ITALIAN JOURNAL OF PUBLIC HEALTH

Report on public health actions and vaccination strategies to monitor measles epidemic in Local Health Unit A in Rome, Italy

Antonietta Spadea[(1)], Simonetta Casini[(1)], Anna Maria D'Amici[(1)], Emanuele Di Cosimo[(1)], Lucia Donno[(1)], Fabio Forleo[(1)], Eugenio Epifanio[(1)], Anna Rita Ferrero[(1)], Lucia Fraboni[(1)], Orazio Grimaldi[(1)], Riccardo Grita[(1)], Gabriella Gozzi[(1)], Fiammetta Iometti[(1)], Patrizia Operamolla[(1)], Daniele Piras[(1)], Paolo Proietti[(1)], Sergio Rogai[(1)], Gianluca Scovero[(1)], Fannina Scipione[(1)], Anna Valentini[(1)], Carmen Vinci[(1)], Andreina Ercole[(2)], Angelo Barbato[(3)]

ABSTRACT

BACKGROUND: Between May 2010 and October 2011 the Unit of Preventive Medicine for the Developmental Ages of District IV, Health Unit ASL RM/A, received 136 measles case notifications from the Unit of Epidemiology and Prophylaxis of Infectious Diseases.
METHODS: In accordance with the infectious diseases monitoring protocol, we introduced a series of preventive measures, such as monitoring subjects in contact with measles-infected patients, recommending the administration of two Measles Mumps and Rubella (MMR) doses four weeks apart, and informing paediatricians, families and school teachers about the measles epidemic.
RESULTS: All the activities above led to an increased number of MMR doses administered and a significant improvement of measles immunization coverage among residents of the District IV health unit of Rome. Concerning MMR 1, in a sample cohort consisting of children ≤24 months, the immunization coverage increased from 77% on the 31/12/09 to 88% on the 31/12/11. Instead, for MMR 2, in a cohort of children ≤6 years, the same ratio improved from 51% on the 31/12/09 to 65% on the 31/12/11.
DISCUSSION: The results indicate a material increase in the immunization coverage once our public health actions and vaccination strategies had been implemented among young residents of District IV ASL RM/A.

Key words: Measles, Vaccination, Public health, Monitoring

(1) Unit of Preventive Medicine for the Developmental Ages District IV, ASL RM/A - (2) Unit of Epidemiology and Prophylaxis of Infectious Diseases, ASL RM/A - (3) Health Manager, ASL RM/A

CORRESPONDING AUTHOR: Dr. Antonietta Spadea - Unit of Preventive Medicine of Development Age IV District, ASL RM/A, Via Dina Galli 3, 00139 Rome, Italy.
E-mail: antonietta.spadea@aslromaa.it

INTRODUCTION

Measles is a highly infectious and potentially fatal disease, which can be prevented by administering a safe and effective vaccine. When two doses of the vaccine are administered, at least 98% of vaccine recipients develop long-term protective immunity.

Measles only infects humans and theoretically the virus can be eradicated as long as a large enough proportion of the worldwide population is vaccinated.

Between 2003-2009, the World Health Organization (WHO) European Region (EUR) member states made substantial progress in reaching the goal of eliminating measles by 2010 (1, 2).

Elimination means permanent interruption of transmission in all European countries. Importation of measles should not result in outbreaks.

However, since late 2009, measles virus transmission has increased and outbreaks have become widespread. In 2011, measles outbreaks were reported in 36 out of 53 EUR member states, accounting for a total of 26074 measles cases reported in the region as of October 2011 (3, 4).

The primary reason for increased transmission and widespread outbreaks of measles in EUR is failing to vaccinate susceptible populations, especially in the Western European (WE) countries, including Italy.

The main factors contributing to a decreasing demand for measles vaccination in EUR include:

1) lack of knowledge about the relevance of the disease, resulting in a reluctance to be vaccinated;
2) skepticism about the benefits of vaccination;
3) fear of adverse effects deriving from vaccination;
4) limited health-care access for some underserved populations (several outbreaks have emerged in Rome and Sinti) and in communities where religious or philosophical objections (anthroposophic, and ultra-orthodox Jewish communities) may obstruct vaccination.

All these elements represent serious barriers to increasing population immunity in certain communities in EUR, particularly in WE (5, 6, 7, 8).

Measles in EUR is causing preventable deaths, illnesses, as well as financial costs with significant global implications.

The nine deaths (six in France, one in Germany, one in Kyrgyzstan and one in Romania) and thousands of measles-associated hospitalizations in EUR during 2011 are reminders that measles is a serious disease, that can lead to death across several age groups, even in countries with high-quality health care systems and/or minimal incidence of malnutrition.

The substantial financial and human costs arising from responding effectively to these outbreaks impose an additional burden on already limited European Public Health resources. In addition, EUR has become a source of virus introduction into other areas, such as the measles-free WHO Region of the Americas. Measles transmission was significantly reduced in the United States in the late 1990s, although cases of measles have been thereafter imported (9).

European countries that are part of the World Health Organization (i.e. all EU and EEA/EFTA countries) have committed to the goal of eliminating measles transmission by 2015 (10, 11).

To eliminate measles it's necessary both to keep the vaccination coverage above 95% with two doses of a measles-containing vaccine (MCV) across all population groups, and to ensure a vigilant monitoring as well as a rapid and effective response to detected outbreaks.

Reaching the EUR measles elimination target by 2015 is possible. However, it will require on-going, strong political commitment to routine childhood immunization throughout EUR.

Additional measures should also be warranted, including the implementation of SIAs to reduce susceptibility among older cohorts, together with strategies to ensure access to health care for underserved populations. Maintaining high 2-dose MMR vaccination coverage is the most critical factor to achieving the elimination target (12). Even a small decrease in measles coverage can increase the risk of large outbreaks and endemic transmission, as occurred in the United Kingdom in the past decade.

The aim of the present study was to report those actions that were put in place in order to effectively monitor a measles epidemic and further improve Measles, Mumps and Rubella (MMR) immunization coverage.

METHODS

Surveillance of measles cases

The District (D) IV territory is a large area in Rome, accounting for a total population of about 230 000 people, 31 000 of which are less than 18 years old.

The staff of the Unit of Preventive Medicine for the Developmental Ages in D- IV local health unit, ASL RM/A, focuses on vaccination activity through its Vaccination Centre, as well as on health educational programs and health monitoring of students across local schools.

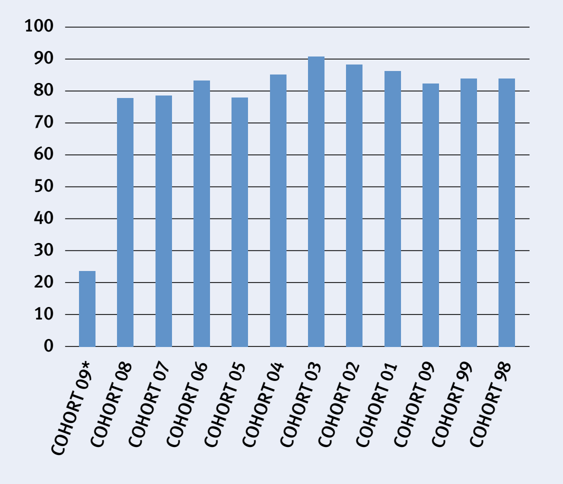
On the 26th of May 2010 we received the first measles case notification from Unit of Epidemiology and Prophylaxis of Infectious Diseases ASL RM/A. It regarded a five year old child attending a nursery school in District IV of Rome. Since that initial case, 136 cases overall were recorded, of which 54 notifications in 2010 and 82 in 2011.

Monitoring Measles Immunization Coverage

Figure 1 shows measles/MMR immunization coverage (%) by birth cohort in District IV residents as of May 2010.

FIG. 1

MMR 1 COVERAGE (%) FOR BIRTH COHORT IN IV DISTRICT RESIDENTS AS OF 20/05/10



** Cohort 09 was incoming into MMR 1 vaccination*

We introduced many preventive measures, in accordance with the infectious diseases monitoring protocol.

Preventive measures

1. Monitoring subjects in contact with measles-infected patients. We monitored all the children in contact with measles cases, offering the first dose of MMR vaccine to those not yet immunized, and the second dose to others that had already been immunized with the first dose.

2. Recommending two MMR doses four weeks apart. We informed every citizen who came to our Vaccination Centre that administering two MMR doses was necessary in order to reach higher vaccine efficacy.

3. Informing paediatricians about the measles epidemic. The team working in the Preventive Medicine for the Developmental Ages in D- IV called up all the paediatricians of the area in order to inform them about the measles epidemic, asking them to recommend the administration of two MMR doses four weeks apart for each patient.

In recent years, we have invested a great deal of effort in developing relationships with paediatricians through educational events, as we believe that creating a network among all the public health actors is the only strategy to achieve the goals set for this topic.

4. Informing families and teachers about the measles epidemic. Our staff promoted MMR vaccination through health education interventions in each school of the area, from kindergartens to secondary schools, and sent letters to families in order to remind them about MMR vaccination and explain the need to receive two MMR doses.

Statistical analysis.

Frequency tables were calculated and bar graphs were plotted.

Differences in changes observed before and after the event for each of the cohorts were tested as the sum of n squared, standard normal variables being distributed as a chi squared.

RESULTS

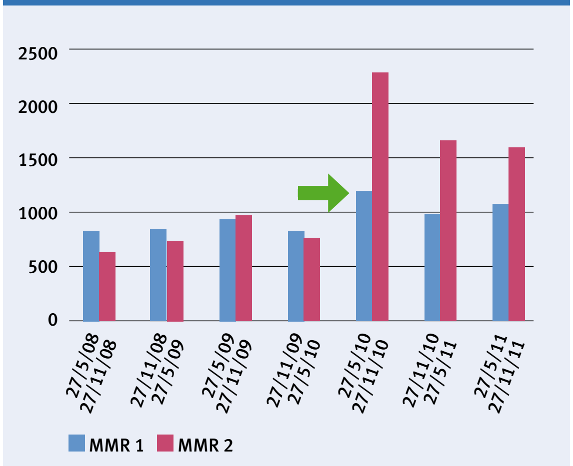
The above-mentioned initiatives altogether led to an increase in the number of MMR doses administered since May 2010 (figure 2). Administered MMR data was consistent over time until the 27/05/10, when a steep rise in both the first and the second dose was recorded.

These data are not aligned with Emilia-Romagna's most recent research on the topic thatshowed a decrease in child vaccination in 2010 vs. 2009 (13), despite a measles epidemic in that area too (14).

In the Figure 2, the abscissa axis represents the time factor every six-months, while the ordinate axis provides the number of administered doses. First doses are shown in violet and second in purple. The first measles case was notified on the 26/05/10 (represented by the green arrow).

FIG. 2

MONITORING OF ADMINISTERED MMR DOSES IN THE VACCINATION CENTRE OF DISTRICT IV



ITALIAN JOURNAL OF PUBLIC HEALTH

The increasing number of administered MMR doses concerned mostly the second doses. That led to the improvement of measles immunization coverage among resident birth cohorts.

At the present time, the measles/MMR 1 immunization coverage for the birth cohort of children ≤ 24 months is 88 % among residents of District IV and MMR 2 coverage for the birth cohort of children ≤ 6 years is 65%. Table 1 and 2 show the comparison with the previous years.

Did MMR 1 coverage significantly increase after the event?

Assumptions. We assumed that the variable "annual change in MMR 1 coverage" (ei) is independently and equally distributed for every cohort (i) as a normal distribution with a mean of 2% (m) and a variance of 10% (sigma^2).

We considered cohorts from 2003 to 2009 (n = 7).

Test. Our null hypothesis (H0) was that all the changes observed before and after the event for each of the cohorts considered were not significantly different from zero, with a confidence level of 90%, 95% and 99%.

This can be tested as the sum of n squared standard normal variables and distributed as a chi squared with n-1 degrees of freedom.

Calculations. The table 3 shows the calculated change in MMR 1 coverage for each of the cohorts from 2003 to 2009; we then standardized these changes as wi = (ei – m)/sigma and we squared the results. The sum of these squares is our test statistic, distributed as a chi squared with 6 degrees of freedom. This value (152.7) should be compared against the critical values of the distribution associated to percentiles 99%, 95% and 90%.

Since the test statistic was higher than the critical values, we can reject the null hypothesis with a confidence level of 99%. We can conclude that the MMR 1 coverage changed significantly between the two periods considered*.

TABLE 1

MEASLES IMMUNIZATION COVERAGE, 1 DOSE, OF THE BIRTH COHORT OF CHILDREN ≤ 24 MONTHS AMONG DISTRICT IV RESIDENTS. COMPARISON BETWEEN ≤ 24 MONTHS BIRTH COHORTS, YEAR BY YEAR

	≤ 24 months birth cohort	MMR 1 vaccinated	residents	coverage (%)
cohort 09	at 31/12/11	1622	1844	87.96
cohort 08	at 31/12/10	1506	1801	83.62
cohort 07	at 31/12/09	1363	1775	76.78
cohort 06	at 31/12/08	1468	1831	80.17
cohort 05	at 31/12/07	1159	1703	68.05
cohort 04	at 31/12/06	1369	1760	77.78
cohort 03	at 31/12/05	1011	1654	61.12

TABLE 2

MEASLES IMMUNIZATION COVERAGE, 2 DOSES, OF THE BIRTH COHORT OF CHILDREN ≤6 YEARS AMONG DISTRICT IV RESIDENTS. COMPARISON BETWEEN ≤6 YEARS BIRTH COHORTS, YEAR BY YEAR

	≤ 6 years birth cohort	MMR 2 Vaccinated	residents	coverage (%)
cohort 05	at 31/12/11	1114	1703	65.41
cohort 04	at 31/12/10	1167	1760	66.30
cohort 03	at 31/12/09	845	1654	51.08
cohort 02	at 31/12/08	849	1602	52.99
cohort 01	at 31/12/07	857	1646	52.06
cohort 00	at 31/12/06	710	1579	44.96
cohort 99	at 31/12/05	373	1545	24.14

TABLE 3

CALCULATED CHANGE IN MMR 1 COVERAGE

	MMR 1 birth cohort ≤24 months	MMR 1 31/12/2011	Change (%)	Change (standardized)	Change ^2
cohort 09 *	88%	88%	0	-0,63	0,4
cohort 08	83%	85%	2	0,00	0,0
cohort 07	76%	83%	7	1,58	2,5
cohort 06	80%	88%	8	1,90	3,6
cohort 05	68%	91%	23	6,64	44,1
cohort 04	78%	91%	13	3,48	12,1
cohort 03	61%	93%	32	9,49	90,0
			Chi squared		152,7
			Alpha	Critical value	Test
			1%	16,81	REJECT
			5%	12,59	REJECT
			10%	10,64	REJECT

*same MPR 1 coverage, in the ≤24 months cohort as calculated on the 31/12/11

Did MMR 2 coverage significantly increase after the event?

Assumptions. We assumed that the variable "annual change in MMR 2 coverage" (ei) is independently and equally distributed for every cohort (i) as a normal distribution with a mean of 2% (m) and a variance of 10% (sigma^2).

We considered cohorts from 1999 to 2005 (n = 7).

Test. Our null hypothesis (H0) was that all the changes observed before and after the event for each of the cohorts considered were not significantly different from zero, with a confidence level of 90%, 95% and 99%.

This can be tested as the sum of n squared standard normal variables and distributed as a chi squared with n-1 degrees of freedom.

Calculations. The table 4 shows the calculated change in MMR 2 coverage for each of the cohorts from 2003 to 2009; we then standardized these changes as wi = (ei – m)/sigma and we squared the results.

The sum of these squares was our test statistic, distributed as a chi squared with 6 degrees of freedom. This value (132.4) should be compared against the critical values of the distribution associated to percentiles 99%, 95% and 90%.

Since the test statistic was higher than the critical values, we can reject the null hypothesis with a confidence level of 99%. We can conclude that the MMR 2 coverage changed significantly between the two periods considered*.

** To be more precise, we must reject the hypothesis that the coverage did not change significantly after the event for all the cohorts considered.*

DISCUSSION

Immunization is one of the most cost-effective available public health actions and immunization programmes in the WHO European Region have been a strong component of primary healthcare (7, 8, 16).

The WHO Regional Committee for Europe endorsed a resolution to eliminate measles and rubella, and prevent congenital rubella infection, by 2010.

While measles and rubella transmission have been eradicated in a number of countries by strong, routine two-dose combined measles and rubella vaccine programmes for children, the regional goal of eliminating measles and rubella by 2010 has not been met according to the epidemiological evidence to date, and the underutilisation of the MMR vaccination in Italy, especially in immigrant children, may be a testimony of this (17).

TABLE 4

CALCULATED CHANGE IN MMR 1 COVERAGE					
	MMR 2 birth cohort ≤6 years old	MMR 2 31/12/2011	Change (%)	Change (standardized)	change ^2
cohort 05 *	65%	65%	0	-0.63	0.4
cohort 04	66%	73%	7	1.58	2.5
cohort 03	51%	64%	13	3.48	12.1
cohort 02	53%	70%	17	4.74	22.5
cohort 01	52%	72%	20	5.69	32.4
cohort 00	45%	67%	22	6.32	40.0
cohort 99	24%	41%	17	4.74	22.5
			Chi squared		132.4
			Alpha	Critical value	Test
			1%	16.81	REJECT
			5%	12.59	REJECT
			10%	10.64	REJECT

same MPR 2 coverage, in the ≤6 years cohort as calculated on the 31/12/11

Therefore, eliminating measles in the WHO region by 2015 (10), will require:

1) increasing and maintaining ≥95% coverage with 2 dose measles-containing vaccines across a wide range of ages;
2) implementing effective control measures if outbreaks are detected;
3) further strengthening controls in order to achieve a timely identification of cases and outbreaks, and to validate measles elimination.

Such coverage goal is recommended in Italy as well, according to the last "National Plan of Measles and Rubella Elimination and Prevention of Congenital Rubella Syndrome by 2015" published on the 23/03/2011 (11).

In 2008, the ICONA 2008 research containing regional surveys on vaccination coverage was conducted simultaneously in 17 Italian Regions and in the Autonomous Province of Trento, using a cluster sampling method. Overall, the population analysed consisted of 3 806 children aged 12-24 months.

According to this research, in the Lazio area, the MMR 1 coverage was 85.4% in child cohorts of <24 months (15).

In our District, MMR 1 coverage of birth cohort 2006 as of 31/12/08 was 80%.

Our study shows a significant increase of MMR vaccine administrations and the consequent overall improvement of measles immunization coverage for all the birth cohorts, and for both first and second doses.

These data are not aligned with Emilia-Romagna's most recent research on the topic, that showed a decrease of child vaccination in 2010 vs. 2009 (13), despite a measles epidemic in that area too (14).

In order to reach these results we suggest to implement the following best practices:

1) Three years ago we worked with the health team of the Unit of Epidemiology and Prophylaxis of Infectious Diseases of ASL RM/A on a shared infectious diseases monitoring protocol, which included vaccine-preventable diseases, actions, and annual reporting. That has allowed us to receive any measles notification in real time.
2) In the last years, we have invested a great deal of effort in developing relationships with paediatricians through the organization of educational events on vaccination reviews. That piece of work has allowed us to create a strong and effective network. In fact, as of today, paediatricians consult us in a friendly manner as soon as they encounter any vaccination issues with their patients.
3) We organised meetings both with parents in the kindergartens and with teachers in nursery schools. We also sent letters to the families in our area to inform them about any measles epidemic and remind them of the importance of MMR vaccination, as well as explaining why they needed to receive two MMR doses. We usually use the school chan-

nel to send letters reminding of vaccinations, both at the kindergarten and at the secondary school level.

4) Last, but not least, as recommended by the "National Plan for Measles and Rubella Elimination and Prevention of Congenital Rubella Syndrome by 2015" (11), we advised every user who came to our Vaccination Centre to get 2 MMR doses four weeks apart from one another.

In our opinion, the latter was the most effective action. In fact, we significantly increased the number of second MMR doses administered, making immunization coverage in the birth cohort of children ≤ 24 months reach 88% and 47% for MMR 1 and MMR 2 respectively, and reach a coverage of 93% and 64% for MMR 1 and MMR 2, respectively, in the birth cohort of children ≤ 6 years.

Administering 2 MMR doses four weeks apart should become routine practice if we want to reach the goal of eliminating measles.

According to the latest report of UOS Epidemiology and Prophylaxis of Infectious Diseases of the health unit ASL RM/A, no measles cases were notified in the last two months of 2011.

ACKNOWLEDGEMENTS: *The authors would like to thank the paediatricians of District IV of Rome.*

References

(1) Surveillance Guidelines for Measles, Rubella and Congenital Rubella Syndrome in the WHO European Region, World Health Organization 2009

(2) Martin R, Wassilak S, Emiroglu N, et al. What will it take to achieve measles elimination in the World Health Organization European Region: progress from 2003–2009 and essential accelerated actions. J Infect Dis 2011;204(Suppl 1):S325–34.

(3) Increase Transmission and Outbreaks of Measles – European Region, 2011, MMWR, December 2, 2011 / 60(47); 1605-10.

(4) Surveillance report: European monthly measles monitoring (EMMO), European Centre for Disease Prevention and Control, Stockholm, 2011, Issue 6: November 2011

(5) Muscat M. Who gets measles in Europe? J Infect Dis 2011;204(Suppl 1):S353–65.

(6) Immunization surveillance, assessment and monitoring. Data, statistics and graphs. Geneva, World Health Organization, 2010.

(7) Muscat M et al. Measles in Europe: an epidemiological assessment. The Lancet, 373(9661):383–389.

(8) Spika JS, Wassilak S, Pebody R et al. Measles and rubella in the World Health Organization European Region: diversity creates challenges. Journal of Infectious Diseases, 2003;187(Suppl 1):191–7Centers for Disease Control and Prevention. Update: Measles – United States, January-July 2008. Morbidity and Mortality Weekly Report, 57(33):893–6.

(9) World Health Organization. Renewed commitment to elimination of measles and rubella and prevention of congenital rubella syndrome by 2015 and sustained support for polio-free status in the WHO European Region. Resolution 12 (EUR/RC60/R12). Copenhagen, Denmark: World Health Organization Regional Committee for Europe; 2010.

(10) "National Plan to Measles and Rubella Elimination and Prevention of Congenital Rubella Syndrome by 2015" published on 23/03/2011.

(11) CDC. Measles—United States, January–May 20, 2011. MMWR 2011;60:666–8.

(12) Report about "Immunization coverage in children – year 2010" (pdf 1,8 Mb), Public Health Department – General Management of Emilia-Romagna. December 2011.

(13) Aggiornamento sull'andamento del morbillo e della rosolia in Emilia-Romagna al 30 giugno 2011.

(14) ICONA 2008: national vaccination coverage survey among children and adolescents. ICONA Working Group 2009, Reporting ISTISAN: 09/29, ISS, VIII, 1-118.

(15) Analysis of determinants for low MMR vaccination coverage in Europe, 2010, VENICE II, Vaccine European New Integrated Collaborated Effort, Consortium October 2010 - October 2011.

(16) Langiano E, Ferrara M, Lanni L, Atrei P, Martellucci G, De Vito E. Rubella seroprevalence in childbearing age women: a cross sectional study in the province of Frosinone, Central Southern Italy. Ital J Public Health 2009; 6(3): 194-201.

(17) Chiaradia G, Gualano MG, Di Thiene D, Galli L, Giacchino R, Castelli Gattinara G, Veneruso G, Ricciardi W, La Torre G. Health status of immigrant children: an epidemiological survey among Italian paediatricians. Ital J Public Health 2011; 8(3): 268-274.