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Review

The imperative for stronger vaccine supply and logistics systems

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ABSTRACT

With the introduction of new vaccines, developing countries are facing serious challenges in their vaccine supply and logistics systems. Storage capacity bottlenecks occur at national, regional, and district levels and system inefficiencies threaten vaccine access, availability, and quality. As countries adopt newer and more expensive vaccines and attempt to reach people at different ages and in new settings, their logistics systems must be strengthened and optimized.

As a first step, national governments, donors, and international agencies have crafted a global vision for 2020 vaccine supply and logistics systems with detailed plans of action to achieve five priority objectives.

Vaccine products and packaging are designed to meet the needs of developing countries.

Immunization supply systems support efficient and effective vaccine delivery.

The environmental impact of energy, materials, and processes used in immunization systems is minimized.

Immunization information systems enable better and more timely decision-making.

Competent and motivated personnel are empowered to handle immunization supply chain issues.

Over the next decade, vaccine supply and logistics systems in nearly all developing countries will require significant investments of time and resources from global and national partners, donors, and governments. These investments are critical if we are to reach more people with current and newer vaccines.

Contents

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1. Current issues facing vaccine supply chain and logistics systems

Since 2000, national-level Expanded Programmes on Immunization (EPIs) have seen their vaccine portfolios grow from 6 basic antigens to the 12 now recommended by the World Health Organization (WHO) for all countries [1]. Additional vaccines are recommended for specific population groups and regions, and more are in the product development pipeline [1,2]. These vaccines have great potential to reduce morbidity and mortality associated with pneumonia, diarrhea, cancers, and other diseases. However, access to all vaccines hinges on the ability of supply and logistics systems to receive, store, and transport vaccines at proper temperatures and get them to the right places in a timely manner [3].

With few exceptions, vaccine supply and logistics systems around the world are unable to keep pace with growing immunization programs [4–10].

1.1. Impact of vaccine schedules and presentations on cold chain volume requirements

The most visible impact of new vaccines is an increase in the volume of products that need to be stored, tracked, and transported. Fig. 1 shows per-dose volume requirements for various immunization schedules. For countries introducing both rotavirus and 10-valent pneumococcal conjugate vaccines (moving from schedule C* to schedule E in Fig. 1 below), the total volume increases by as much as 143% per dose, assuming wastage rates remain constant [11]. This figure does not reflect the fact that closed vial wastage rates are substantially higher for vaccines in multi-dose vials than in single dose presentations. This means that more doses must be ordered, stored, and managed than implied by the figure [12,13].

In a recent analysis of 20 countries planning to introduce pneumococcal and/or rotavirus vaccine in 2011 and 2013, researchers from WHO and PATH compared vaccine volume requirements with available capacity [14]. Fig. 2 shows how planned vaccine introduction impacts capacity utilization at the national store between 2011 and 2015, assuming no new equipment is purchased beyond already planned expansions and no changes are made to current delivery strategies.

Figs. 3 and 4 show how the introduction of new vaccines impacts capacity at regional and district levels. Because only a portion of regional and district-level facilities were assessed, these graphs show the proportion of assessed facilities for which the required capacity exceeds available capacity by at least 25%. When compared to Fig. 2, one can see how capacity constraints at one level can sometimes be overcome by moving products to another level. Nonetheless, Figs. 3 and 4 show that regional and district stores in some countries are and will continue to face severe capacity constraints requiring new equipment or new delivery strategies.

1.2. Choices for cold chain equipment

Choosing the right cold chain equipment is strategically important, as such choices can facilitate changes in delivery routes and frequencies, which in turn could have an impact on vaccination schedules and strategies. For example, the availability of cold boxes with long hold-over times for stationary storage may enable countries to provide the birth dose of hepatitis B vaccine in remote areas with no access to electricity [15]. New direct-drive solar refrigerators without batteries are a reliable choice for areas with only intermittent access to electricity, but they require adequate sunlight. Domestic refrigerators may be an attractive and low-cost choice but do not often meet minimum WHO Performance, Quality, and Safety (PQS) specifications and can damage vaccines through unreliable temperature control [16–19]. To navigate equipment choices, countries need more information and tools that allow them to assess trade-offs and select equipment that best fits their needs and programmatic goals. Budgets need to be made available. Equipment manufacturers, in turn, need adequate demand to spur new

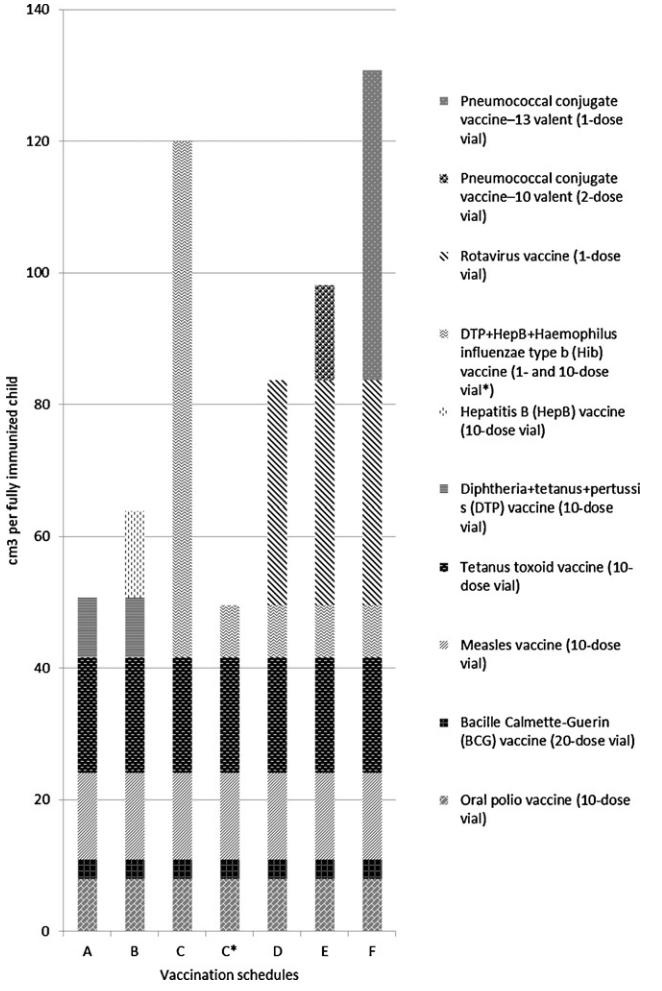

Fig. 1. Vaccine volume requirements for various immunization schedules. *Notes*: Volumes shown in the graph are for full immunization (e.g., all recommended doses). Schedule A: traditional EPI vaccines: 4 doses oral polio, 1 dose BCG, 2 doses measles, 3 doses DTP, and 4 doses TT vaccine. Schedule B: traditional EPI vaccines, plus 3 doses HepB vaccine. Schedule C and C*: traditional EPI vaccines, replacing DTP with 3 doses pentavalent (DTP + HepB + Hib) vaccine. Schedule D: Schedule C* plus 2 doses rotavirus vaccine. Schedule E: Schedule D plus 3 doses pneumococcal conjugate vaccine–10 valent. Schedule F: Schedule D plus 3 doses pneumococcal conjugate vaccine–13 valent.