3, 4]. Moreover, operative documents were emanated in 2013 and 2018 to rule integrated surveillance system [5, 6].

In 2016, the project "Verso l'eliminazione di Morbillo e Rosolia: realizzazione di una rete di Laboratori Sub-Nazionali (MoRoNet) coordinata dal Laboratorio di Riferimento Nazionale – OMS" was financed by the Italian Ministry of Health to implement a network of laboratories for measles and rubella, coordinated by the WHO accredited National Reference Laboratory.

The aim of the network is to improve the surveillance of measles and rubella and guarantee a proficient laboratory surveillance in Italy.

At the beginning of 2017, the network MoRoNet was officialised. Laboratories belonging to MoRoNet are supervised and accredited by the Italian National Reference Laboratory for measles and rubella (NRL), according to WHO standards for measles and rubella laboratory surveillance.

Currently, the network consists of 14 subnational ref-

erence laboratories (SRLs) from 13 Italian Regions in addition to the NRL.

As part of its commitment to coordinate the network, NRL roles are: confirmation of measles and rubella cases and outbreaks through serological and molecular assays, and genotyping of wild-type strains; annual evaluation of the accreditation status of all laboratories belonging to MoRoNet through proficiency testing in serological and molecular diagnostics; training of the Italian health personnel operating in the field of measles and rubella surveillance.

Italy experienced two large epidemics in 2017 and 2018, with a total of 5402 and 2526 suspected cases, respectively. Three hundred twenty-two cases (5.9%) occurred among health care workers (HCWs) in 2017, and 100 cases (3.9%) in 2018 (data available on www.epicentro.iss.it/morbillo/bollettino). As in previous outbreaks in Italy, nosocomial transmission was an important transmission setting. MPRV (measles, mumps, rubella and varicella) vaccines is the most effective medical intervention to control the disease, and vaccine hesitancy is a global challenge to the achievement of full vaccination coverage despite availability of vaccination services.

As training of HCWs is one of the tasks of the NRL, at the beginning of 2017, the e-learning course "The elimination of measles and rubella and laboratory surveillance in Italy" was developed as a collaboration between ISS's experts. A first edition of the course was provided to 200 HCWs defined as any hospital or other healthcare staff having regular contact with patients, actively involved in the surveillance of measles and rubella.

Afterwards, considering the topic relevance and the consequent need to extend the course to a wider target of participants, an updated second edition developed for all HCWs entitled "The elimination of measles and rubella, a priority of the WHO: the National Elimination Plan and the laboratory surveillance in Italy".

This study describes the development of the second edition of the e-learning course, focusing on the knowledge acquired after the training and the perceptions about contents and teaching methodology.

METHODS
Course characteristics

Two editions of a e-learning course on measles and rubella laboratory surveillance in Italy were provided, free of charge by the ISS e-learning platform EDUISS (www.eduiss.it), based on the LMS (learning management system) Totara Learn 10 (Moodle expansion), characterized by a constructivism approach that matched with the active learning methodology selected.

The course was set up based on the problem based learning (PBL) methodology. PBL is an active learning approach that challenges participants to "learn to learn" by solving real-world problems that mirror their working context, with the goal of developing life-long learning skills. This way, the process of working towards the understanding or solving of a "problem" leads to the participants' learning through a seven steps cycle [7]. PBL has been progressively adapted to the e-learning context by the ISS since 2004. Over the years, different course's models have been experimented to reproduce

the PBL steps, depending on the numerosity of participants and the level of interaction between them [8, 9].

The courses "The elimination of measles and rubella and laboratory surveillance in Italy" and "The elimination of measles and rubella, a priority of the WHO: the National Elimination Plan and the laboratory surveillance in Italy" were settled up in an asynchronous and self-learning modality to allow a high number of participants to get the course in autonomy. Participants were expected to spend 16 hours (no tracking based on time spent on the platform was settled up) to complete the course, accessing freely the platform every time within 24 hours.

The entire PBL cycle has been settled using the Totara Learn 11 tools.

The second edition of the e-learning course "The elimination of measles and rubella, a priority of the WHO: the National Elimination Plan and the laboratory surveillance in Italy" was offered to a very large number of participants (up to 5000) within a time frame of 364 days, from 19 September 2017 to 18 September 2018.

In line with the classification of CME (continues medical education) health professions, as indicated by the Italian Ministry of Health, different professions are grouped in 8 main headings: Physician, Psychologist, Pharmacist, Chemist, Biologist, Physicist, Nursing and Obstetric Nursing (Nurse, Paediatric Nurse, Obstetrician), Technical Health Professions (Healthcare Assistant, Medical Laboratory Technician, Workplace Safety and Prevention Technician).

Passing the course allowed the participants to acquire 24 credits CME.

Two general objectives were provided, further divided into four "specific objectives" about what participants would have been able to do at the end of the course.

General and specific objectives are outlined below.
General objectives of the course:
• improve the knowledge on laboratory surveillance for the elimination of measles and rubella and congenital rubella, according to the WHO;
• promote the national network of subnational reference laboratories for the elimination of measles and rubella and congenital rubella.
Specific learning objectives:
• define the epidemiology of measles and rubella at national and international level;
• describe the national measles and rubella elimination plan;
• describe the main features of laboratory surveillance for measles and rubella elimination;
• identify roles and responsibilities (functions) within the national network of reference laboratories for measles and rubella MoRoNet.

The production of materials was implemented in order to reproduce all the steps of the PBL cycle, providing all the tools to get an overview of the topics dealt with and to reach the solution of the problem, through:
• problem exercise: problem presentation with animated slides; open questions related to the course topics; open question related to the learning objectives; presentation of the learning objectives identified by the experts;
• supporting materials: key words, bibliography and

web sites provided to participants to address their documents' search for the achievement of autonomous learning objectives;

• study materials: developed on purpose by the experts, that integrated them with scientific literature;

• tutorials: power point presentations, where the experts in laboratory and epidemiological surveillance synthesized the topics related to each learning objective;

• problem solution: expert presentation on a possible solution to the problem.

Assessment and evaluation tools

Assessment and evaluation were based on the tools described below.

Two self-assessment tests, at the beginning (pre-test) and at the end of the course (post-test), containing the same question set: 8 multiple choice questions (MCQs) – 4 answer options (only one possible correct answer). Time to complete the test was 15 minutes. The correct answers were valued 1 point (zero points for wrong answers). The final score was calculated on a scale of 100 and expressed in percentage. It was not required a minimum score to pass. The post-test also provided a suggestion about the specific object to deepen for each wrong answer.

A final certification test, containing 72 MCQs – 4 answer options (only one possible correct answer). The correct answers were valued 1 point (zero points for wrong answers). The final score was calculated on a scale of 100 and expressed in percentage. The minimum score to pass the test was set at 75% of the correct answers. Three passing attempts were allowed. Time to complete the test was 120 minutes.

A satisfaction questionnaire was also mandatory to complete the course and obtain the certification. It was composed by 20 questions (18 closed and 2 open) to collect participants' satisfaction on learning methodology, contents and platform. Data analysis was directed to the 18 closed questions based on a five-point Likert scale: 1 = I don't agree at all, 2 = I disagree, 3 = I don't agree nor disagree, 4 = I agree, 5 = I fully agree. Two open fields were also provided to collect comments on positive aspects and perceived weaknesses *(Table 1)*.

Participants characteristics

The course was direct to the following HCWs: Physicians, Biologists, Chemists, Physicists, Obstetricians, Nurses, Paediatric Nurses, Healthcare Assistants, Psychologists, Pharmacists, Workplace Safety and Prevention Technicians and Medical Laboratory Technicians.

Regarding the degree of participation to the course, the users were classified as:

• *Completers*: participants who passed the final certification test, filling also the satisfaction questionnaire;

• *Dropouts:* participants enrolled to the course who have not completed it, for voluntary withdrawing or that not started it at all;

• *Not passed*: participants enrolled who failed all the attempts to pass the final certification test.

Statistical analysis

A descriptive analysis was conducted on the Com-

Table 1
Satisfaction questionnaire's closed questions

Learning methodology
1. The objectives of the course were clear
2. The content was consistent with the objectives of the course
3. The teaching methodology was effective
4. The overall organization (course articulation, timing, intermediate and final evaluations) was satisfactory
5. The test questions were enough clear
6. The time available to perform the tests was adequate
7. The quality of tutoring for this e-learning event was satisfactory

Contents
1. The level of treatment was appropriate to my knowledge
2. I have learned new concepts
3. I have acquired new skills
4. I can apply what I learned in this course in my working reality
5. The documentation made available was adequate to acquire the necessary information
6. The quality of the documentation available was appropriate
7. The documentation available was updated to the most recent literature
8. The consultation of the participant's Guide was useful in orienting myself in the educational path

Platform
1. The functioning of the platform was adequate
2. The methods of access to the platform were simple and immediate
3. The quality of technical support has been satisfactory

pleters' profiles. Analyse was performed using the statistical software SPSS (Statistical Package for Social Science) version 25.0 (IBM, Corp., Armonk, NY) and Microsoft Excel 2010 software.

Data from the pre- and post-test were utilized to evaluate participants' learning level after having completed the course. The comparisons between pre- and post-tests were performed using the paired samples student's t test. A p value lower than 0.05 was considered as statistically significant.

The data obtained from the final certification test scores area presented as mean, median and standard deviation (SD).

Results of the satisfaction questionnaire were analysed and represented through a radar chart. The 18 closed questions were grouped under 3 categories: learning methodology (7 questions/radials), contents (8 questions/radials) and platform (3 questions/radials). The scale was from 1 to 5, where 5 expressed the highest degree of satisfaction.

RESULTS
Participant characteristics

A total of 5822 users registered for the course. Regarding the level of participation, 3995 (68.6%) participants completed the course (Completers) passing the

final test and filling in the satisfaction questionnaire; 1740 (29.9%) were "Dropouts"; 87 (1.5%) "Not passed" the final test (*Figure 1*).

Completers' data

Demographic and professional data of the Completers have been analysed and results are presented.

Regarding the gender: females were the 71.6% of the participants, the average age was 47.2 years and the 69.8% was over 40 years old *(Table 2)*.

The main represented professions were: Nursing and Obstetric Nursing (28.4%), followed by Technical Health (24.9%) and Physicians (23.3%), as shown in *Figure 2A*.

Type of employment status was classified in: Employee (74.2%) and Other (25,8%) (unoccupied, self-employed, private contractors), according with CME criteria *(Figure 2A-B)*.

Pre- and post-test analysis and final certification test results

Pre- and post-test answers analysis showed that the mean of correct answers was 50.8±21.5 in the pre-test and 67.1±23.9 in the post-test: the mean value of the improvement was 16.4±25.4 (*Figure 3*). This improvement in knowledge is statistically supported by t test (t value was 40.6 [95% confidence interval (CI), 15.6 to 17.1], p<0001), performed using the statistical software SPSS. The mean value of the percentage of correct answers in the final certification test was 86.7%: the minimum acceptable value to pass the test was 75%.
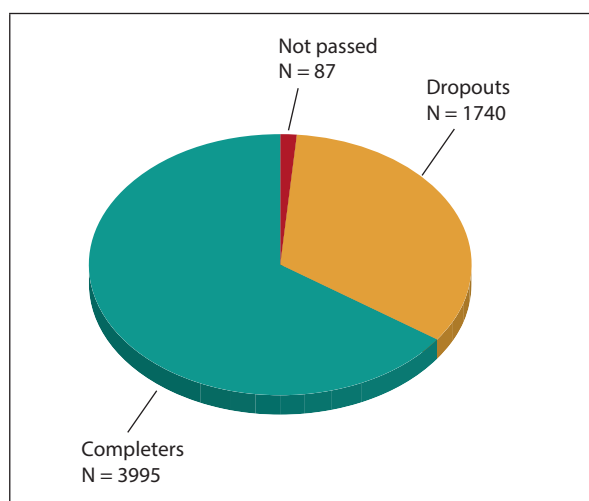
Satisfaction questionnaire results

Most participants consider effective the learning method, the adequacy of contents and the platform. It emerges a high overall liking, considering that the values are always between 4 and 5, where 5 express the highest degree of satisfaction (*Figure 4*).
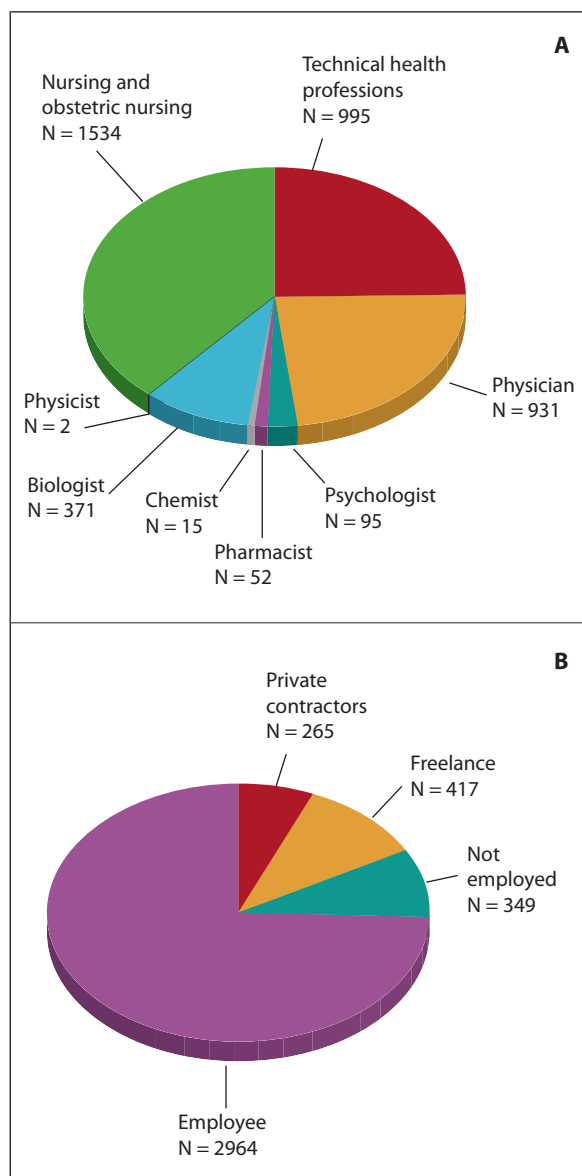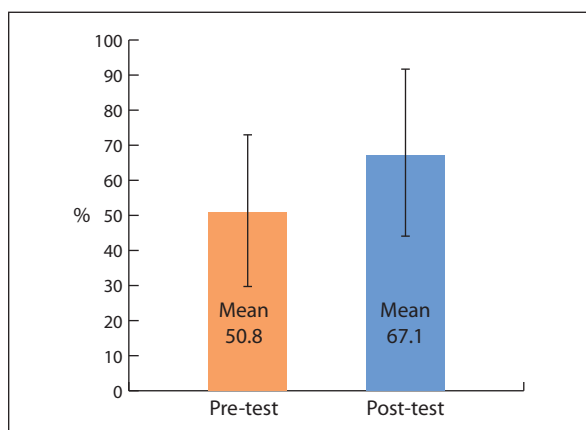
Figure 1
Degree of participation to the course (N = 5822).

Figure 2 A-B
Distribution by CME profession/category of the Completers' (N = 3995) and distribution by type of employment.

Table 2
Demographic and professional data of the Completers (N = 3995)

Demographic and professional data	Completers' gender		
	Female	**Male**	**Total sample**
Gender N (%)	2861 (71.6)	1134 (28.4)	3995 (100)
Age, mean ± SD (range)	44.9 ± 11.4 (23-80)	49.5 ± 12 (22-79)	47.2 ± 11.7 (22-80)

Figure 3
Completers' pre/post-test score (% of correct answers, 8 questions) (N = 3995).
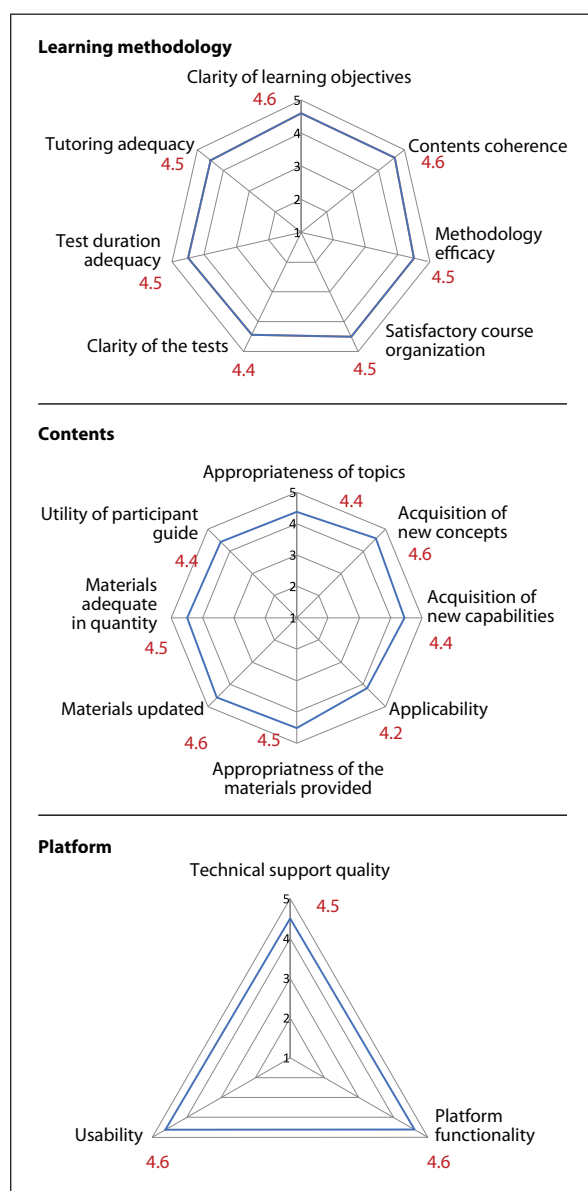
Figure 4
Radar charts for satisfaction questionnaire scores.

DISCUSSION AND CONCLUSIONS

Italy experienced two large epidemics in 2017 and 2018, with 5.9% and 3.9% of cases occurred among HCWs, respectively. During the first half of 2019 that percentage was similar to 2018 (data not shown). As in previous outbreaks in Italy, nosocomial transmission was an important transmission setting during the last two outbreaks.

As training is one of the tasks in the network MoRoNet, two editions of a e-learning course were organized through the cooperation of ISS's experts, belonging to the NRL and the Epidemiologic Unit of the Infectious Disease Department and to the Training Office. The course was provided free of charge by the ISS e-learning platform and addressed to the HCWs.

The first edition of the course entitled "The elimination of measles and rubella and laboratory surveillance in Italy" was specifically addressed to HCWs involved in the surveillance activities of the network MoRoNet. The second edition "The elimination of measles and rubella, a priority of the WHO: The National Elimination Plan and the laboratory surveillance in Italy" was addressed to several health professions as defined by CME and provided from 19 September 2017 to 18 September 2018.

A total of 5822 users registered to attend this last course and 68.6% of them completed it (Completers). Moreover, only 1.5% of the participants did not pass the final test. This represents a satisfying result, considering the expected level of completion in the e-learning context, as descripted in literature [10] and found out in ISS's previous experiences [7, 8].

The goal of this e-learning course consisted in the training of the HCWs on the surveillance of measles and rubella, with a particular regard to laboratory approaches, and promoting knowledge on vaccination in healthcare settings with higher probability of contact with infectious patients. Coherently with these tasks, the main represented professions among completers were: Nursing and Obstetric Nursing Professions (28.4%), followed by Technical Health Professions (24.9%) and Physicians (23.3%).

Demographic characteristics of participants in e-learning courses, including gender and age, are not found to be significantly different between completers and Dropouts, as reported in literature [11].

However, regarding the demographic data of the completers, the females were the 71.6%, coherently with the gender distribution among all the enrolled participants (72.5%). This data reflects the distribution by gender among health professions in Europe, where about the 70% of the employed are females, with a peak of 78% for the auxiliary professions [12].

The participants came from all the 21 Italian regions and from 105 out of the 107 Italian provinces, indicating a high degree of diffusion of the course, and can be considered a factor of success of the training.

Most participants worked as employee in the Italian National Health Service (74.2%), likely the workers most interested in the elimination of measles and rubella and laboratory surveillance. The categories of private contractors, free-lance and not employed were less represented.

Statistical analysis on pre- and post-test data shows a significant improvement in participants learning level after having completed the course.

Moreover, the satisfaction questionnaire analysis shows a high overall liking from most participants, that consider effective the learning method, the adequacy of the contents and the platform. As reported in literature, satisfaction from e-learning is a major factor in participants' decision to complete or drop from such courses [11].

The high number of completers, the wide dissemination of the training, the significance of the increase in knowledge and the high level of satisfaction, suggest that providing training on measles and rubella by this e-learning course has been a successfully experience. The data show that the general objectives of the course, to improve the knowledge on laboratory surveillance for the elimination of measles and rubella and congenital rubella and to promote the national network MoRoNet, have been reached.

Wide immunity gaps and nosocomial transmission are major challenges to measles elimination in Italy. As Italy has recently experienced, transmission of measles in hospital settings from infected HCWs to susceptible patients is possible and ensuring that all HCWs are immune to measles virus is necessary to avoid this threat. HCWs immunization gaps may be of particularly importance because of the high concentration of susceptible people in healthcare settings such as pregnant women and immunocompromised individuals, with potentially severe and fatal consequences, and the higher probability of contact with infectious patients. According to findings published in the American Journal of Infection Control, patients who are exposed to a healthcare worker who is sick – in hospital settings – are five times more likely to get a hospital-acquired influenza-like illness [13].

Moreover, immunization gaps among HCWs represent a critical example especially for people that have some doubts about vaccination. For that reasons, training in this field is particularly important to provide knowledge and expertise, promoting vaccination practice to HCWs.

In this context, this course permitted to answer the need of training among HCWs on measles and rubella. At the same time, it represents one of the possible strategies to overcome resistance and mistrust about vaccinations among HCWs [14].

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BRIEF NOTES