OPINION

A priority-setting aid for new vaccine candidates

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Policy and investment decisions regarding new health technologies are often complex. They require a careful balancing of multiple perspectives and differing objectives. On some occasions, policymakers or analysts approaching these decisions have access to cost-effectiveness or cost-benefit analyses to help guide their decisions, but almost invariably such analyses are inadequate.

Recent advances in decision-support systems have offered ways to embed a range of different preferences and parameters into formal modeling structures, known as multicriteria decision analysis. The Institute of Medicine (IOM) has released a software tool called SMART Vaccines, short for Strategic Multi-Attribute Ranking Tool for Vaccines. This early-stage prototype—the use of which needs to be evaluated by interested parties—is grounded on multiattribute utility theory (see screenshot in Fig. 1). The software and associated reports in the *Ranking Vaccines* series can be downloaded free of charge from www.nap.edu/smartvaccines (1, 2).

As a decision-support system—and not a decision maker—SMART Vaccines significantly expands the number of factors previously used in ranking new vaccine candidates. This expansion includes prioritization efforts carried out by the IOM in the 1980s and 1990s using benefit (lives saved) and efficiency (cost-effectiveness) measures, respectively (3–5).

Briefly, SMART Vaccines allows the users to specify the population, vaccine-preventable diseases affecting that population, and potential vaccines of interest. Up to 28 predefined attributes are available for users' selection in eight categories, including health, economic, demographic, scientific and business, and policy considerations, which are typically omitted from traditional cost-effectiveness and other analyses for vaccine prioritization.

To further accommodate stakeholder preferences, users can define up to seven additional attributes to include in SMART Vaccines 1.0. Upon selection of desired attributes, the software machinery calculates from the entered population, disease, and vaccine characteristics a number of traditional benefit measures, such as premature deaths averted per year, incident cases prevented per year, cost-effectiveness, workforce productivity gains, and costs or savings resulting from vaccine use per year.

Because SMART Vaccines allows users to specify their own preferences, the output SMART Scores are relative and not absolute. Therefore, the scores are not comparable from one user to another. This concept also relates to the fact that SMART Vaccines cannot create a single societally optimum score that merges or reflects the values and preferences of all stakeholders. Therefore, SMART Vaccines is best suitable to help facilitate discussions among stakeholders so they can agree upon priorities for new vaccine development. Finally, we note that although SMART Vaccines was originally designed to rank potential new vaccines, users can readily adapt it to choose among existing vaccines. With modifications, users may also use the tool to compare vaccination programs with alternative public health interventions, for example, malaria vaccination versus insecticide-treated mosquito nets.

SMART Vaccines places a relatively large data burden on users. The population of interest, population-specific disease burden, and characteristics of potential vaccines need to be described separately. Appropriate data for health and economic burden are widely available from various sources, such as the World Health Organization and country-specific health agencies. Users need to specify product profile characteristics for vaccine candidates that do not yet exist; as such, these inputs must be estimated. More importantly, the tool allows for sensitivity analyses to assess trade-offs associated with the vaccine characteristics and costs. By way of testing and improving the prototype, the software will be evaluated with use case studies determined by users of SMART Vaccines.

To benefit potential users, eventually a large-scale, curated data warehouse describing various populations, diseases across different nations, and prototypes of several vaccine candidates is necessary. Possible approaches to help augment data collection for SMART Vaccines include: (*i*) creating sets of prototype databases for diseases and treatments costs in health services that users can apply and modify; (*ii*) determining funding sources to create relevant population and disease datasets; and (*iii*) potentially crowdsourcing data through a reviewed archiving process. None of these approaches are mutually exclusive, and the optimal solution will probably involve combinations of all three, as the recent IOM report *Ranking Vaccines: A Prioritization Software Tool* describes (1).

A potential mechanism to enhance adoption and use of SMART Vaccines would be to integrate this tool into public health, health policy, health systems management, decision science, and biomedical engineering educational courses. As a multicriteria decision support tool, SMART Vaccines is well suited to introduce and demonstrate the concepts of trade-offs, decision analysis, epidemiology, vaccine policy, economics, and systems engineering in an educational environment. An advantage of creating such educational courses would be the augmentation of available datasets (as course projects) for SMART Vaccines, thus merging the concept of crowd sourcing with the educational goals of improving decision making, public policy, and global public health.

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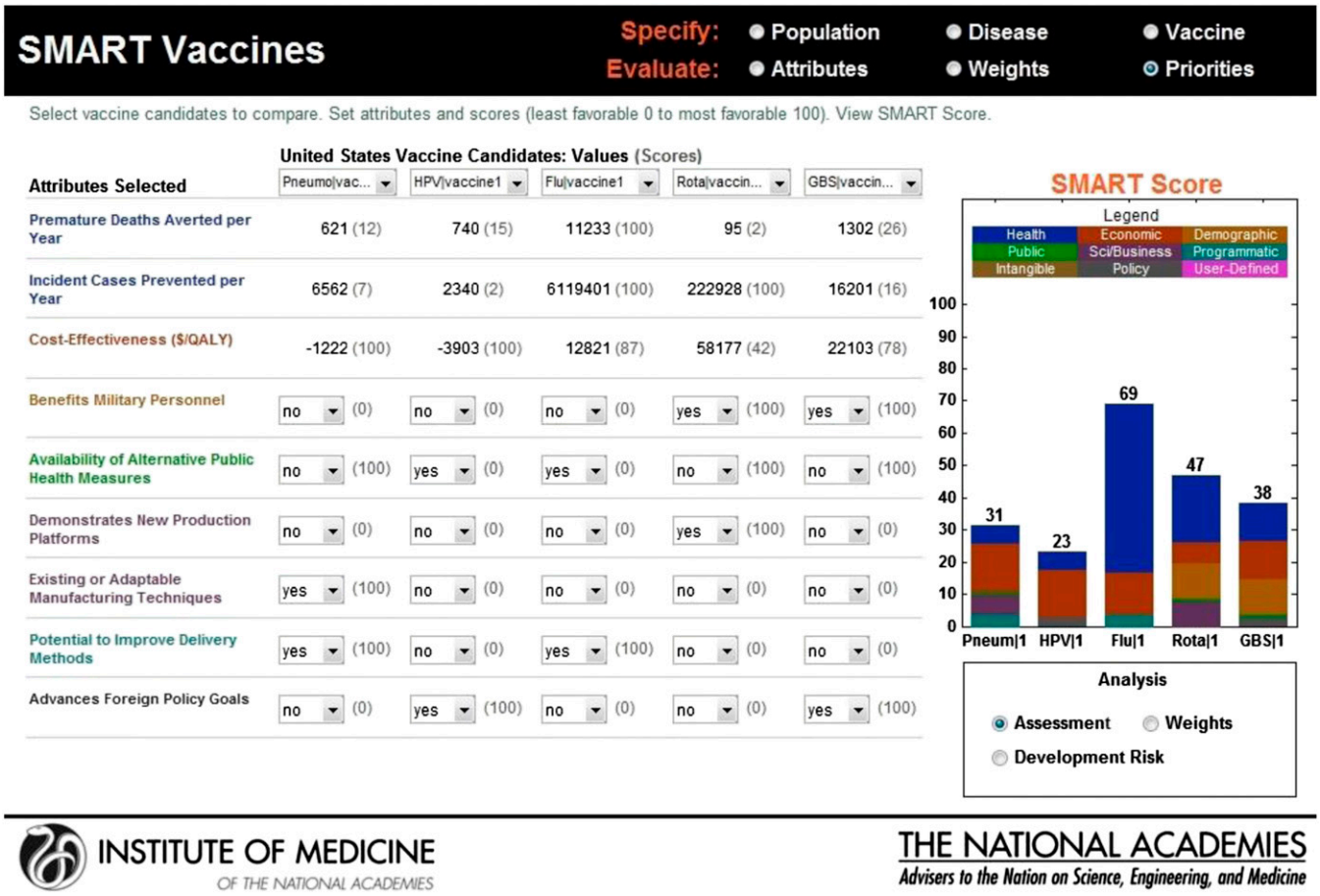

Fig. 1. Screenshot of the SMART Vaccines dashboards. This screen enables users to compare multiple vaccine candidates in accordance to the selected, color-coded attributes to yield SMART Scores, a value score assigned to each vaccine candidate based on data input and weights. SMART Scores are also color-coded to reflect the weight each attribute has on the final score. SMART Scores are relative and not absolute.

1 Institute of Medicine (IOM) (2013) *Ranking Vaccines: A Prioritization Software Tool* (The National Academies Press, Washington, DC).

2 IOM (2012) *Ranking Vaccines: A Prioritization Framework* (The National Academies Press, Washington, DC).

3 IOM (2000) *Vaccines for the 21st Century: A Tool for Decision Making* (National Academy Press, Washington, DC).

4 IOM (1986) *Diseases of Importance in Developing Countries*, New Vaccine Development: Establishing Priorities (National Academy Press, Washington, DC), Vol 2.

5 IOM (1985) *Diseases of Importance in the United States*, New Vaccine Development: Establishing Priorities (National Academy Press, Washington, DC), Vol 1.