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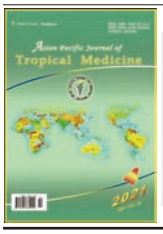

Perspective

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How much will be the cost for universal coverage of COVID-19 vaccination and how shall it be financed?

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Given the failure to find a definitive cure for COVID-19, the only hopes for controlling the pandemic right now are vaccine production and universal vaccination. Therefore, vaccine is vital to the prevention and control of COVID-19 outbreak and it will support global health security. So far, many efforts have been made to develop, manufacture, and stockpile the coronavirus vaccines that have given everyone hope[1-3]. The last attempts by the world's premier biopharmaceutical companies have given world the hope to end the pandemic, with the successful results of the Phase 3 clinical trial of their coronavirus vaccine[4,5]. However, making COVID-19 vaccine is not the final step to end the pandemic. There will still be many questions including how much it will cost to carry out this extensive vaccination. Also, the price of COVID-19 vaccine, its pricing method, safety duration, effectiveness, and the number of booster doses have not yet been determined.

The world population was estimated to have reached 7.8 billion[6]. If we consider the price of COVID-19 vaccine at least equal to the average price of a seasonal flu vaccine ($ 36)[7], providing at minimum one dose of vaccine will cost more than $ 276 billion for international community. If the vaccine is not 100% effective or requires booster doses, the cost will be doubled or tripled. The recent reports of vaccine by the world's premier biopharmaceutical companies showing an effectiveness of 90%-95% with two doses required[4,5,8,9], it means that more than 600 billion dollars is needed to only finance the vaccine vials required for universal vaccination. On the other hand, both of the vaccines are mRNA vaccines which require cold chain for vaccination [at least -20 ℃ (-4 °F) for use up to six months], which greatly increases the cost and logistics issues. Such a cost and logistic requirement may make it impractical for massive vaccination in Africa and other developing regions. Inactivated vaccines[8,9], which offer a potential economical alternative for use, will give more hope to ensure universal vaccination.

Financing the cost of COVID-19 vaccination is impossible to low-income countries and will be catastrophic to lower-middle-income countries. According to our estimations (Table 1), financing at least one dose of vaccination in Ethiopia, Guinea, Niger, and Chad will exceed these countries' total health expenditure in one year (Table 1). Countries such as Afghanistan, Pakistan, India, and Ghana have to spend more than half of their total health expenditure on one dose of vaccine, which is unaffordable.

Considering that public vaccination may not be financially possible at the first stage, necessary planning should be done to prioritize the population from now on. It is suggested as follows: (1) Age group who are mostly at risk should be prioritized. (2) Healthcare workers should be prioritized. (3) Mostly at risk job groups should be prioritized. (4) People infected over the past 3 months and are relatively immunized now may be excluded from first-stage vaccination.

Since COVID-19 eradication requires complete break of infection transmission chain through maximizing vaccination coverage, necessary planning should be done to finance universal vaccination coverage. Incomplete disruption of transmission chain could lead to further mutations of virus and a much more difficult pandemic in the world. Therefore, the following aspects should be considered: (1) Prepayment mechanisms should be developed for the vaccination. (2) Fiscal space for the vaccination should be created. (3) Resource mobilization should be developed for the vaccination. (4) Official development assistance for COVID-19 vaccination should be designed.

Universal immunization for COVID-19 will be a global health and development success. In this regard, the responsible international organizations and institutions including the World Health Organization, International Monetary Fund, and international non-governmental organizations, should already plan to mobilize all human and financial resources to finance and implement a public vaccination for COVID-19. Also, since the implementation of

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Table 1. Estimated vaccination cost for universal COVID-19 vaccination in selected countries.

Country by income classification[10]		Population (2019)[6]	Single-dose vaccination cost		Double-dose vaccination cost	
			10^3 $	% THE*[6]	10^3 $	%THE[6]
Low income	Afghanistan	38 041 754	1 369 503	53.63	2 739 006	107.27
	Tajikistan	9 321 020	335 557	62.17	671 113	124.35
	Ethiopia	112 078 730	4 034 834	142.51	8 069 669	285.03
	Guinea	12 771 250	459 765	106.76	919 530	213.52
	Niger	23 310 720	839 186	123.03	1 678 372	246.06
	Chad	15 946 876	574 088	121.08	1 148 175	242.17
Lower-middle income	India	1 366 417 750	49 191 039	51.95	98 382 078	103.91
	Ukraine	44 385 150	1 597 865	20.29	3 195 731	40.58
	Ghana	30 417 860	1 095 043	54.54	2 190 086	109.09
	Egypt	100 388 070	3 613 971	34.03	7 227 941	68.07
	Pakistan	216 565 320	7 796 352	80.73	15 592 703	161.47
	Moldova	2 657 640	95 675	18.82	191 350	37.65
Upper-middle income	Russia	144 373 540	5 197 447	6.14	10 394 895	12.28
	China	1 397 715 000	50 317 740	8.16	100 635 480	16.33
	Brazil	211 049 053	7 597 766	3.87	15 195 532	7.75
	Iran	82 913 910	2 984 901	7.57	5 969 802	15.14
	Malaysia	31 949 780	1 150 192	9.37	2 300 384	18.74
	Turkey	83 429 620	3 003 466	8.09	6 006 933	16.19
High income	United States	328 239 520	11 816 623	0.35	23 633 245	0.70
	Germany	83 132 800	2 992 781	0.71	5 985 562	1.43
	United Kingdom	66 834 400	2 406 038	0.93	4 812 077	1.86
	France	67 059 890	2 414 156	0.82	4 828 312	1.64
	Spain	47 076 780	1 694 764	1.43	3 389 528	2.87
	South Korea	51 709 000	1 861 524	1.57	3 723 048	3.15

*Total health expenditure.

universal vaccination is both time consuming and costly, before its implementing, the experiences of successful countries and regions in controlling the epidemic (such as Vietnam, Taiwan, *etc.*) should be identified and made available to health policy makers in different countries. That is where the responsibility lays national efforts and unprecedented international cooperation to protect humanity health facing the pandemic.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

Authors' contributions

The conceptualization was done by A.M.T. The resource and drafting of the manuscript were carried out by M.M.A., H.A. and A.M.T. The writing review and editing were performed by M.M.A. The supervision was done by H.A. and A.M.T. The whole manuscript was read and approved by all authors.

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