Meeting Report: Convening on immunization delivery costs

Conducted by University of Washington for the Bill & Melinda Gates Foundation
October 14-15, 2015
Seattle, WA
Meeting report:
Convening on immunization delivery costs

Carol Levin
University of Washington for the
Bill & Melinda Gates Foundation
October 14-15, 2015
Seattle, WA
1. Purpose of the meeting

A convening on immunization delivery costs (October 14-15, 2015) supported by the Bill & Melinda Gates Foundation brought together approximately 40 experts and policy makers to review the current evidence on immunization delivery costs across a range of delivery strategies and platforms, vaccines and age groups. The main aim of the meeting was to collectively identify essential information needs, methodological issues, gaps in use of data for policy and at country level, as well as priorities and actions needed to support a common understanding of the direction of future efforts in this field.

The specific objectives of the meeting were to (1) present the review a subset of current literature on published immunization delivery costs; (2) identify additional sources of delivery cost information; (3) assess the sources of data and general quality of delivery cost data; (4) discuss methodological issues that affect the quality of data; (5) identify the uses of delivery cost information for a range of stakeholders from countries, industry, donors, multilateral agencies and the GAVI Alliance and how well data and evidence are used; (6) identify key gaps in delivery costs, relative to stakeholder uses; and, (7) generate recommendations and conclusions, stemming from the evidence and discussions. In order to meet these objectives, participants were active in completing a pre-meeting survey, as well as invited to submit posters of current work on delivery cost (published or unpublished). A background working paper was also distributed to participants prior to the workshop. Appendices 1-3 provide the meeting participant list, the agenda and a summary of responses to key questions from the pre-meeting survey. Appendix 4 provides summary of small group work conducted during the convening meeting. A separate file Appendix 5 provides a copy of the 14 posters that were submitted.

The meeting was comprised of short oral presentations and posters presenting evidence on what is known about delivery costs for routine immunization, campaigns and SIAs, new vaccines and for reaching new age groups. There was small group work organized by a facilitator to (1) discuss current knowledge; (2) identify uses and users of data; (3) identify gaps and challenges; and (4) prioritizing problems and solutions that would have the greatest impact on improving global health.

There was much discussion around a definition of delivery costs. Delivery costs were defined as a subset of total routine immunization costs required to deliver vaccines to the target population, excluding the cost of vaccines and injection supplies. Delivery costs include health worker time and transport to administer vaccines and personnel, supplies and equipment for supply chain logistics, waste disposal and management and supervision at each level of the health system. Delivery costs also include other critical health system activities related to training,
surveillance and monitoring and evaluation. In this way, delivery costs reflect the vaccines that are being delivered and are not divorced from them.

2. Preliminary review of immunization delivery costs

A preliminary review of the literature, as well as new information brought to the meeting in the form of posters and presentations suggest that there is wide variation in immunization delivery costs, depending upon the delivery strategy, the scale and scope of programs, country setting and other factors. The Background Paper reflected an initial review of the literature to give a flavor of study findings so far. Appendix X provides further detail.

Meeting discussions centered around cost composition and determinants, the difference between normative costs and actual costs with respect to reaching targets, efficiency and quality of health services, methodological issues related to standards, sampling, allocating and classifying shared costs, and using data better to support policy and decision makers’ needs.

A preliminary and rapid review of the published literature on the costs of immunization was conducted for the period 2005 to 2015. Methods for this review are described more in detail the Background Working Paper. Estimates are largely based on information from the recent EPIC studies in Honduras, Moldova, Ghana, Uganda, Benin and Zambia. Results are reported in $US 2012.

- **Routine immunization estimates:**
  - Routine immunization facility-level delivery costs ranged between $1 to nearly $16 per dose, with higher cost estimates found in the EPIC study results Honduras and Moldova. This range reflected older EPI programs (prior to 2005) with traditional vaccine schedules, and delivery costs for more recent immunization programs with pentavalent and other new vaccines.
  - Routine immunization facility-level delivery costs per fully immunized child ranged from US$ 5.44 in the Gambia to US$288 in Moldova. These figures are largely driven by information from the EPIC costing studies in Honduras, Moldova, Ghana, Uganda, Benin and Zambia.

- **New vaccine introduction:**
  - The range for new vaccine incremental delivery costs was $0.37 per dose for a RTS, S malaria vaccine intervention in Malawi, to $4.10 per dose for school-based HPV vaccination in Tanzania.

- **Other delivery platforms:**
  - From available data for different delivery platforms, campaigns have the lowest delivery costs per dose at US$0.57 per dose; while school-based strategies generally have higher unit delivery costs at 2012 US$3.70 per dose. Preliminary estimates of OPV SIA operational costs indicate some SIA costs may be even lower, with a range the of 2014 US$0.17 to US$0.38, depending on the region.
  - A single study on the cost of integrating immunization with child health days indicates that the delivery cost is around 2012 US$0.50-$0.60 per intervention per child.
Participants also identified new country studies and forthcoming data sets, notably for Costa Rica (PAHO), India and Tanzania (Path), Mozambique (Malaria- University of Barcelona), and Mozambique (Tetanus- JHU). It will be useful to follow up with these groups to learn more about the focus of these studies and availability of data.

3. Data sources, quality and new sources of data and information

The presentations and posters confirmed three main sources of data for estimating delivery costs. These include (1) country-level comprehensive multi-year plans (cMYP); (2) published cost and cost-effectiveness studies using empirical data or models to estimate vaccine and non-vaccine program costs; and (3) primary data collection on costs conducted as stand-alone studies or alongside clinical trials or pilot (demonstration) projects. Some of these data sets are used in the published studies in (2) above.

During meeting discussions and group work, participants expressed concerns about the comprehensiveness and quality of the data sources. The cMYP data are planning estimates and are not comprehensive evaluations of costs. However, data are available in a WHO database (ref) and have been used for modeling and research purposes. The data limitations of using planning estimates were acknowledged during the meeting. Modeled estimates of costs may have been based on older cost estimates. Finally, studies based on primary data collection have better country-level information, but quality of the analysis or presentation of the results in the publication may not be as useful.

Participants expressed concern about the quality and variability in the current set of cost estimates and the challenges of differentiating between quality differences and true heterogeneity in cost structures between countries. Participants asked about the balance between improving quality and relevance/generalizability and how the use of the data may influence requirements for quality, precision and a set of stable unit cost estimates. In addition, there was much discussion about the need to evaluate and differentiate between costs of higher and lower quality immunization services, which so far are hard to distinguish in the estimates generated.

Summary Points

- The quality of current cost data is variable, but there have not been efforts to understand variation in costs due to quality and due to actual structural differences across settings.
- There are quality issues related to the source of the primary data, for instance whether from budgetary or planning documents or whether from micro-costing studies. For each of these sources methodological issues may challenge the quality. Related to the quality issues with the source of data is the variability in the quality of cost estimates, which is affected by different definitions of costs, measurement issues and analytical methods used to derive costs.
- There is a need to strengthen understanding of the limitations of data sources and to improve quality of estimates.
- More effort should be to evaluate differences in the quality of service delivery to see how much this is driving variation in costs.
4. Uses of data and priority uses

Although obvious, there are multiple uses of immunization delivery data. These range from planning and budgeting to advocacy, mobilizing funds and conducting economic evaluations. Similarly, there are multiple users of delivery cost data, including health workers, donors, governments, vaccine manufacturers, bloggers and academics. Appendix 4 items (1) and (2) provide a larger list of users and uses of delivery cost data. A surprising result from the small group work, was that there was limited understanding of how immunization managers and health workers could use cost data in their day-to-day work, when in fact these are the individuals for whom the data are often collected. WHO and UNICEF argued for routine cost data collection at the district, or even the facility level in order to improve the efficiency of immunization services. The use of delivery cost data by vaccine manufacturers did not receive much attention during the meeting, though presumably this information would be of use to them in addressing access to their vaccines.

A panel of representatives from WHO, the Gavi Secretariat, and the BMFG was asked to speak about the importance of delivery cost information for their organizations. The WHO stressed the need for routine collection and monitoring of total facility cost information at country level, and the challenges around focusing too narrowly on one intervention cost. Health system costs can then be disaggregated into costs for specific programs and diseases. Information is needed to help allocate spending to narrow the gap between the rich and the poor, and hence information is needed to identify shared program costs that may increase as coverage for the poor increases. There was a call to shift to whole health sector costing to improve estimating health system costs and then more accurately allocating these to specific programs and even specific vaccines. In addition, the time is ripe for new methods of data collection to (1) focus on key drivers of costs, such as labor; and (2) to use innovative methods of data collection, such as using mobile phone technology for regular cost surveillance. For the Gavi Secretariat, delivery cost information is essential for supporting the design of Gavi policies related to subsidies to support introduction of new vaccines at country level; and for advocacy with ministries of health and finance to mobilize domestic resources for national immunization programs. The Foundation also views delivery cost information as essential for country planning and budgeting of routine immunization services, and for addressing questions regarding what will it cost to deliver new vaccines being developed for different age groups, given through platforms other than routine immunization. The panel highlighted the various uses of delivery cost data and the need for better understanding of results from current studies.

Summary points

- Out of a variety of potential uses for immunization cost data, participants felt that five key uses were essential for improving the quality and availability of immunization delivery cost information. These include: (1) planning, (2) budgeting, (3) priority setting, (4) performance measurements and (5) economic evaluations.
- Participants urged data collection to be conducted at sub-national levels in order to inform management decisions.
• Understanding the decision-space of managers and health facility staff would be useful in order to better tailor the focus of studies and presentation of results.

5. Key gaps in immunization delivery costs relative to stakeholder uses

A pre-meeting survey and the background paper identified some of the data gaps in immunization delivery. Cost estimates for introducing new and underutilized vaccines dominate our knowledge base. Participants expressed a number of gaps and challenges to support a full range of delivery costs estimates for multiple uses (Appendix 4, section 5), and these were reduced to 18 combined statements (Appendix 4, section 6). Participants then selected the 10 problem statements and then voted on the top five problem statements (by use of data) that would have the greatest impact globally if the problem were solved. The key messages in this section are those top 5 problem statements.

When considering the full set of responses regarding gaps in data, information and evidence delivery costs, they fall into four broad categories. The first is incomplete cost data for target groups, including hard to reach populations, diseases and their eradication, platforms other than health facilities and geographic regions, including delivery costs for lower-middle and upper middle-income countries. The second is information on disaggregated cost data by inputs, activities and service delivery levels that can help to assess quality and variation in unit costs across countries, vaccine types and delivery platforms. The third area is lack of knowledge and methods for extrapolating data for budget forecasts and to estimate costs in the absence of data for geographic settings or for early evaluations of new vaccines that require a range of delivery platforms. The fourth is gaps in what types of costs are needed for different types of stakeholders to maximize the demand for and use of cost data for policy and decision-making. Participants expressed a number of gaps and challenges (Appendix 4, section 5), and these were combined into 18 statements (Appendix 4, section 6). A final set of 10 problem statements were selected and then the top five problem statements were selected that were expected to have the

Summary points

• Current methods and approaches are not well suited to address equity and coverage issues of current and future immunization programs.
• There is a lack of information on exploring or measuring cost savings of integrating immunization and other maternal and child health services.
• Current methods don’t permit a better understanding of how costs relate to quality and performance.
• Data from existing studies don’t capture enough costs of reaching the last mile.
• We have a limited scope of cost studies on routine immunization, and even less for SIAs and delivery through the private sector.
6. Priorities for moving forward

The meeting output was a prioritization of problems and potential solutions that if addressed and acted upon would have the greatest health impact on improving population health. While many of the proposed solutions are likely to address multiple priority problems, participants described a number of different approaches that may not all be headed in the same direction (for example, solutions included conduct more cost studies, but also advocated for collecting routine resource use and costs). The five priority problems and their solutions offer some new and exciting opportunities for advancing delivery costs. In fact, they focus on addressing some persistent gaps in information (greater geographic representation, new platforms and age groups), but they also highlight new trends in thinking to cost immunization delivery services within a broader health perspective, focusing on equity and expanding coverage to the poor, and identifying new and innovative ways to engage countries for more regular and sustainable resource and cost data collection to improve the performance and quality of services.

In the key messages below, we present a synthesis of solutions, not by problem per se, but by eight ideas or innovations that if invested in would advance our knowledge on immunization delivery costs. For a listing of specific solutions by problem, see appendix 4, section 9.

Summary points

- **Understand** decision-space of national and sub-national immunization managers and how they can possibly use results of costing studies to improve resource allocation and efficiency.
- **Analyze** existing data to estimate cost functions to answer a range of questions related to economies of scope (integration), equity and coverage, quality and performance, and estimating the costs or reaching the last mile.
- **Expand** the scope of costing studies to estimate immunization delivery costs (1) for the poorest of the poor; (2) integrated with other health programs; and (3) capturing the costs of health system strengthening; and (4) using full facility costing.
- **Explore** the use of modelling and experimental design estimate the costs and benefits of interventions to reach the last mile and to implement integrated programs.
- **Innovate** and change the way we do things, including how to collect costs, by disaggregating quantities and prices and developing new metrics for capturing equity and performance. Start to better link costing studies to on-going country level initiatives (for example include resource use data into National HMIS) and other types of surveys (such as EVM, sero-surveys). Make the effort to include delivery costs for mobile outreach and underserved areas.
- **Borrow and adapt** technologies and methods to reduce the cost of data collection, such as mobile technology for capturing routine monitoring of costs and delivery platforms.
- **Mind the Gap** and conduct studies to increase availability of data beyond just the facility platform, to collect longitudinal and panel data, to understand both public and private delivery costs, to estimate costs of quality and out of pocket expenses for a range of beneficiaries.
- **Strengthen** the relevance of cost data for country use and increase capacity and incentives for higher quality, more accurate data at all levels of the system, including at the facility level. Support efforts by establishing a center of excellence at the national level and use of sentinel sites.
- **Engage** the donor to pool finances for strengthening quality and availability of costs, encourage bilateral organizations to promote this work and get donors to fund underlying approaches, such as integration, reaching the last mile and health system strengthening and estimate quantities and prices alongside interventions.
Appendix 1: Final Agenda

<table>
<thead>
<tr>
<th>DAY 1 - OCTOBER 14</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td><strong>Agenda Item</strong></td>
<td><strong>Presenters/Facilitators</strong></td>
</tr>
<tr>
<td>08:00 – 09:00</td>
<td><em>Registration and breakfast</em></td>
<td></td>
</tr>
</tbody>
</table>
| 09:00 – 09:40     | • Welcome  
|                   | • Introductions  
|                   | • Review of objectives of meeting  
|                   | • Present survey results and highlights of working background paper | Carol Levin, University of Washington  
|                   | Linda Callecod, Facilitator |
| 09:40 – 10:00     | *Economics of vaccination in developing countries: a view from 10 years on.* | Logan Brenzel, BMGF |
| 10:00 – 10:15     | *Evolution of Vietnam EPI costs over time: A case study* | Hoang van Minh, Hanoi Medical University |
| 10:15 – 10:30     | *Immunization supply chain logistic costs* | Mercy Mvundura, PATH |
| 10:30 – 10:45     | *Brazil’s EPI delivery costs from a large sample survey* | Stephen Resch, Harvard University |
| 09:40 – 10:15     | *Discussion on routine Immunization costs* | Linda Callecod, Facilitator |
| 11:00 – 11:25     | *Coffee break* |  |
| 11:25 – 11:40     | *Dengue* | Donald Shepard, Brandeis University |
| 11:40 – 11:55     | *Malaria* | Fabrizio Tediosi, STI (TBC) |
| 11:55 – 12:10     | *HPV* | Ann Levin, Consultant |
| 12:10 – 12:30     | *Discussion* | Linda Callecod, Facilitator |
| 12:30 – 14:00     | *Lunch and poster viewing* |  |
| 14:00 – 14:15     | *Update on the Comprehensive Multi-Year Planning Process (cMYP)* | Claudio Politi, WHO |
| 14:15 – 15:30     | *Introduction to group work and discussion*  
|                   | • Identification of users, producers, and uses of immunization delivery cost data, gaps and methodological challenges  
<p>|                   | • Breakout groups | Linda Callecod, Facilitator |
| 15:30 – 16:00     | <em>Coffee break</em> |  |
| 16:00 – 16:45     | <em>Discussion on users, producers, and uses of immunization delivery cost data</em> | Linda Callecod, Facilitator |
| 16:45 – 17:00     | <em>Wrap up</em> | Carol Levin, UW |
| 17:00 – 19:00     | <em>Happy Hour (Club Room at the WAC)</em> |  |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Agenda Item</th>
<th>Presenters/Facilitators</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:30 – 09:00</td>
<td>Breakfast</td>
<td></td>
</tr>
<tr>
<td>09:15 – 09:30</td>
<td>Welcome and review of previous day</td>
<td>Linda Callecod, Facilitator</td>
</tr>
</tbody>
</table>
| 09:30 – 10:30| **SESSION 4: POLICY PANEL**  
A panel discussion on institutional uses, gaps and need for improved delivery costs—a policy and program perspective — Gavi, UNICEF and WHO  
• Discussion                                              | Santiago Cornejo, Gavi  
Thomas O’Connell, UNICEF  
Tessa Tan-Torres, WHO  
Carol Levin, Facilitator                                   |
| 10:30 – 11:00| Coffee break                                                               |                                                             |
| 11:00 – 11:15| **SESSION 5: DELIVERY COST OF CAMPAIGNS**  
Supplementary Immunization Activities (SIAs) for global cost estimates | Sachi Ozawa, JHU                                              |
| 11:15 – 11:30| Cost of oral cholera campaigns                                             | Vittal Mogasale, IVI                                        |
| 11:45 – 12:30| Discussion                                                                 | Linda Callecod, Facilitator                                 |
| 12:30 – 1:45 | Lunch                                                                     |                                                             |
| 13:45 – 15:00| **SESSION 7: GROUP WORK—IDENTIFYING PRIORITY AREAS**  
Breakout groups working on identifying and prioritizing needs | Linda Callecod, Facilitator                                 |
| 15:00 – 15:30| Coffee break                                                               |                                                             |
| 15:30 – 16:30| Plenary discussion                                                         | Linda Callecod, Facilitator                                 |
| 16:30 – 17:00| Recommendations                                                             | Participant, TBC                                             |
| 17:00 – 17:30| Closing and Next Steps                                                     | Carol Levin                                                 |
## Appendix 2: Participant list

<table>
<thead>
<tr>
<th>NAME</th>
<th>AFFILIATION</th>
<th>EMAIL ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Taiwo Abimbola</td>
<td>Centers for Disease Control and Prevention</td>
<td><a href="mailto:tabimbola@cdc.gov">tabimbola@cdc.gov</a></td>
</tr>
<tr>
<td>2. Alice Abou Nader</td>
<td>MCSP/JSI</td>
<td><a href="mailto:alice_abou_nader@jsi.com">alice_abou_nader@jsi.com</a></td>
</tr>
<tr>
<td>3. Logan Brenzel</td>
<td>BMGF</td>
<td><a href="mailto:Logan.Brenzel@gatesfoundation.org">Logan.Brenzel@gatesfoundation.org</a></td>
</tr>
<tr>
<td>4. Dagna Constenla</td>
<td>Johns Hopkins University</td>
<td><a href="mailto:dconstel@jhu.edu">dconstel@jhu.edu</a></td>
</tr>
<tr>
<td>5. Santiago Cornejo</td>
<td>Gavi</td>
<td><a href="mailto:SCornejo@gavi.org">SCornejo@gavi.org</a></td>
</tr>
<tr>
<td>6. Gabriela Felix</td>
<td>Pan American Health Organization</td>
<td><a href="mailto:felixg@paho.org">felixg@paho.org</a></td>
</tr>
<tr>
<td>7. Sarah Gimbel</td>
<td>U. of Washington/Health Alliance International</td>
<td><a href="mailto:sgimbel@uw.edu">sgimbel@uw.edu</a></td>
</tr>
<tr>
<td>8. Ketevan Goguadze*</td>
<td>Curatio International Foundation</td>
<td><a href="mailto:k.goguadze@curatio.com">k.goguadze@curatio.com</a></td>
</tr>
<tr>
<td>9. George Gotsadze*</td>
<td>Curatio International Foundation</td>
<td><a href="mailto:G.Gotsadze@curatio.com">G.Gotsadze@curatio.com</a></td>
</tr>
<tr>
<td>10. Jennifer Grasso</td>
<td>University of Washington</td>
<td><a href="mailto:jkgrasso@uw.edu">jkgrasso@uw.edu</a></td>
</tr>
<tr>
<td>11. Simrun Grewal</td>
<td>University of Washington</td>
<td><a href="mailto:skgrewal@uw.edu">skgrewal@uw.edu</a></td>
</tr>
<tr>
<td>12. Ulla Griffiths</td>
<td>LSHTM</td>
<td><a href="mailto:ulla.griffiths@lshtm.ac.uk">ulla.griffiths@lshtm.ac.uk</a></td>
</tr>
<tr>
<td>13. Kate Harris</td>
<td>BMGF</td>
<td><a href="mailto:kate.harris@gatesfoundation.org">kate.harris@gatesfoundation.org</a></td>
</tr>
<tr>
<td>14. Robert Hecht</td>
<td>Results for Development Institute</td>
<td><a href="mailto:rhecht@r4d.org">rhecht@r4d.org</a></td>
</tr>
<tr>
<td>15. Minh Van Hoang</td>
<td>Hanoi Medical University</td>
<td><a href="mailto:hoangvanminh@hmu.edu.vn">hoangvanminh@hmu.edu.vn</a></td>
</tr>
<tr>
<td>16. Raymond Hutubessy</td>
<td>WHO</td>
<td><a href="mailto:hutubessyr@who.int">hutubessyr@who.int</a></td>
</tr>
<tr>
<td>17. Aleksandra Krukar</td>
<td>UNICEF</td>
<td><a href="mailto:akrukar@unicef.org">akrukar@unicef.org</a></td>
</tr>
<tr>
<td>18. Yann Le Tallec</td>
<td>Clinton Health Access Initiative</td>
<td><a href="mailto:yletallec@clintonhealthaccess.org">yletallec@clintonhealthaccess.org</a></td>
</tr>
<tr>
<td>19. Ann Levin</td>
<td>Independent</td>
<td><a href="mailto:annlevin@verizon.net">annlevin@verizon.net</a></td>
</tr>
<tr>
<td>20. Carol Levin</td>
<td>University of Washington</td>
<td><a href="mailto:clevin@uw.edu">clevin@uw.edu</a></td>
</tr>
<tr>
<td>21. Vittal Mogasale</td>
<td>International Vaccine Institute</td>
<td><a href="mailto:vmogasale@ivi.int">vmogasale@ivi.int</a></td>
</tr>
<tr>
<td>22. Mercy Mvundura</td>
<td>PATH</td>
<td><a href="mailto:mmvundura@path.org">mmvundura@path.org</a></td>
</tr>
<tr>
<td>23. Thomas O'Connell</td>
<td>World Health Organization</td>
<td><a href="mailto:oconnellt@who.int">oconnellt@who.int</a></td>
</tr>
<tr>
<td>24. Mead Over</td>
<td>Center for Global Development</td>
<td><a href="mailto:mover@cglobaldev.org">mover@cglobaldev.org</a></td>
</tr>
<tr>
<td>25. Sachiko Ozawa</td>
<td>Johns Hopkins University</td>
<td><a href="mailto:sozaow@jhu.edu">sozaow@jhu.edu</a></td>
</tr>
<tr>
<td>26. Clint Pecenka</td>
<td>PATH</td>
<td><a href="mailto:cpecenka@path.org">cpecenka@path.org</a></td>
</tr>
<tr>
<td>27. Claudio Politi</td>
<td>WHO</td>
<td><a href="mailto:politic@who.int">politic@who.int</a></td>
</tr>
<tr>
<td>28. Stephen Resch</td>
<td>Harvard School of Public Health</td>
<td><a href="mailto:steve.resch@gmail.com">steve.resch@gmail.com</a></td>
</tr>
<tr>
<td>29. Arthorn Riewpaiboon</td>
<td>Faculty of Pharmacy Mahidol University</td>
<td><a href="mailto:arthorn.r.e@mahidol.ac.th">arthorn.r.e@mahidol.ac.th</a></td>
</tr>
<tr>
<td>30. Helen Saxenian</td>
<td>Independent Consultant</td>
<td><a href="mailto:helensaxenian@gmail.com">helensaxenian@gmail.com</a></td>
</tr>
<tr>
<td>31. Donald Shepard</td>
<td>Brandeis University</td>
<td><a href="mailto:shepard@brandeis.edu">shepard@brandeis.edu</a></td>
</tr>
<tr>
<td>32. Tessa Tan-Torres Edejer</td>
<td>World Health Organization</td>
<td><a href="mailto:tantorrest@who.int">tantorrest@who.int</a></td>
</tr>
<tr>
<td>33. Fabrizio Tediosi*</td>
<td>Swiss Tropical and Public Health Institute</td>
<td><a href="mailto:fabrizio.tediosi@unibas.ch">fabrizio.tediosi@unibas.ch</a></td>
</tr>
<tr>
<td>34. Brad Tytel</td>
<td>Bill &amp; Melinda Gates Foundation</td>
<td><a href="mailto:brad.tytel@gatesfoundation.org">brad.tytel@gatesfoundation.org</a></td>
</tr>
<tr>
<td>35. Beena Varghese</td>
<td>Public Health Foundation of India</td>
<td><a href="mailto:beena.varghese@phfi.org">beena.varghese@phfi.org</a></td>
</tr>
<tr>
<td>36. Stephane Vergaet</td>
<td>Harvard T.H. Chan School of Public Health</td>
<td><a href="mailto:verguet@hsph.harvard.edu">verguet@hsph.harvard.edu</a></td>
</tr>
<tr>
<td>37. Maya Vijayaraghavan</td>
<td>Asian Development Bank</td>
<td><a href="mailto:mvijayaraghavan@adn.org">mvijayaraghavan@adn.org</a></td>
</tr>
<tr>
<td>38. Damian Walker</td>
<td>BMGF</td>
<td><a href="mailto:damian.walker@gatesfoundation.org">damian.walker@gatesfoundation.org</a></td>
</tr>
<tr>
<td>39. Hong Wang</td>
<td>BMGF</td>
<td><a href="mailto:hong.wang@gatesfoundation.org">hong.wang@gatesfoundation.org</a></td>
</tr>
<tr>
<td>40. Thomas Wilkinson</td>
<td>NICE International</td>
<td><a href="mailto:thomas.wilkinson@nica.org.uk">thomas.wilkinson@nica.org.uk</a></td>
</tr>
<tr>
<td>41. William Winfrey</td>
<td>Avenir Health</td>
<td>bwinfrey@av enferhealth.org</td>
</tr>
<tr>
<td>42. Chris Wolff</td>
<td>BMGF</td>
<td><a href="mailto:Chris.Wolff@gatesfoundation.org">Chris.Wolff@gatesfoundation.org</a></td>
</tr>
<tr>
<td>43. Sandra Wrobel</td>
<td>Applied Strategies</td>
<td><a href="mailto:swrobel@appliedstrategies.com">swrobel@appliedstrategies.com</a></td>
</tr>
<tr>
<td>44. Prashant Yadav</td>
<td>William Davidson Inst. &amp; U. of Michigan</td>
<td><a href="mailto:yadavp@umich.edu">yadavp@umich.edu</a></td>
</tr>
</tbody>
</table>
Appendix 3: Summary of pre-workshop survey findings (N=28)

(1) Main concerns about delivery costs

1. Cost level, composition and determinants
   a. How have costs changed over time? How do immunization delivery costs differ across countries and platforms?
   b. What are the levels, composition and main drivers of immunization delivery costs?
   c. What proportion of costs are shared costs?
   d. Better understanding of the drivers in the variation of delivery costs. Better understanding of the true incremental delivery costs associated with new vaccine introductions (at facility level or impact on shared health system resources).
   e. Understanding delivery costs in other platforms than routine immunization (EPI+, for the 2nd year of life, etc)
   f. What are the implication of start-up (one time) and recurrent costs of new vaccine introductions? And what are the cost implications of different strategies for expanding coverage?

2. Efficiency and quality of health services
   a. What are the main factors influencing delivery costs and of these, which factors are modifiable?
   b. How can we use costing information to improve quality and efficiency of the vaccine delivery system at all levels of health system?
   c. How can we advance the field with better quality data? How does it aid us in health systems strengthening?
   d. How to translate immunization delivery cost data into better planning for achieving higher program coverage more efficiently.
   e. What is the total and marginal cost of vaccines delivery system and certain interventions? The objective is typically to ensure good planning and sustainability of interventions targeted at improving effectiveness and identifying the main opportunities for efficiency.

3. Using data better
   a. Improved delivery cost benchmarks
   b. How to use the information we have to enhance country-level planning and budgeting for immunization; understanding better what numbers to use in advocacy messages.

4. Methodological improvements
   a. How are costs currently classified in analyses? Is there consistent classification that allows for data synthesis and analysis?
   b. Is there a general rule of thumb that can guide us to what level of granularity do we need to go in collating cost data to usefully inform policy.
   c. Methods for including system-strengthening costs.

5. Financing and Sustainability
   a. Who is the ultimate payer—what is the supply cost and what is the other cost to ensure vaccines are delivered?
   b. What are the generic resources/inputs that can be used to project future needs?

(2) Main methodological issues of concern

1. Shared program costs and allocation methods
   a. How to handle shared program costs across other child health programs and within immunization?
   b. How to estimate and allocate health system resources to immunization services.
   c. Estimating personnel costs
d. Consistent definition of immunization delivery costs

Methods for modeling costs of vaccine introduction and scale up.

f. Accuracy and/or precision of delivery costs.

2. Analytical methods and sampling issues
   a. Derivation of cost functions for delivery of a package of interventions either through routine health programs or periodic campaigns.
   b. Extrapolating from one setting and platform to another; measurement and definition of costs: we still tend to conflate expenditures, costs, and budgets for our estimates.
   c. Sample-based extrapolation methods for constructing national estimates.
   d. How to generalize findings from small samples and representativeness of delivery costs.

3. Standardization of methods to derive cost estimates and standard reporting of immunization delivery costs.
   a. Standardization of methods for routine and systematic collection of immunization delivery costs.
   b. Consistency of reporting costs.

4. Translational methods for policy, sustainability and budget resource allocation.
   a. Relating types of costs (economic, financial, total, incremental) to planning and budgeting.
   c. Understanding paths for sustainability
   d. Comparators—having benchmark costs of comparators (other non-vaccine interventions) to decide between immunization and other mechanisms to treat/prevent illness.

5. Data completeness and accuracy
   a. Need improved information that is complete, accurate and credible.
   b. Data are of poor quality
   c. EPI program are not homogenously organized and therefore data is not consistently available across and within countries.
   d. Sufficient information related to immunization delivery costs, but they are not readily available.
   e. It is difficult to ascertain the heterogeneity across immunization delivery costs due to methodological differences, poor or lacking resource or immunization data on coverage from actual differences in costs due to different vaccines in EPI or national immunization system and different cost structures.

(3) Main gaps in evidence and knowledge

1. Incomplete cost data for target groups, diseases, platforms and geography
   a. Costs of hard to reach population
   b. Costs of eradicating disease
   c. Costs of SIAs (not from budget data)
   d. Costs of integrated services.
   e. Costs of school based programs.
   f. Delivery costs for target populations other than infants /children less than 5 years of age.
   g. Delivery costs in LMIC and MIC

2. Disaggregated data by inputs, activities and service delivery levels
   a. Accurate and context appropriate unit costs disaggregated to service delivery level.
   b. Understanding variation in cost of service delivery across countries, packages and platforms
   c. Knowledge of human resources capacity constraints and supply chain requirements
   d. Lack of data by cost category to support evaluations of how different vaccine product profiles will affect delivery cost

3. Extrapolating data for budget forecasts and missing data for geographical settings
   a. Understanding of how budget is estimated and forecast
b. How to use existing data to extrapolate to other countries where data do not exist

(4) Priorities for the future

1. Evidence to support immunization programs and the introduction of new vaccines
   a. When introducing new vaccines what are the main drivers of the incremental service delivery costs?
   b. Estimating the costs of delivering vaccination to older children and mothers; evaluating SIA costs.
   c. Collect data from field and develop a database.
   d. More research on how costs evolve over time and change to help government maintain progress or improve coverage.
   e. Being able to derive a set of country specific delivery costs that can be used for current and projected estimates of delivery costs for current and future vaccines.

2. Immunization within the broader health systems and integrated with other services
   a. Further research into potential cost-savings from integrated services.
   b. Framing immunization service delivery costs within the broader health systems
   c. Develop methodologies for costing services as part of primary health care delivery instead of doing it separately. Even if we were trying to estimate the costs of increasing coverage, this is part of the whole health system.
   d. Sector agreement on cost categories and then significant data collection to generate cost category benchmarks.

3. Methodological solutions
   a. Development of standardized methods and tools that allow more frequent assessment of program costs at various administrative levels (central, local, etc.).
   b. Getting a better understanding of "shared system cost" and how impacting one program will impact other programs.
   c. To standardize costing methods.

4. Use and User-driven information
   a. A standardized, principle-based guide to what direct, and indirect costs are likely to be relevant to decisions makers; funding for national-level costs databases.
   b. Involving MOH in decision making and having them use the data generated from the research.
   c. Capacity building at country level.
   d. To have a network for sharing information and experiences.

5. Support efficient use of resources
   a. Understanding the components and ways to make the process more efficient both in terms of cost and processes.
   b. Increased emphasis on accurate tracking of expenditures and outputs at all service provision points.
Appendix 4: Flip chart poster information

(1) Who uses delivery cost data?
- Health workers, donors, government, and others (vaccine manufacturers, bloggers, academics)
- Surprising result: The group found it interesting that there was only 1 sticky note on health workers, when these are the individuals for whom this often collected.

(2) How the users use the data?
- Planning, budgeting, priority setting, improving efficient, market shaping, product development, research, lobbying & developing, variety of planning activities, measuring performance, benchmarking, increase efficiency, identifying high-performing facilities and honoring them for it, advocacy, mobilizing funds for programs, economic evaluations
- Surprising result: Users use data very differently

(3) What are the informational pieces needed to estimate and/or project costs?
- Cost components, slack time & quality indicators, clear method of analysis, demographic information, epidemiological information (outreach vs. SIA, tech assistance of quality, objectives), and technical inputs & requirements (labor, time delivery, task shifting, maintenance, training, M&E)
- Surprising result: No sticky notes included private sector costing or increasing coverage

(4) New Data sets (not available or published yet)
- Costa Rica, Brazil (PAHO)
- India/Tanzania (PATH)
- Mozambique- Malaria (University of Barcelona)
- Mozambique- Tetanus, HPV (JHU)
- Dengue Endemic Countries (JHU)
- India routine immunization (PHFI)
- APR (GAVI)

(5) What are the gaps between the data generation & what is needed? (Responses by group tables)

**Group Ocean viewers**
1) Labor costs are difficult to evaluate
2) Extrapolation & application are difficult
3) We don’t have a standard to project the actual toward the ideal
4) Most analyses focus on limited intervention instead of wide variety. How should we be thinking about our comparators?

**Group Cyclists**
5) Methods are consistently in the “grey” area
6) Current methods don’t relate cost relate to performance
7) Cost analyses are not well understood by countries
8) Standard techniques don’t exist

**Group Cutting Edge**
9) Lack of standards
10) Unable to translate cost data into effective management actions
11) Lack of data & quality data at the country level
12) Extrapolation is difficult but important to consider
13) Uncertainty of useful life of capital goods

Group The Glasses

14) Missing data or poorly reported data limit the use of findings
15) Data across countries is not always comparable
16) Data may not be relevant or used by policy makers
17) Data may be driven by the limited scope of costing analysis and therefore may not relevant to decision-makers

Group SMACKS

18) Data in functioning systems may not be applicable to LMICs
19) Impossible to obtain private sector delivery cost
20) Limited data from countries on program management

Group Globetrotters

21) There are different methods for allocating shared costs but we don’t know how they have been estimated in delivery costs
22) There is a common perception that costs are fixed and don’t vary overtime
23) No one reports quantity separately from solutions for attacking problems with prices
24) The drivers of delivery costs is not fully understood
25) There exist a geographical area with no cost data

(6) Problem statement derived from gaps assessment; summarized and organized by type of problem (gaps, methods and user issues)

Gaps:

- G1: Data from existing studies don’t capture enough costs of reaching the last mile.
- G2: Few cost studies report on prices and quantities separately.
- G3: There exist geographic areas with no cost data.
- G4: There are a lot of studies out there (other than EPIC) that have not been analyzed collectively as a panel.
- G5: Most analyses evaluate the delivery costs of vaccination in isolation of other preventative treatment for that disease.
- G6: We haven’t explained and measured costs and cost savings of integrating immunization and other services.
- G7: The current scope of studies is limited to routine immunization cost information, with little data on SIAs, the private sector and

Methodological issues:

- M1: There are different methods for allocating shared costs and we don’t know how shared costs have been estimated in delivery cost.
- M2: Ex-ante predictions are not validated with ex-post country data.
- M3: We don’t have a standard and accepted methodology to project “ideal” costs from “actual” costs.
- M4: If we are concerned with equity of coverage rather than only achieving higher coverage, our methods/approaches are not well suited.
• M5: Current methods don’t permit better understanding of how cost relates to quality and performance.
• M6: Standard methods for extrapolating and inferring data/results across countries and platforms do not exist.
• M7: We lack guidance on sampling methods for cost evaluation

User issues:

• U1: Data on unit or total economic cost does not always match what is needed for budgeting (needs-based).
• U2: Confusion in the use of estimates that reassure different things in economic costs, expenditures, budgets, financial costs.
• U3: We don’t understand the types of decisions that would be affected by cost data at various levels of the system; some types of cost data may not be relevant or used by policy or program makers.
• U4: There is need for increased knowledge and capacity building of in-country stakeholders on economics/financing.

(7) Identifying Priority Areas

*Participants ranked the use cases and problem statements.*

The top 5 uses of cost data included:

1. Planning
2. Budgeting
3. Priority setting
4. Performance measurements
5. Economic Evaluations

*Photo: Matrix for prioritizing problem statement  (top 10 problem statements in column one and all uses of data in row 1).  Top five uses noted above were weighted more heavily.*
The top 10 problem statements prioritized and refined:

1. Our methods/approaches are not well suited if we are concerned with equity/coverage.
2. We haven’t explored or measured cost savings of integrating immunization and other services.
3. We don’t understand the types of decisions that would be affected by cost data at various levels of the system.
4. We don’t have a standard and accepted methodology to project “ideal costs” from “actual costs”.
5. Most analyses evaluate the delivery costs of vaccination in isolation of other preventative treatment.
6. Current methods don’t permit better understanding of how costs relate to quality and performance.
7. There is a need for increased knowledge and capacity building of in-country stakeholders on economics/financing.
8. Data from existing studies don’t capture enough costs of reaching the last mile.
9. There are different methods for allocating shared costs and we don’t know how shared costs have been estimated in delivery costs.
10. We have a limited scope of cost studies on routine immunization; no SIAs, no private sector.

* Statements in italics were later ranked the 5 most important problems

The top five problems and potential solutions:

1) Problem: Data from existing studies don’t capture enough costs of reaching the last mile.
   a. Look at other sectors including public sector
   b. Costing RED (reach every district) and REC (reach every community)—therefore, consider including these programs in primary cost studies (may be necessary to over sample)
   c. Estimate cost functions to get at marginal cost (see photo below).
d. Don’t do costing studies only; do interventions for the last mile and cost these interventions.

e. Model potential last mile interventions to understand their benefits and costs.

f. Demand side financing.

2) **Problem:** Our methods/approaches are not well suited if we are concerned with equity of coverage.

   a. Strengthen health systems in remote areas.

   b. Incorporate distributional impacts in our cost analyses.

   c. Demand side financing approaches vs. delivery strategies.

   d. Targeted vaccination strategies.

   e. Experimental designs to evaluate costs/benefits of different strategies.

   f. EPIC analysis in selected geographical areas with low/inequitable coverage.

   g. Use existing method on equity metrics (e.g., Health achievement index or mother’s education).

   h. Include information on quantity of mobile outreach (start counting) mobile outreach.

   i. Demonstrate through use of cost functions: example mobile and fixed are different platforms and have different cost functions (see photo below).

   j. Important to choose areas that are underserved.

3) **Problem:** Current methods don’t permit better understanding of how costs relate to quality and performance.

   a. Identify measurable, comparable, context-specific, and quality performance metrics.

   b. Start including identified metrics in routine data collection.

   c. Develop standard approved measures for quality and performance (e.g., WHO coverage surveys).

   d. Identify the costs that are affected by (vary with) quality and performance.

   e. Establish guidelines to promote the above aspects.

   f. Sample/select and compare high performing and low performing facilities and do deep dive.

   g. Link costing with other types of surveys (like sero-surveys, EVM).

   h. Include process/intermediate indicators linked to quality.

   i. Include qualitative components to costing studies.

   j. Require mandatory P x Q reporting.

   k. Use cost functions to estimate efficiency frontier (see photo below).
Problem: We haven’t explored a measured costs and cost savings of integrated immunization and other services
   a. Health system strengthening in REAL
   b. Identify the political economy/decision space for integration
   c. Use cost functions to capture economies of scope (see photo below)
   d. Leveraging mobile technology to capture costing platforms
   e. Start evaluating integrated programs and disaggregate costs
   f. Implement integrated programs with an experimental design (randomizing localities or facilities between integrated vs. separate) and measure each
   g. Get donors to fund integrated programs
   h. Identify the priorities for service integration
   i. Encourage bilateral organizations to promote this work
   j. Evaluate the counterfactuals (baseline) experimental design

Problem: We have a limited scope of our studies: no SIAs, no private sector, etc.
   a. Do panel data (overtime)
   b. Pay facilities for reporting accurate data
   c. Promote facility-based studies in both public and private sectors
   d. Pool finances from donors for costing sites in general
   e. Conduct special studies on OOP spending
   f. Collect longitudinal data in analyses
   g. Full facility costing
   h. Have a center of excellence districts with sentinel sites
   i. Experiment with different technologies
   j. Study quality of care in private sector (NGOs)
   k. Studies on costs of campaign delivery
   l. Include resource use data into National HMIS
   m. Include more private facilities in the sample

(10) Advantages and disadvantages of “a single number to capture immunization delivery costs per child”

Advantages
   • Good for advocacy
   • Easy to understand and communicate
   • Ease of comparability
   • Good for planning and decision-making
   • Good for benchmarking
Easy to input into further analyses
Simplicity
CEA

Disadvantages
Variability can be hidden/not captured
May not be generalizable
May overlook complexities and reduce data's richness
Can be misleading or inaccurate
Difficult to capture quality
May not be useful at country level
Difficult to validate