



Original article

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TIMELINESS AND LEVEL OF PRIMARY IMMUNISATION COVERAGE AGAINST DIPHTHERIA, WHOOPING COUGH AND TETANUS IN MONTENEGRO

SUMMARY

The aim of the paper was to determine the timeliness and level of primary immunization coverage against diphtheria, tetanus and whooping cough (pertussis), as well as the dropout rate in Montenegro in the cohort born from January 1 to December 31, 2006.

Cross-sectional study was conducted in the period from October to December 2008. All immunization points in Montenegro were visited, and immunization records of entire cohort born in 2006 were reviewed.

Timeliness of primary immunization coverage with DTP₃ was 92.6% at the level of Montenegro, but in four out of 21 municipalities (19%) the timeliness of primary immunization coverage was less than 90%. After the additional activities on the vaccination of previously unvaccinated children, the primary immunization coverage with DTP₃ reached the value of 98.1% at the level of Montenegro, and in all but two municipalities exceeded the value of 95%. Dropout rate was 1.7% at the level of Montenegro, not exceeding the value of 5.5% in any municipality.

In the cohort born during 2006, timely primary immunization with DTP₃ was carried out in 1/5 of Montenegrin municipalities, with the value less than 90%. Supplemental immunization activities related to unvaccinated children significantly increased the primary immunization coverage with DTP₃, reaching the value of 95% at both the state and municipalities' level. Dropout rate was rather low both at the state and municipalities' level. Compared to routine administrative reporting on immunization coverage, surveys that include the review of immunization records after additional immunization activities provide more realistic rate of completeness and timeliness of primary immunization coverage.

Key words: vaccine-preventable diseases, diphtheria, tetanus, whooping cough (pertussis), timeliness of immunization, primary immunization coverage, immunization records

INTRODUCTION

The World Health Organization (WHO) had planned to eliminate the neonatal tetanus in the European region by 2005 as well to decrease by 2010 the incidence of diphtheria to the value lower than 1

per 1.000.000 people, and of whooping cough to the value lower than 1 per 100.000 people (1,2). To obtain such results it is indispensable to achieve the high level of primary immunization coverage against the aforementioned diseases (> 95% at the national level and > 90% in all subnational administrative units).

The rate of successfulness of prevention and control of vaccine-preventable diseases depends not only on the level of collective immunity, i.e. obtaining and maintaining the high immunization coverage rates related to the target population groups but also on the timeliness of conducted immunization aiming to shorten the time period for possible exposure of the target population to infectious agents (3).

Using routine administrative methods of reporting on compulsory immunization coverage, it is not possible to determine the timeliness of immunization as well as the influence of additional immunization activities on the total rate of primary immunization coverage (3-5). In order to perform the analysis of vaccine application timeliness, it is necessary to undertake special field investigations by means of which we could obtain data on the time of vaccine application in respect to the age of children included into compulsory immunization, or to establish more complex systems for monitoring and evaluation of immunization programmes' implementation (6-12).

The aim of the paper was to determine the timeliness and completeness of primary immunization coverage against diphtheria, tetanus and whooping cough as well as the dropout rate in Montenegro in the cohort born from January 1 to December 31, 2006.

STUDY POPULATION AND METHODS

The investigation, by design of cross-sectional study, was conducted in the period from October to December 2008 by visiting all immunization points in Montenegro, when immunization records of the whole cohort born in 2006 were reviewed. At the time of immunization, the eligibles of the cohort were aged 22-34 months, which means that all the eligibles, excluding those with permanent contraindications, should have undergone the primary immunization with three vaccine doses against diphtheria, tetanus and whooping cough (DTP₃). For the purposes of investigation, a special questionnaire was designed, into which we inserted data on the age-appropriate vaccination, recommended time interval for vaccination, and the date of the applied third dose of DTP₃ vaccine. The timeliness of primary immunization with DTP₃ vaccine means complete vaccination (three doses) conducted between the age of two and twelve months (13,14). The dropout rate in primary immunization with DTP₃ was calculated using the following formula (15, 16):

$$\text{Dropout rate} = \frac{\text{proportion of population having received all three doses of DTP(DTP}_3\text{)}}{\text{proportion of population having received the first dose of DTP (DTP}_1\text{)}} \times 100$$

Proportion of population having received the first dose of DTP.

The values of dropout rates over 5% at the national level and over 10% at the level of certain subnational units (municipalities) are considered unfavorable indicators (16).

RESULTS

By field visiting all immunization points at the territory of Montenegro, out of 7.095 children born during 2006, as was presented in the official reports on primary immunization with DTP₃ vaccine, valid data were collected for about 6.890 eligibles or 97.1% (17). A slightly smaller number of reviewed immunization records compared to the number of eligibles from the official reports was the consequence of the fact that this investigation did not include the data on immunization status of the children who, after the split between Montenegro and Serbia, moved out of Montenegro.

The review of immunization records during the investigation conducted after additional activities directed to the immunization of previously unvaccinated eligibles showed that primary immunization coverage, almost in all municipalities, exceeded 95%, and reached 98.1% at the state level. (Table 1). After additional immunization activities in only two out of 21 municipalities (9.5%) the primary immunization coverage with DTP₃ vaccine was just below 95%, while in eight municipalities (38.1%) the coverage was 100%, and over 98% in six municipalities (Table 1).

Timely primary immunization coverage with DTP₃ vaccine in Montenegro was 92.6%. In nine (42.8%) out of 21 municipalities in Montenegro the percentage of primary immunization did not reach the required 95%, of which less than 90% in four (19%) municipalities (Table 2).

In five (23.8%) municipalities, timely primary immunization with DTP₃ was carried out in all the eligibles (100%); in five (23.8%) municipalities it involved more than 98% of eligibles; in two municipalities the percentage ranged between 95% and 98%.

In eight (38.1%) municipalities, mostly from the north of Montenegro, the primary immunization with DTP₃ was carried out in more than 95% of eligibles up to nine months of age, while in one municipality primary immunization over 90% was conducted in children aged six months.

There were no indications in this investigation that primary immunization with DTP₃ started before the children turned two months of age.

Table 1. DTP₃ immunization in Montenegro in the cohort born in 2006: comparison between the investigation results from 2008 and the official immunization reports from 2007

Municipality	Number of reviewed immunization records of the eligibles born in 2006 presented in the investigation conducted in 2008	DTP ₃ (coverage in %) Results of the investigation from 2008 on completeness of coverage of the cohort born in 2006 by DTP ₃ primary immunization	DTP ₃ (coverage in %) Official reports from 2007 on coverage of the cohort born in 2006 by DTP ₃ primary immunization
Herceg Novi	329	97.3	92.5
Kotor	198	94.9	98.4
Tivat	133	100.0	94.4
Budva	225	97.8	92.2
Bar	379	100.0	98.1
Ulcinj	213	95.8	88.9
Podgorica	2.329	98.0	89.9
Cetinje	150	98.7	89.7
Danilovgrad	157	97.4	93.2
Nikšić	770	97.0	95.9
Plužine	24	100.0	95.0
Šavnik	19	100.0	100.0
Pljevlja	282	99.6	99.3
Žabljak	31	100.0	100.0
Bijelo Polje	537	99.8	97.9
Mojkovac	88	100.0	100.0
Kolašin	70	100.0	98.7
Andrijevica	47	100.0	97.8
Plav	143	98.6	98.8
Rožaje	373	99.5	97.5
Berane	393	94.6	82.3
Montenegro	6.890	98.1	93.1

Table 2. Timeliness of primary immunization with DTP₃ in the cohort born in 2006 at the level of municipalities and Montenegro

Municipality	DTP ₃ Up to 6 months of age ¹ %	DTP ₃ Up to 9 months of age ² %	DTP ₃ Up to 12 months of age ³ %	DTP ₃ 12 months+ ⁴ %	DTP ₃ total ⁵ %
Herceg Novi	42.2	93.0	95.1	2.2	97.3
Kotor	63.6	90.4	91.9	3.0	94.9
Tivat	51.1	88.7	97.7	2.3	100.0
Budva	44.0	89.3	93.3	4.5	97.8
Bar	73.3	96.0	98.9	1.1	100.0
Ulcinj	21.6	74.6	86.3	9.5	95.8
Podgorica	31.5	80.0	88.2	9.7	98.0
Cetinje	14.0	70.7	87.3	11.3	98.7
Danilovgrad	47.1	85.3	91.7	5.7	97.4
Nikšić	72.7	91.0	93.5	3.5	97.0
Plužine	12.5	95.8	100.0	0.0	100.0
Šavnik	42.1	89.5	100.0	0.0	100.0
Pljevlja	50.7	97.5	99.3	0.3	99.6
Žabljak	16.1	93.5	100.0	0.0	100.0
Bijelo Polje	72.2	95.7	98.1	1.7	99.8
Mojkovac	93.2	98.9	100.0	0.0	100.0
Kolašin	61.4	97.1	100.0	0.0	100.0
Andrijevica	53.2	93.6	93.6	6.4	100.0
Plav	60.8	95.1	98.6	0.0	98.6
Rožaje	80.4	95.4	98.9	0.6	99.5
Berane	50.9	78.9	86.5	8.1	94.6
Montenegro	50.0	87.0	92.6	5.5	98.1

¹ DTP₃ (up to 6 months of age) - primary immunization coverage with DTP₃ in % carried out in children up to 6 months of age

² DTP₃ (up to 9 months of age) - primary immunization coverage with DTP₃ in % carried out in children up to 9 months of age

³ DTP₃ (up to 12 months of age) - primary immunization coverage with DTP₃ in % carried out in children up to 12 months of age

⁴ DTP₃ (12 months +) - primary immunization coverage with DTP₃ in % carried out in children after 12 months of age

⁵ DTP₃ (total) – total primary immunization coverage with DTP₃ obtained prior to this investigation (children aged 22-34 months)

The first dose of DTP vaccine, at the level of Montenegro, was given to 99.8% of eligibles, of which the coverage reached 100% in 15 municipalities, and 99% in only one municipality.

Up to 12 months of age, the dropout rate was 7.2% at the level of Montenegro, while in four (19%) municipalities it exceeded 10%. (Table 3).

At the time of this investigation (children being aged 22-34 months), the dropout rate was 1.7% at the level of Montenegro, noting that it did not exceed 10% in any of the municipalities, and reached 5% in just one municipality.

with DTP₃ in % obtained in eligibles up to 12 months of age

$DTP_1 - DTP_3 (12) / DTP_1$ – dropout rate for immunization with DTP vaccine in % in eligibles up to 12 months of age

DTP₃ (total) - primary immunization coverage with DTP₃ obtained up to this investigation (eligibles aged 22-34 months)

$DTP_1 - DTP_3 (total) / DTP_1$ dropout rate for immunization with DTP vaccine at the time of this investigation (eligibles aged 22-34 months)

DISCUSSION

Compulsory immunization against diphtheria in Montenegro was introduced in 1951, first in the form of a single vaccine, and since 1962 in the form of DTP. Up to 1977, when the last case of this disease was registered, because of insufficient coverage of the population by immunization programmes, diphtheria had endemic/epidemic character with annual number of diseased reaching several hundreds in epidemic years, i.e. the incidence from 2.4 to 93.7 per 100.000 people. Nowadays, diphtheria is, virtually, eliminated in Montenegro (18).

Compulsory immunization against tetanus was introduced in Montenegro in 1960. Before that period, as well as during the first ten years of

Table 3. Dropout rate in DTP₃ immunization for the cohort born in 2006 at the level of municipalities and Montenegro

Municipality	DTP ₁ ¹	DTP ₃ (12) ²	$DTP_1 - DTP_3 (12) / DTP_1$ ³	DTP ₃ (total) ⁴	$DTP_1 - DTP_3 (total) / DTP_1$ ⁵
Herceg Novi	99.7	95.1	4.6	97.3	2.4
Kotor	98.5	91.9	6.7	94.9	3.7
Tivat	100.0	97.7	2.3	100.0	0.0
Budva	99.5	93.3	6.2	97.8	1.7
Bar	100.0	98.9	1.1	100.0	0.0
Ulcinj	100.0	86.3	13.7	95.8	4.2
Podgorica	99.9	88.2	11.7	97.9	2.0
Cetinje	99.3	87.3	12.0	98.7	0.6
Danilovgrad	100.0	91.7	8.3	97.4	2.6
Nikšić	99.6	93.5	6.1	97.0	2.6
Plužine	100.0	100.0	0.0	100.0	0.0
Šavnik	100.0	100.0	0.0	100.0	0.0
Pljevlja	100.0	99.3	0.7	99.6	0.4
Žabljak	100.0	100.0	0.0	100.0	0.0
Bijelo Polje	100.0	98.1	1.9	99.8	0.2
Mojkovac	100.0	100.0	0.0	100.0	0.0
Kolašin	100.0	100.0	0.0	100.0	0.0
Andrijevica	100.0	93.6	6.4	100.0	0.0
Plav	100.0	98.6	1.4	98.6	1.4
Rožaje	100.0	98.9	1.1	99.5	0.5
Berane	100.0	86.5	13.5	94.6	5.4
Montenegro	99.8	92.6	7.2	98.1	1.7

DTP₁ - percentage of eligibles having received the first dose of DTP vaccine

DTP₃ (12) - primary immunization coverage

vaccination, the incidence was up to 3.2 per 100.00 people followed by very high lethality reaching even 60%. From the beginning of the '70s to the present

time, tetanus has been rarely registered, only in sporadic forms (annual incidence ranges from 0 to 0.2 per 100.000 people). However, despite the most modern treatment methods, lethality is still high amounting to 50%.

Compulsory immunization against whooping cough was introduced in Montenegro in 1962. Prior to this period, the reported incidence was up to 167.2/100.000 people. A significant reduction in the number of the diseased was obtained at the beginning of the '80s in the past century, with just a few reported cases annually in the past fifteen years (18).

Even though the aims of the World Health Organization related to Montenegro have been fulfilled, there are several reasons why health care workers should continue with their attempts to improve the immunization coverage in Montenegro. The first reason lies in the fact that even by applying the available vaccines against the aforementioned diseases their eradication is impossible, as the causative agents are still in the surrounding. The second reason is the experience of reemergence of diphtheria reaching epidemic proportions in the former Soviet Union due to significant fall in the vaccinated population percentage (19, 20). The third reason refers to the data that the official primary immunization coverage with DTP₃ in the last ten years, at the level of the state as a whole, reached 92.8%, while after first revaccination it amounted to 90.1% (18). The second and third revaccination against diphtheria and tetanus in the last ten years were carried out with high coverage (98.3%) (18). Because of the low rates of primary immunization coverage and first revaccination, providing that additional activities on primary immunization of unvaccinated subjects had not been undertaken, there might be a significant number of completely unvaccinated children aged between three and six years (the period between primary immunization/first revaccination and the second and third revaccination against diphtheria and tetanus). That is why it is necessary to conduct additional investigations to determine the real degree of coverage and timeliness of primary immunization.

The conducted investigation of immunization status of the cohort born in 2006 shows that the health service of Montenegro undertakes significant additional activities related to immunization of the eligibles not having been covered by primary immunization with DTP₃ vaccine, which significantly improved the official coverage of the cohort (93.1%). Thus, the coverage of 98.1% at the level of Montenegro reached the required 95% (17). The analysis of the obtained coverage at subnational level yielded encouraging results that only in two municipalities (9.5%) the coverage was below 95%, i.e. 94.9% and 94.6%, respectively. Therefore,

speaking of the analyzed cohort, it can be concluded that primary immunization at national and subnational levels, thanks to additional immunization activities, meet the requirements.

The data, obtained by this investigation, that 92.6% of the cohort population born in 2006 underwent primary immunization up to the age of 12 months points to the timeliness of DTP₃ vaccine application at the level of the state as a whole. On the other hand, if we do the analysis of coverage timeliness at subnational level, i.e. municipalities' level, we will face the results that in nine municipalities timely primary immunization was carried out in less than 95% of the population, in four municipalities of which with the coverage under 90%. These results question the timeliness of collective immunity developing, i.e. greater exposure of unvaccinated eligibles to infectious agents of the aforesaid vaccine-preventable diseases. As we have seen, the additional immunization activities significantly improved the total immunization coverage. However, they cannot improve the timeliness of immunization (timeliness of immunity developing), i.e. they cannot completely make up for the consequences of primary immunization delay. Besides drawing conclusion that the improvement of primary immunization with DTP₃ is indispensable, the investigation results show that it is quite possible, as has been confirmed by experiences of one half of the investigated municipalities which carried out the timely primary immunization with DTP₃ in more than 98% of the subjects. The same experience was shared by eight municipalities (38.1%) of Montenegro in which primary immunization with DTP₃ covered 95% of the population up to nine months of age. Generally, the problem of primary immunization delay has been in the focus of interest of a growing number of researchers who are trying to explain the reemergence of vaccine-preventable diseases (3, 21-27). In the states of former Yugoslavia, similar investigations on immunization timeliness have been conducted only within the so-called "Researches on multiple indications of the situation of children and women" conducted every five years in association with Unicef (28-31). However, comparison of our results with those investigations is not wholly possible as such investigations consider only the data on immunization status noted in health cards or data provided by parents or guardians on immunization of their children if such data have not been noted in their health cards, which prevents precise determination of immunization timeliness. It should be emphasized that these investigations also point to the problems related to timely DTP vaccine application.

It is not possible to identify all the reasons of untimely DTP₃ application without conducting additional investigations, even though, based on

certain field experiences, there are suppositions that parents do not stick to the vaccination calendar, as they are poorly informed about the importance of primary immunization timeliness or vaccination delay by health workers because of temporary contraindications.

The initial contact between parents and health workers implementing the programme of compulsory immunization was rather successful, as the coverage with DTP vaccine was 99.8% at the level of the state as a whole, without fluctuations at subnational level (in none of the municipalities was the coverage with DTP vaccine under 98.5%). If dropout rate in DTP immunization is taken as the measure of contact quality between health care service and immunization programme beneficiaries, i.e. the measure of trust and satisfaction of parents for obtained information and services, then the obtained

results for the cohort aged 12 months would point to significant mistakes and thereof dissatisfaction expressed by the parents (dropout rate over 5% at the level of Montenegro and in 1/5 of municipalities over 10% ranging from 11.7% to 13.5%). Finally, such results would be poor indicators (16). However, by accepting additional immunization activities, a significant number of parents completed the primary immunization of their children, so that the dropout rate for the children aged 22-34 months was 1.7% at the level of Montenegro. As for subnational level, there have not been registered municipalities with the dropout rate exceeding 10%. Moreover, the dropout rate more than 5% was reported only in one municipality. Therefore, we can say that rather successful contact has been established between the parents of the cohort and health care service implementing the obligatory immunization programme.

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PRAVOVREMENOST I NIVO OBUHVATA VAKCINACIJE PROTIV DIFTERIJE, VELIKOG KAŠLJA I TETANUSA U CRNOJ GORI

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SAŽETAK

Cilj rada bio je da se utvrdi pravovremenost i nivo obuhvata primoinmunizacijom protiv difterije, tetanusa i velikog kašlja, kao i stopa odustajanja obveznika od započete vakcinacije u sklopu sprovođenja programa obaveznih imunizacija u Crnoj Gori, u kohorti rođenih od 01. januara do 31. decembra 2006. godine.

U istraživanju je korišćena studija presjeka, koja je sprovedena u periodu od oktobra do decembra 2008. godine obilaskom svih imunizacionih punktova u Crnoj Gori, tokom kojih su pregledani vakcinalni kartoni cjelokupne kohorte rođene u 2006. godini.

Pravovremena primoinmunizacija protiv difterije, tetanusa i velikog kašlja sa DTP₃ sprovedena je kod 92,6% obveznika na nivou države kao cjeline, s tim da je u četiri opštine (19%) pravovremena primoinmunizacija sprovedena kod manje od 90% obveznika. Nakon dopunskih aktivnosti na vakcinaciji prethodno nevakcinisanih osoba, obuhvat obveznika kohorte rođene 2006. godine primoinmunizacijom sa DTP₃ dostigao je 98,1% na nivou Crne Gore, i u gotovo svim opštinama (osim dvije) premašio je vrijednost od 95%. Stopa odustajanja od započete vakcinacije sa DTP na nivou Crne Gore iznosila je 1,7%, s tim da ni u jednoj opštini nije prešla vrijednost od 5,5%.

U kohorti rođenih tokom 2006. godina pravovremena primovakcinacija sa DTP₃ sprovedena je u obimu manjem od 90% u jednoj petini crnogorskih opština. Dopunske aktivnosti na imunizaciji nevakcinisane djece iz navedene kohorte u značajnoj mjeri su podigle obuhvat primovakcinacijom sa DTP₃ koji je dostiga zahtijevanih 95% i na državnom i na opštinskom nivou. Stopa odustajanja od započete imunizacije sa DTP je vrlo niska i na državnom i na opštinskom nivou. U poređenju sa rutinskim administrativnim izvještavanjem o sprovedenim imunizacijama, istraživanja koja uključuju pregled vakcinalnih kartona nakon dopunskih imunizacionih aktivnosti daju realniju sliku o stvarnom primovakcinacijskom obuhvatu obveznika kao i podatke o pravovremenosti sprovedenih primovakcinacija.

ključne riječi: vakcino preventibilne bolesti, difterija, tetanus, veliki kašalj, pravovremenost vakcinacije, obuhvat primovakcinacijom, vakcinalni kartoni