
Original Article

Hepatitis B vaccination of adolescents: A report on the national program in Iran

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Abstract Since 2007, Iran's Ministry of Health carried out a nationwide hepatitis-B vaccination campaign for 17-year-old adolescents in four stages. We report the outcomes of the second and third stages targeting adolescents born during 1990 and 1991. The National Committee for Hepatitis selected a passive approach – media education – for mass vaccination. (A community mobilization strategy, for example, would be termed *active*.) The target populations in 2008 and 2009 included 1 709 337 and 1 673 571 adolescents. In each year, Iran organized three rounds of vaccination throughout the country. At the end of each round, data were collected and sent to Ministry of Health for analysis. The overall coverage rate was 74.9 per cent for one dose of vaccination, and 62.76 per cent for all three doses in 2008; 75.7 per cent and 55.6 per cent, respectively in 2009. Coverage rates in rural areas were significantly higher ($P < 0.001$). The media education approach achieved acceptable outcomes in current campaign. Constant performance monitoring, and perhaps a new catch-up vaccination campaign are warranted to expand coverage.

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Keywords: hepatitis B vaccination; national campaign; coverage rate; adolescents

Introduction

Hepatitis B (HBV) infections pose a great burden on health systems around the world. In August 2008, WHO estimated 2 billion HBV



infections and approximately 350 million cases of chronic infections.¹ In Iran, seroprevalence of HBV surface antigen was estimated to be 2.14 per cent over the past 5 years.^{2,3}

Because of high morbidity associated with chronic infection and the effectiveness of protection offered by HBV vaccination, mass vaccination was adopted by many countries.^{4,5} In the United States, nationwide HBV vaccination, starting in 1991, resulted in a dramatic decline in HBV incidence, from 8.5 per 100 000 population in 1990 to 1.5 per 100 000 persons in 2007.^{6,7}

In Iran, a neonatal HBV vaccination program was deployed in 1993 and a significant decline in HBV prevalence has been reported.⁸ In 2006, Iran's Ministry of Health and Medical Education (MOHME) announced a new plan for extending HBV vaccination coverage to those born before 1993 and not yet included in national vaccination program. A 4-year mass campaign was planned for those born between 1989 and 1992 to provide immunization against HBV infection. We have previously reported outcomes for the first stage of this campaign that included adolescents born in 1989 and carried out in 2007.⁹

In this survey, using available administrative data, we report vaccination coverage rates in adolescents born in 1990 and 1991, the second and third stages of campaign implemented in 2008 and 2009.

Methods and Materials

Subjects and target groups

Starting in 2007, experts at MOHME organized a 4-year vaccination strategy for 17-year-olds, to vaccinate all individuals born from 1989 to 1992.⁸ The first stage of the campaign was directed at individuals born between 21 March 1989 and 19 March 1990, and conducted between March 2007 and March 2008. The second and third stages targeted individuals born between 20 March 1990 and 20 March 1991 and between 21 March 1991 and 19 March 1992, respectively. They were conducted in 2008 and 2009. A fourth stage is currently being conducted and targets adolescents born between 20 March 1992 and 20 March 1993. The target population for the four consecutive campaign years (2007–2010) is all 17-year-olds.

Protocol implementation

National Committee for Hepatitis and MOHME experts chose a passive, media-oriented, approach for mass HBV vaccination. The objective was to increase families' and teenagers' awareness via mass media and to persuade the target population to attend health-care centers for vaccination. The HBV vaccination series consisted of intramuscular administration of 20 µg of recombinant vaccine (Euvax B[®], LG Life Sciences, South Korea) in three doses, with second and third doses given at 1 and 6 months after first dose. Three rounds of vaccination were carried out across the country: the first from 5 March to 18 March, the second from 4 April to 19 April, and the third round from 5 August to 21 September.

This campaign was promoted using mass media, educational interviews, announcements in newspapers, and televised programs.

Iran's health network infrastructure provided a platform to implement such national programs.¹⁰ As vaccination centers, *health houses* in urban areas and *health posts* in rural parts received HBV vaccine. Their staffs received posters and pamphlets to hand out to people. Beginning 2 weeks before each round of vaccination until the end of the round, a daily average of five television programs or animations were televised on three national channels, also two to three radio programs per day. The programs introduced HBV infection – its significance and the current campaign. In each province, the broadcasts enumerated the health centers offering vaccination with their schedules for each round. To advance the campaign, MOHME experts offered regular interviews. Posters and fliers were distributed at high schools and offices. Newspapers and television programs provided regular coverage until the end of each round. Each year, the same approach was used.

The campaigns used a uniform spreadsheet for recording information, such as age, sex, and location. Distributed throughout national health network, information was recorded for each 17-year-old receiving vaccination.

At the end of each round, officials at each provincial University of Medical Sciences representing MOHME collected the spreadsheets. The first stage of the campaign has been described in detail elsewhere.⁹

Target population in each stage was calculated using the latest National Population Census dated back to October 2006.¹¹ Coverage



rates for HBV vaccination by sex and province were calculated and results compared by stage. Coverage > 70 per cent was considered to be high and sufficient; between 50 per cent and 69 per cent medium; and < 50 per cent low and inadequate.

Statistical analysis

Differences among provincial coverage rates and in different years were considered statistically significant, $P < 0.05$ using the Pearson Chi-square test.

Results

In 2008 and 2009, the target population included 1 673 571 and 1 709 337 17-year-olds, respectively, based on national census data. The overall demographic data of target populations is demonstrated in Table 1.

Second stage results (2008)

In 2008, 2 647 426 vaccine doses were administered in three rounds.

Table 2 describes the coverage rates by province. After the first round, coverage overall was 74.9 per cent for the first vaccine dose. National coverage for completed series dropped to 62.76 per cent in that year. Results for three provinces: Semnan, Sistan-va-Baloochestan, and Qazvin were not available for this report and hence these

Table 1: Demographic features of the target population in 2008 and 2009

<i>Demographic features of 17-year-old adolescents in Iran</i>	<i>Year 2008 (1990-born individuals)</i>	<i>Year 2009 (1991-born individuals)</i>
<i>Gender</i>		
Male	876 775	858 567
Female	832 562	815 004
<i>Location</i>		
Rural areas	584 777	583 107
Urban areas	1 085 729	1 123 385
Total number of target population	1 709 337	1 673 571

**Table 2:** Coverage rates for HBV vaccination at provincial level after each round of the campaign in two consecutive years (2008–2009)

<i>Province</i>	<i>First round of vaccination in 2008 (individuals who at least received one dose) (%)</i>	<i>Third round of vaccination in 2008 (Full dose vaccination) (%)</i>	<i>First round of vaccination in 2009 (individuals who at least received one dose) (%)</i>	<i>Third round of vaccination in 2009 (Full dose vaccination) (%)</i>
East Azarbayejan	88.5	98.5	94.8	91.6
West Azarbayejan	95.7	65.7	81.0	65.6
Ardebil	88.7	79.5	78.9	64.7
Esfahan	81.7	82.0	86.5	70.3
Ilam	67.3	70.6	81.4	100.9
Booshehr	72.3	56.3	71.1	45.6
Tehran	59.8	43.9	70.4	30.2
Chaharmahal va Bakhtiari	98.3	99.0	88.5	86.6
South Khorasan	79.6	63.6	75.9	55.8
Khorasan e Razavi	84.4	70.0	82.3	61.6
North Khorasan	77.0	66.7	83.6	62.2
Khoozestan	75.5	61.4	71.4	52.3
Zajan	96.3	83.0	92.8	74.7
Fars	64.9	49.7	67.5	45.7
Qom	68.9	42.7	46.4	32.6
Kordestan	86.1	73.6	82.3	71.1
Kerman	74.4	69.7	72.6	58.0
Kermanshah	81.4	75.8	81.1	69.9
Kohkilooye va Boyerahmad	72.7	56.2	77.9	56.4
Golestan	82.7	72.0	80.6	72.2
Gilan	92.6	67.4	91.2	112.1
Lorestan	90.6	69.0	85.2	68.3
Mazandaran	75.6	69.4	72.9	62.2
Markazi	97.4	89.2	87.8	68.3
Hormozgan	82.2	67.7	80.5	45.0
Hamedan	86.5	80.5	84.9	61.8
Yazd	69.4	64.4	73.3	50.4
Total	74.9	62.8	75.7	55.6



provinces are excluded from final report. Eleven provinces, located mostly in Northern, Western, and Northwestern parts of Iran, achieved high coverage (>70 per cent); from 70 per cent in Khorasane-Razavi to 99 per cent in Chaharmahal-va-Bakhtiari. Another 13 provinces achieved medium coverage (>50 per cent and <70 per cent), while three provinces: Tehran, Fars, and Qom failed to achieve sufficient coverage (43.9 per cent, 49.7 per cent, and 42.7 per cent) (Figure 1).

The number of individuals who received at least one dose of HBV vaccine during this campaign was significantly greater than those completing the series. ($P<0.001$) Tehran, Fars, and Qom provinces also recorded the lowest coverage for at least one dose of vaccine (59.8 per cent, 64.9 per cent, and 68.9 per cent). Comparison of coverage rates by gender for completed vaccination series revealed significantly higher coverage rates in girls. ($P<0.001$) Higher coverage rates were observed in rural (76.4 per cent) compared to urban areas (56 per cent) in this stage. ($P<0.001$)

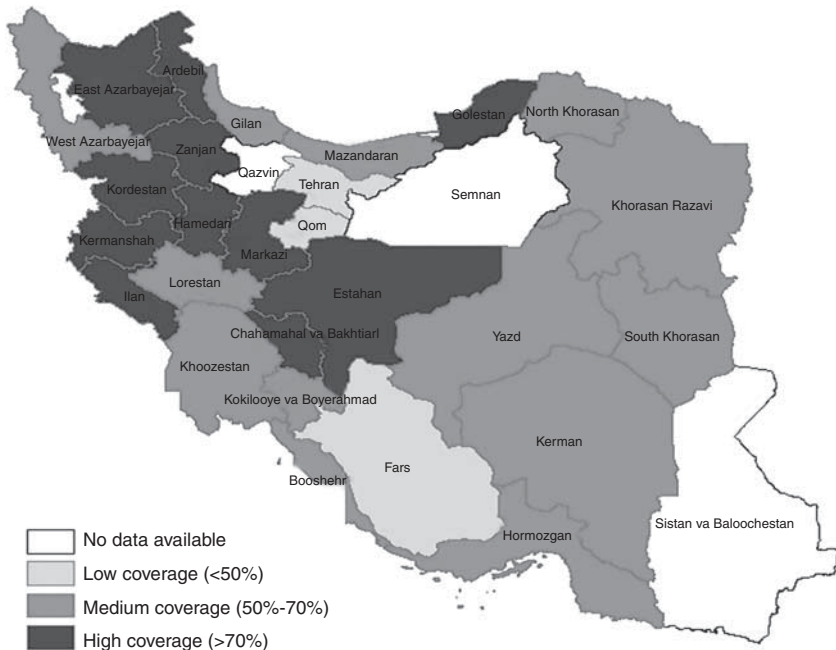


Figure 1: Provincial coverage rates for hepatitis B vaccination campaign in 2008 (Second stage).

Third stage results (2009)

In 2009, a total number of 2 571 841 doses of vaccine were administered in three rounds nationwide. Information regarding the number of doses and provincial coverage rates is presented in Tables 2 and 3.

Figure 2 presents coverage rates for completed vaccination series by province. More provinces were able to achieve high coverage rates (>70 per cent) for at least one dose in 2009 than in 2008.

Better coverage in 2009 was observed in rural areas (70.5 per cent) and in girls (62.3 per cent) compared to urban areas (48 per cent) and boys (49.3 per cent)(Table 4).

Discussion

This report updates information on an ongoing national campaign to vaccinate 17-year-olds.⁹ Large-scale campaigns are challenging, time consuming, and sometimes not as cost-effective as initially presumed.

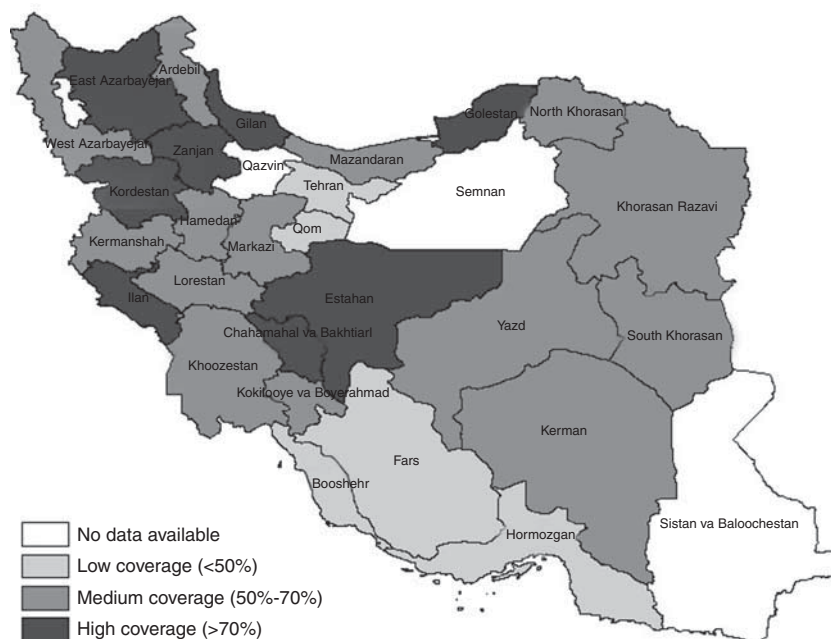


Figure 2: Provincial coverage rates for hepatitis B vaccination campaign in 2009 (Third stage).



Table 3: Doses of HBV vaccine administered at provincial level in 2008 and 2009 campaigns

Province	First round of vaccination in 2008	Second round of vaccination in 2008	Third round of vaccination in 2008 (Full dose vaccination)	First round of vaccination in 2009	Second round of vaccination in 2009	Third round of vaccination in 2009 (Full dose vaccination)
East Azarbayejan	72 246	72 493	80 357	73 844	75 301	72 813
West Azarbayejan	69 252	60 179	47 546	58 913	56 527	47 685
Ardebil	30 210	27 937	27 053	26 031	25 253	21 356
Esfahan	84 272	84 455	84 572	83 741	78 538	68 058
Ilam	11 024	10 013	11 561	11 907	12 728	15 773
Booshehr	16 401	12 723	12 761	15 527	13 069	9974
Tehran	158 096	125 992	116 126	175 811	177 403	76 183
Chaharmahal va Bakhtiari	23 840	22 609	24 004	21 432	21 477	21 010
South Khorasan	13 030	11 260	10 411	12 178	10 552	8957
Khorasan e Razavi	119 177	110 630	98 871	111 452	102 518	83 464
North Khorasan	17 550	15 400	15 195	18 689	15 887	13 912
Khoozestan	76 477	85 597	69 541	83 359	71 512	61 137
Zajan	24 935	23 287	21 491	23 452	22 740	18 867
Fars	72 576	46 344	55 572	73 255	55 035	49 558
Qom	17 026	11 224	10 549	11 260	9315	7921
Kordestan	28 756	34 011	29 079	30 498	31 974	27 632
Kerman	50 238	51 317	48 113	48 641	50 325	40 200
Kermanshah	40 933	34 534	38 142	39 737	37 398	34 264
Kohkilooye va Boyerahmad	14 384	12 580	11 110	14 654	13 589	10 604
Golestan	37 002	32 574	32 186	35 461	35 093	31 757
Gilan	50 448	33 600	36 731	45 205	49 079	60 298
Lorestan	43 914	40 831	33 423	42 223	40 836	33 838
Mazandaran	49 767	46 389	45 721	46 959	46 528	40 103
Markazi	30 974	30 512	28 368	27 424	27 359	21 316
Hormozgan	30 871	28 605	25 414	30 160	25 576	16 869
Hamedan	39 774	36 937	37 033	38 102	35 409	27 735
Yazd	15 340	14 979	14 231	15 076	13 136	10 377
Total	971 509	861 845	814 072	960 555	905 310	705 976



Table 4: Comparison of coverage rates for HBV vaccine based on gender and living location

	Number of vaccinated individuals (Coverage rate %)					
	1st Round of 2008 campaign	2nd Round of 2008 campaign	3rd Round of 2008 campaign	1st Round of 2009 campaign	2nd Round of 2009 campaign	3rd Round of 2009 campaign
Girls	510 592 (80.8%)	456 899 (72.3%)	439 354 (69.5%)	498 044 (80.5%)	474 517 (76.73%)	385 187 (62.3%)
Boys	460 917 (69.3%)	404 946 (60.9%)	374 718 (56.3%)	462 511 (71.1%)	430 793 (66.2%)	320 789 (49.3%)
<i>P</i> value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Urban areas	606 498 (70.9%)	529 748 (61.9%)	478 588 (56.0%)	631 664 (76.3%)	589 727 (71.3%)	396 740 (48.0%)
Rural areas	365 011 (83.1%)	332 097 (75.6%)	335 484 (76.4%)	328 891 (74.9%)	315 583 (71.9%)	309 236 (70.5%)
<i>P</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Data were analyzed using Pearson Chi-square test with $P < 0.05$ considered statistically significant.



In the second and third stages of Iran's campaign, in 2008 and 2009, overall coverage of 62.8 per cent and 55.6 per cent for completed series was achieved, lower than achieved in 2007, when approximately 70 per cent completed the vaccination series.⁹ Comparisons with 2007 results show that in each subsequent year, fewer provinces achieved high rates: 19 provinces in 2007; 11 provinces in 2008; and eight provinces in 2009. In all three stages, only northwestern and some central parts of the country successfully maintained high coverage rates. In the three consecutive years, more provinces fell into the 'Medium Coverage Area', while only Tehran and Qom provinces continuously failed to achieve a high coverage.

The hallmark of Iran's current campaign is its passive approach, which requires less budget.⁹ In view of acceptable coverage across three stages, use of the passive approach seems reasonable, especially where financial resources are limited.

Other experiences

Similar experiences in mass vaccination programs are reported in the literature.^{12,13} One study, among Vietnamese-American children in the USA, compared the efficacy of a *passive* 'media education campaign strategy' for HBV vaccination with an *active* 'community mobilization strategy' in the same target group.¹⁴ Both strategies increased in vaccination rates significantly; however, coverage remained insufficient overall: 39.4 per cent with the media education strategy and 33.5 per cent for the community mobilization strategy. The media education strategy resulted in a slightly but significantly higher coverage and a significant increase in general knowledge and awareness of HBV vaccination in the community.¹⁴ The target population (140 000 children) in the US study was far smaller than Iran's campaign (1 709 337 adolescents in 2008 and 1 673 571 in 2009). HBV vaccination coverage in Iran decreased significantly from 2007 to 2008 and 2009, but Iran's experience in mass HBV vaccination using a passive approach seems more successful than in the United States, considering the large target population.

In 1994, a similar campaign was conducted in Philadelphia, targeting 4384 Asian-American children for HBV vaccination.¹⁵ An active approach using door-to-door visits for HBV vaccination resulted in a 12 per cent increase in pre-intervention coverage rates.

The 15.5 per cent who completed the vaccination series is far less than Iran achieved, where in 2009 at least 55.6 per cent of 17-year-olds received all three doses. Despite relatively low coverage results in the US campaigns, the passive media education strategy and approach were shown to be effective and cost-beneficial.^{15–17}

In such campaigns, maintenance and continuation of success in out years constitutes a challenge. Continuous monitoring and sustaining the primary success is as challenging as the primary success itself.¹⁸ Iran's gradual decline in coverage from 2007 to 2009 warrants further investigations, particularly possible shortcomings in campaign promotion at national level. We expect the overall coverage rate of the fourth stage (2010) will decline further and might drop below 50 per cent.

Despite success in the first year, the public seemed to lose its initial interest in participating. This highlights the need for further social marketing. Why would people actively participate in this campaign? Novel and interesting media announcements might increase public awareness and draw the public's attention as in the first year of the campaign.

Dilraj and colleagues published similar results from Hawaii, USA.¹⁹ They investigated HBV vaccination coverage over 3 consecutive years among preadolescents, fourth and fifth graders. In the first year of the campaign almost 70 per cent (10003 individuals) received complete vaccination series, the rate dropped to 51 per cent and 24 per cent in the next 2 years of this statewide campaign. Furthermore, the participation rate continued to decline in subsequent years. Interestingly, in 2009, the coverage rate for those who received at least one dose of hepatitis vaccine was slightly higher than that of 2008 (75.7 per cent versus 74.9 per cent), yet coverage for completed vaccination series in 2009 was far less than 2008 (55.6 per cent versus 62.8 per cent). Perhaps another campaign for booster dose administration is needed to narrow the gap between those who received one dose of vaccine and those who completed the series.

Growing evidence suggests greater efficacy for school-based vaccination programs, although they are usually more costly.^{20,21} As our target group in Iran is high school students, at least one round of school-based program might increase coverage of the current campaign, as a supplementary catch-up especially for those who participated but failed to complete the series.



Coverage comparisons between rural and urban areas of the country reveals more consistency in rural rates. Although coverage decreased everywhere, changes were less significant in rural areas. Coverage in rural areas remained in the range of 70.5–83.1 per cent, while in urban areas it ranged from 48 per cent to 70.9 per cent. Obviously the national campaign was more successful in rural areas, more than a third of the campaign's target population.

Higher compliance in rural areas was also observed following the neonatal vaccination program, with a more significant decline in the prevalence of HBV carrier state. During a 9-year period, the carrier state among 2–14-year-olds in rural areas declined 0.9 per cent compared to 0.2 per cent in Iran's urban areas.²² Perhaps the infrastructure of Iran's health network and its functionality explain these results.²³ The health network is more organized in rural areas. A closer and more continuous contact exists between health-care workers and people. An effective surveillance system persists and communities are not merely recipients of health services. They actively participate in programs and provide an opportunity for campaigns to succeed.^{10,23,24}

Does this explain significant discrepancies in coverage? Except for Isfahan, all other major provinces with large crowded cities and increasing urban sectors performed worse, especially compared to smaller provinces and those with more rural areas and smaller towns possessing well-established health networks. Tehran province, for example, is one of the most crowded parts of Iran. Its big cities, like Tehran, Iran's capital with more than 12 million residents has a health network unable to reach to all social classes. Thus national campaigns' effects fade away. Chaharmahal-va-bakhtiari, a small, less populated province with a well-established health network regularly achieved high coverage. Surely, if a strong network could be put in place in urban areas, it might enable Iran to achieve more acceptable results in national health campaigns.

Limitations

Concerns were initially raised over the credibility of data obtained from the national population census to measure the target population, but given the close monitoring and door-to-door approach of the census, our denominator data seem reliable, and acceptably accurate.

Several other limitations of our survey are worth noting:

- Difficulty accessing administrative data at provincial levels. As information on participants and doses given was initially collected at health houses and health posts, mistakes and misinformation in primary reports were possible with the large number of participants. Several measures were taken to reduce such mistakes: each adolescent was given a vaccination card after receiving the first vaccine dose. It contained information on name, number of doses, and date and place each dose was administered. On subsequent visits the card was checked and the information recorded on spreadsheets.
- Vaccinees might have received their three vaccine doses in different cities. Because health centers in different provinces were not linked and could not cross-check information, different data might be recorded in each center, affecting coverage measurement. (Health centers in each province did exchange information regularly and try to complement or correct recorded information.)

Without improvements in data gathering and sharing, we have to consider causes for certain findings. Discrepancies in coverage rates in big cities, like Tehran where we witnessed major drop-offs in the third round, might be explained because it was conducted during summer breaks, a time for travel to northern parts of the country. Reported coverage rates in provinces like Tehran and Fars might be expected to decline. Perhaps it also has resulted in increased third round coverage in Northern provinces like Gilan, where many teenagers from other provinces might have received their third dose.

The duration of each round may have significantly affected coverage rates. Those attending after the end of a campaign would have been vaccinated and data recorded on spreadsheets, but the accuracy and reliability of those data might be questionable because surveillance diminished after the end of each round.

Combining adolescent and neonate vaccination efforts

Since 1993, HBV vaccine has been administered in all neonates in Iran. The program achieved 95 per cent vaccination coverage 1 year after it began.²² The current campaign was designed to expand vaccination to cover children born between 1989 and 1992.



Several European countries undertook similar universal HBV vaccination campaigns for adolescents along with neonates: Poland, Germany, Slovenia, and Switzerland.²⁵ Furthermore, countries such as Switzerland, Italy, Portugal, and Slovenia also conducted national surveys to evaluate campaign efficacy for adolescents. They reported 52 per cent, >80 per cent, 76.7 per cent, and 98 per cent coverage for completed vaccination series.²⁵

Conclusion

Iran's ongoing National Campaign to vaccinate 17-year-olds efficiently provides at least medium coverage in target groups, especially in rural areas. Yet, steady decline in coverage during consecutive years speaks to the short life of media-oriented campaigns' benefits. In the long run, other approaches, such as school-based programs, can be added to expand the coverage.

Iran targeted adolescents in the final year of high school, as thereafter they are increasingly exposed to the virus as they enter military service and colleges with dormitories, both considered as high-risk environments for HBV infection. In Iran, as elsewhere, transmission is linked to behaviors like injection drug use and unprotected sexual contact, both of which increase in adolescence.^{26,27}

Thus targeting high school students for a national campaign for HBV vaccination seems reasonable. But additional strategies are needed to expand the coverage to those not vaccinated in this campaign. Regular performance monitoring will be needed to assess success in coming years. We must also assess the impact on incidence and burden of HBV infection, and measure the efficacy of our efforts.

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