Ranking Vaccines

A Prioritization Framework

Phase I: Demonstration of Concept and a Software Blueprint

INSTITUTE OF MEDICINE
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Advising the nation • Improving health

National Vaccine Plan Priorities for Implementation

A.	Develop a catalogue of priority vaccine targets of domestic and global health importance (Goal 1).
B.	Strengthen the science base for the development and licensure of new vaccines (Goals 1 and 2).
C.	Enhance timely detection and verification of vaccine safety signals and develop a vaccine safety scientific agenda (Goal 2).
D.	Increase awareness of vaccines, vaccine-preventable diseases, and the benefits/risks of immunization among the public, providers, and other stakeholders (Goal 3).
	access to routinely recommended vaccines (Goal 4).
G.	Create an adequate and stable supply of routinely recommended vaccines and vaccines for public health preparedness (Goal 4).
H.	Increase and improve the use of interoperable health information technology and electronic health records (Goal 4).
I.	Improve global surveillance for vaccine-preventable diseases and strengthen global health information systems to monitor vaccine coverage, effectiveness, and safety (Goal 5).
J.	Support global introduction and availability of new and under-utilized vaccines to prevent diseases of public health importance (Goal 5).

A. Develop a catalogue of priority vaccine targets of domestic and global health importance (Goal 1).

Vision of the National Vaccine Program Office

Step 1

Create and Validate the Model

Phase I

Enhance the Model

Phase II

Step 2

Execute and Populate the Model

Step 3

Prioritize Vaccines and Evaluate the Catalogue Against Ideal Attributes

Charge to the Committee

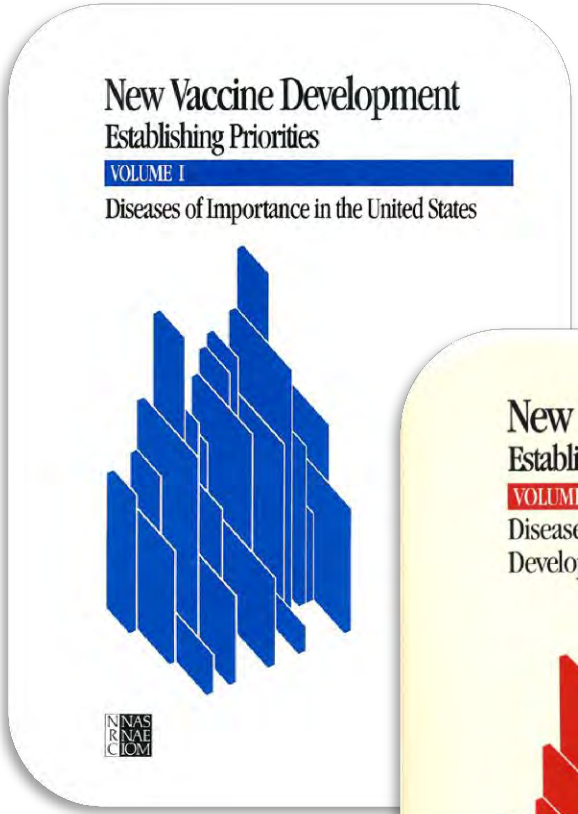
1. Review domestic and global research and development prioritization activities relevant to identifying **new preventive vaccine targets**.

2. **Develop an analytical framework and model for prioritizing vaccines of domestic and global importance**. Engage stakeholders to inform the process of the model development and implementation.

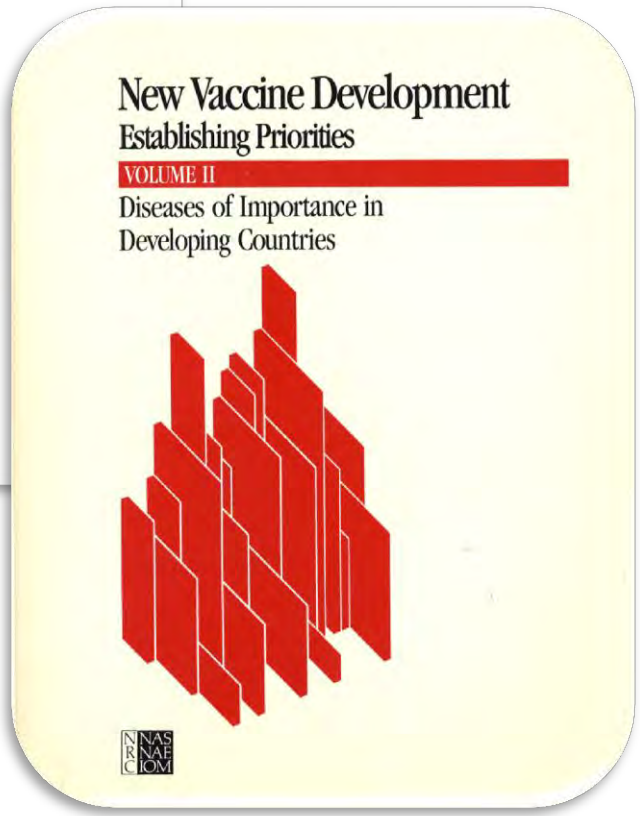
3. **Test and validate the model using two to three predetermined vaccines**, including at least one vaccine candidate of domestic importance and one of global importance.

4. Prepare a report containing the analytical framework and model for evaluating and prioritizing vaccine targets along with recommendations as to how to use the model for reviewing the catalog of preventive vaccines every two to three years.

Previous IOM Reports



1985



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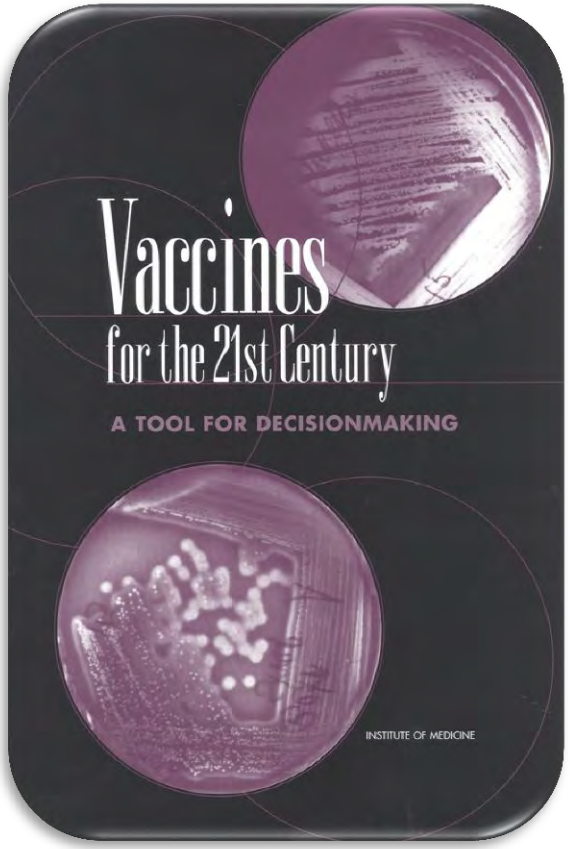


2000

The Committee Approach

16 Expert Members

5 Committee Meetings

2 Public Meetings

n Subgroup Meetings

2 Modeling Consultants

2 Software Designers

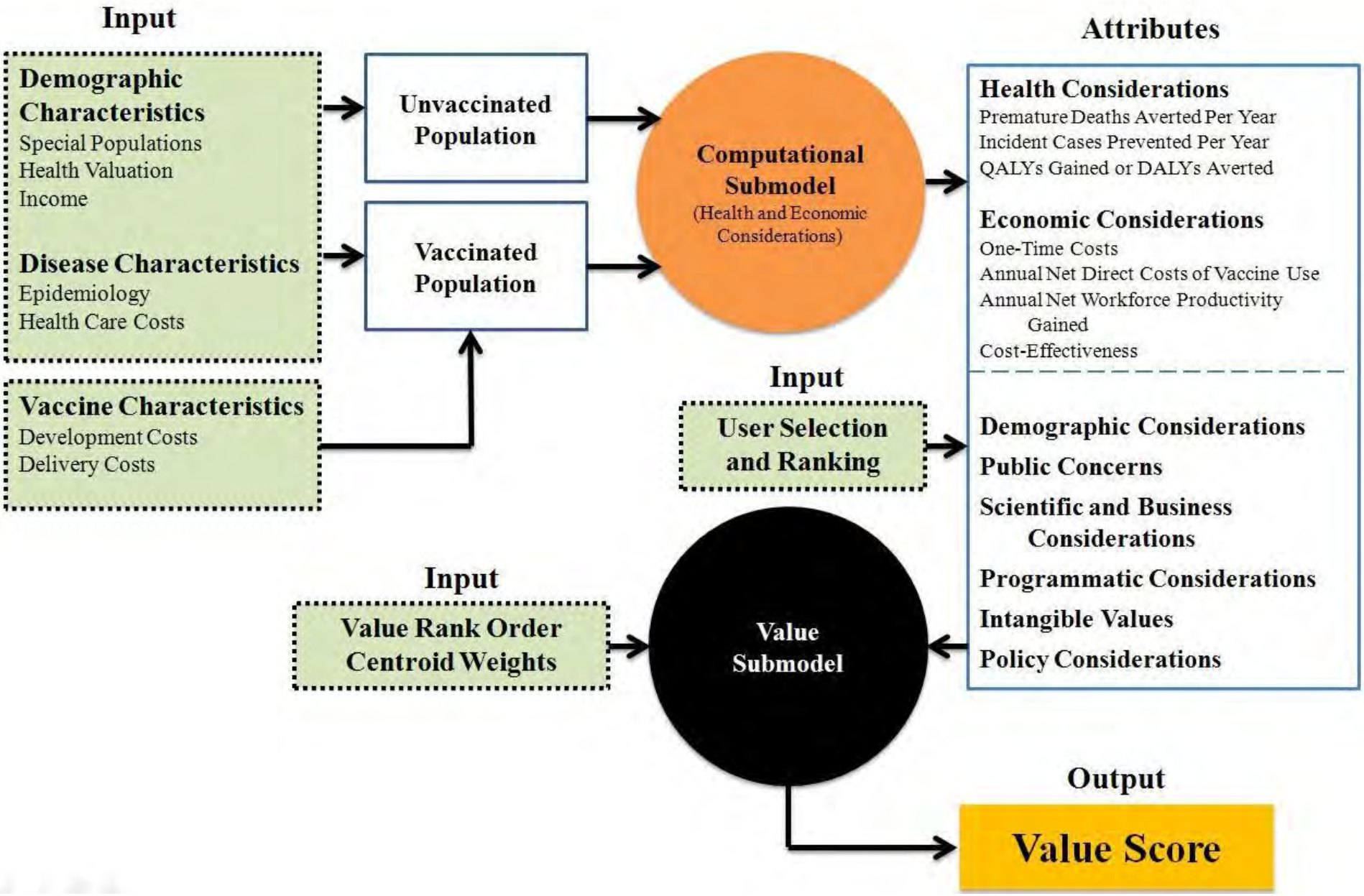
11 Concept Evaluators

3 Research Staff Members

Modeling Considerations

1. Multi-Stakeholder Application
2. Axiomatic Foundation
3. Relative Priority Scaling
4. Sensitivity Analysis
5. Transparency
6. User-Friendly Software Base

The Multi-Attribute Framework



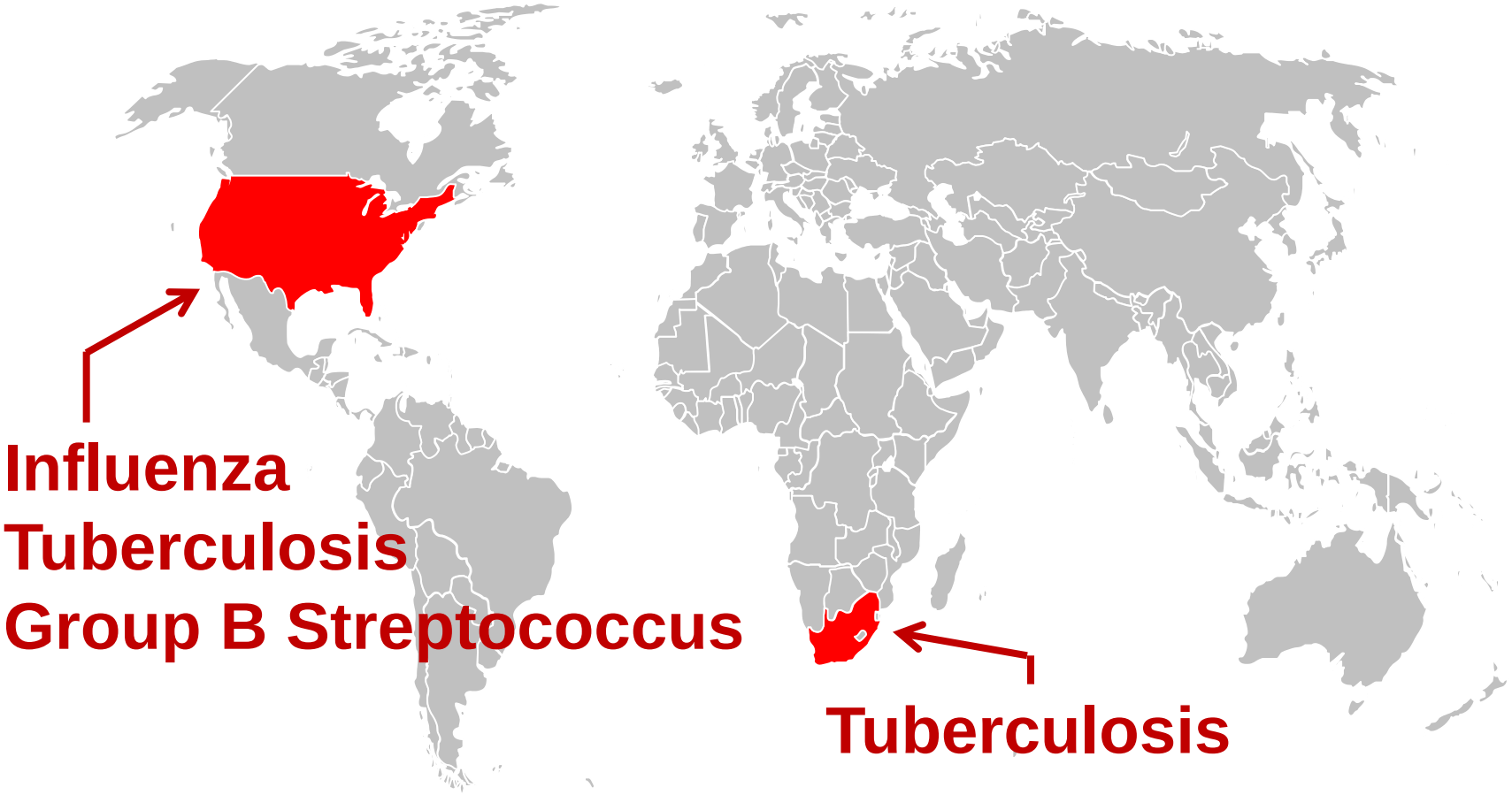
Attribute Selection

8

29

Health Considerations	• Premature Deaths Averted Per Year • Incident Cases Prevented Per Year • QALYs Gained or DALYs Averted
Economic Considerations	• One-Time Costs • Annual Net Direct Costs (Savings) of Vaccine Use • Annual Net Workforce Productivity Gained • Cost-Effectiveness
Demographic Considerations	• Benefits Infants and Children • Benefits Women • Benefits Socioeconomically Disadvantaged • Benefits Military Personnel • Benefits Other Priority Population
Public Concerns	• Availability of Alternative Public Health Measures • Potential Complications Due to Vaccines • Disease Raises Fear and Stigma in the Public • Serious Pandemic Potential
Scientific and Business Considerations	• Likelihood of Financial Profitability for the Manufacturer • Likelihood of Successful Licensure in 10 Years • Demonstrates New Production Platforms • Existing or Adaptable Manufacturing Techniques • Potential Litigation Barriers Beyond Usual • Interests from NGOs and Philanthropic Organizations
Programmatic Considerations	• Potential to Improve Delivery Methods • Fits into Existing Immunization Schedules • Reduces Challenges Relating to Cold-Chain Requirements
Intangible Values	• Eradication or Elimination of the Disease • Vaccine Raises Public Health Awareness
Policy Considerations	• Special Interest for National Security, Preparedness, and Response • Advances Nation's Foreign Policy Goals

New Vaccine Candidates



Influenza
Tuberculosis
Group B Streptococcus

Tuberculosis

Rank Order Centroid Weighting

	Number of Attributes Selected													
Rank	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1*	0.750	0.611	0.521	0.457	0.408	0.370	0.340	0.314	0.293	0.275	0.259	0.245	0.232	0.221
2	0.250	0.278	0.271	0.257	0.242	0.228	0.215	0.203	0.193	0.184	0.175	0.168	0.161	0.155
3		0.111	0.146	0.157	0.158	0.156	0.152	0.148	0.143	0.138	0.134	0.129	0.125	0.121
4			0.063	0.090	0.103	0.109	0.111	0.111	0.110	0.108	0.106	0.104	0.101	0.099
5				0.040	0.061	0.073	0.079	0.083	0.085	0.085	0.085	0.084	0.083	0.082
6					0.028	0.044	0.054	0.061	0.065	0.067	0.068	0.069	0.069	0.069
7						0.020	0.033	0.042	0.048	0.052	0.054	0.056	0.057	0.058
8							0.016	0.026	0.034	0.039	0.043	0.045	0.047	0.048
9								0.012	0.021	0.027	0.032	0.036	0.038	0.040
10									0.010	0.017	0.023	0.027	0.030	0.033
11										0.008	0.015	0.019	0.023	0.026
12											0.007	0.012	0.017	0.020
13												0.006	0.011	0.014
14													0.005	0.009
15														0.004
Total**	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

$$w_i = \sum_{j=i}^{n} \frac{1}{j} \qquad i = 1 \ldots n$$

*Highest rank = 1

**Totals may not add to 1.00 due to rounding

SMART Vaccines Beta

Step 0 of 7

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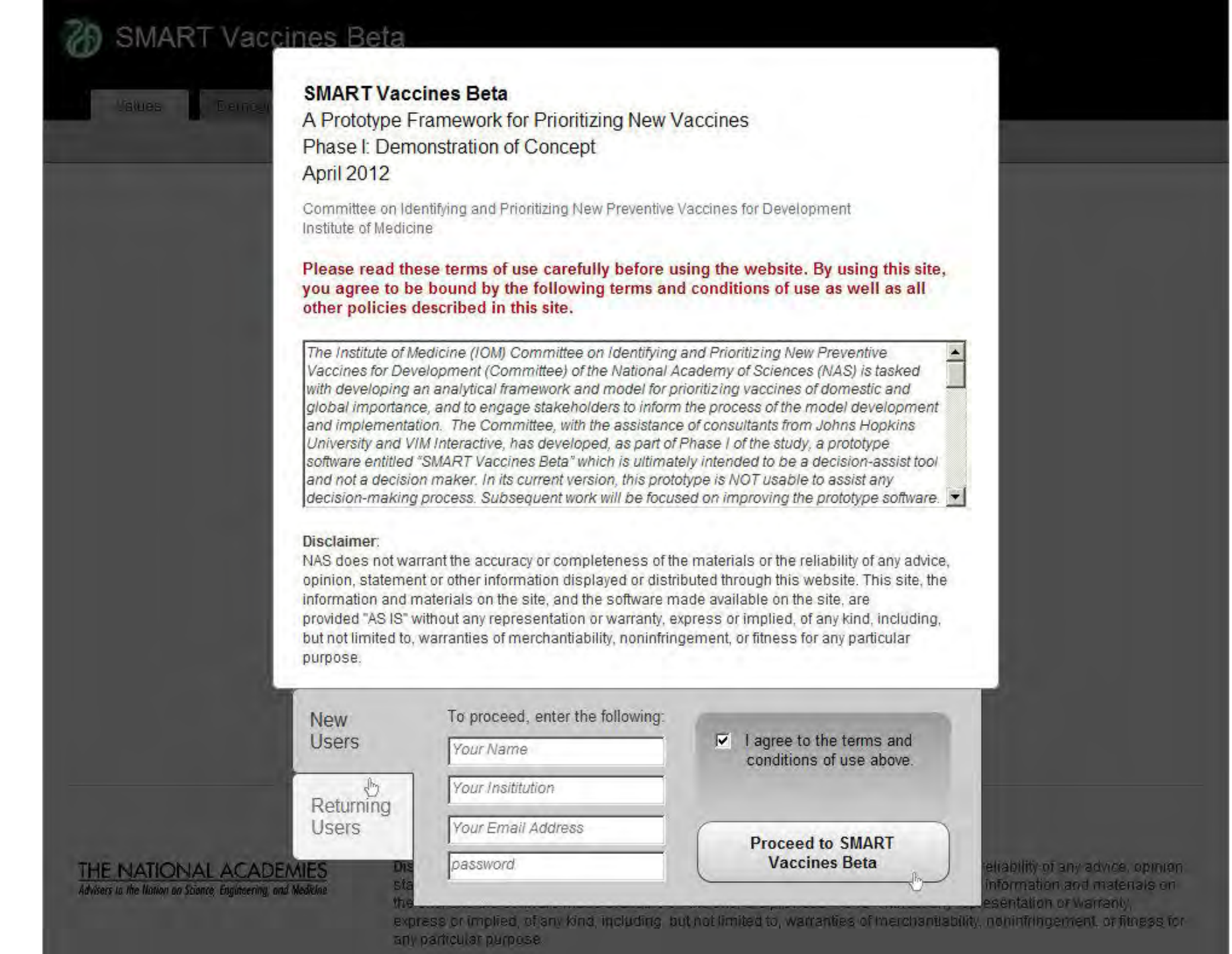
SMART Vaccines Beta
Values
SMART Vaccines Beta
A Prototype Framework for Prioritizing New Vaccines
Phase I: Demonstration of Concept
April 2012
Committee on Identifying and Prioritizing New Preventive Vaccines for Development
Institute of Medicine
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The Institute of Medicine (IOM) Committee on Identifying and Prioritizing New Preventive Vaccines for Development (Committee) of the National Academy of Sciences (NAS) is tasked with developing an analytical framework and model for prioritizing vaccines of domestic and global importance, and to engage stakeholders to inform the process of the model development and implementation. The Committee, with the assistance of consultants from Johns Hopkins University and VIM Interactive, has developed, as part of Phase I of the study, a prototype software entitled "SMART Vaccines Beta" which is ultimately intended to be a decision-assist tool and not a decision maker. In its current version, this prototype is NOT usable to assist any decision-making process. Subsequent work will be focused on improving the prototype software.
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New Users
Returning Users
To proceed, enter the following:
Your Name
Your Insititution
Your Email Address
password
I agree to the terms and conditions of use above.
Proceed to SMART Vaccines Beta
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Advisers to the Nation on Science, Engineering, and Medicine

Disclaimer

SMART Vaccines is intended to serve only as a decision-support tool and should *not* be used as a decision maker.

SMART Vaccines Beta

Step 1 of 7

Selection and Ranking of Values

SMART Vaccines Beta

Instructions Glossary Advanced Mode ▼

Values | Demographics | Disease Burden | Vaccines | Value Assessment | Value Score

Step 1: Select Vaccine Values and Rank Their Importance

To Demographics

HEALTH CONSIDERATIONS

- Premature Deaths Averted Per Year
- Incident Cases Prevented Per Year
- QALYs Gained or DALYs Averted Per Year

ECONOMIC CONSIDERATIONS

- One-Time Costs
- Annual Net Direct Costs of Vaccine Use
- Annual Net Workforce Productivity Gained
- Cost Effectiveness

POLICY CONSIDERATIONS

- Special Interest for National Security, Preparedness, and Response
- Potential Complications Due to Vaccines

PUBLIC CONCERNS

- Availability of Alternative Public Health Measures
- Potential Complications Due to Vaccines
- Disease Raises Fear and Stigma in the Public
- Serious Pandemic Potential

DEMOGRAPHIC CONSIDERATIONS

- Benefits Infants and Children
- Benefits Women
- Benefits Socioeconomically Disadvantaged
- Benefits Military Personnel
- Benefits Other Priority Population

PROGRAMMATIC CONSIDERATIONS

- Potential to Improve Delivery Methods
- Fits into Existing Immunization Schedules
- Reduces Challenges Relating to Cold-Chain Requirements

SCIENTIFIC AND BUSINESS CONSIDERATIONS

- Likelihood of Financially Profitability for the Manufacturer
- Likelihood of Successful Licensure in 10 Years
- Demonstrates New Production Platforms
- Existing or Adaptable Manufacturing Techniques
- Potential Litigation Barriers Beyond Usual
- Interests from NGOs and Philanthropic Organizations

INTANGIBLE VALUES

- Eradication or Elimination of the Disease
- Vaccine Raises Public Health Awareness

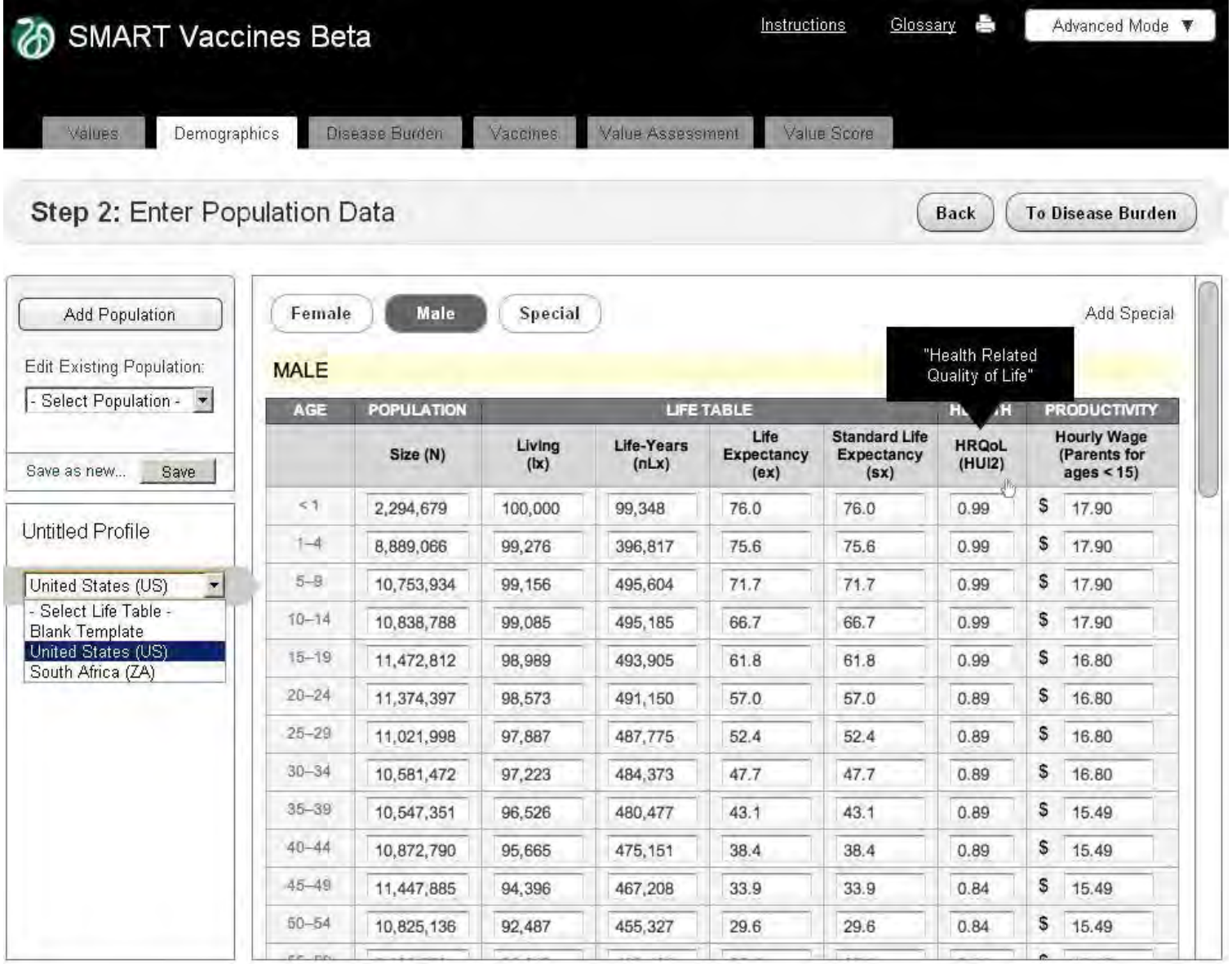
Drop values here

(Drag to rank in order of importance)

SMART Vaccines Beta

Step 2 of 7

Population Profile



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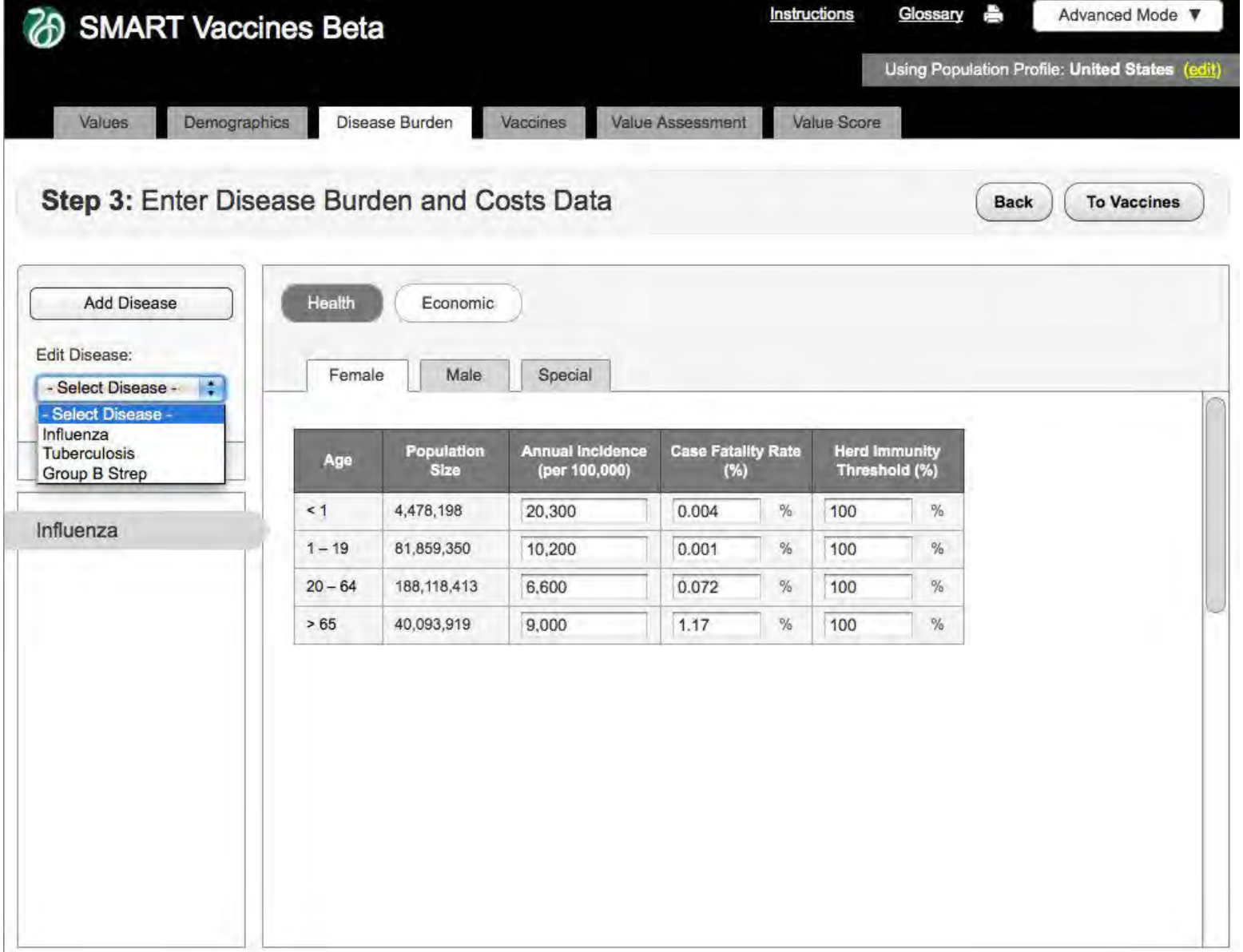
SMART Vaccines Beta

Step 3 of 7

Disease Profile



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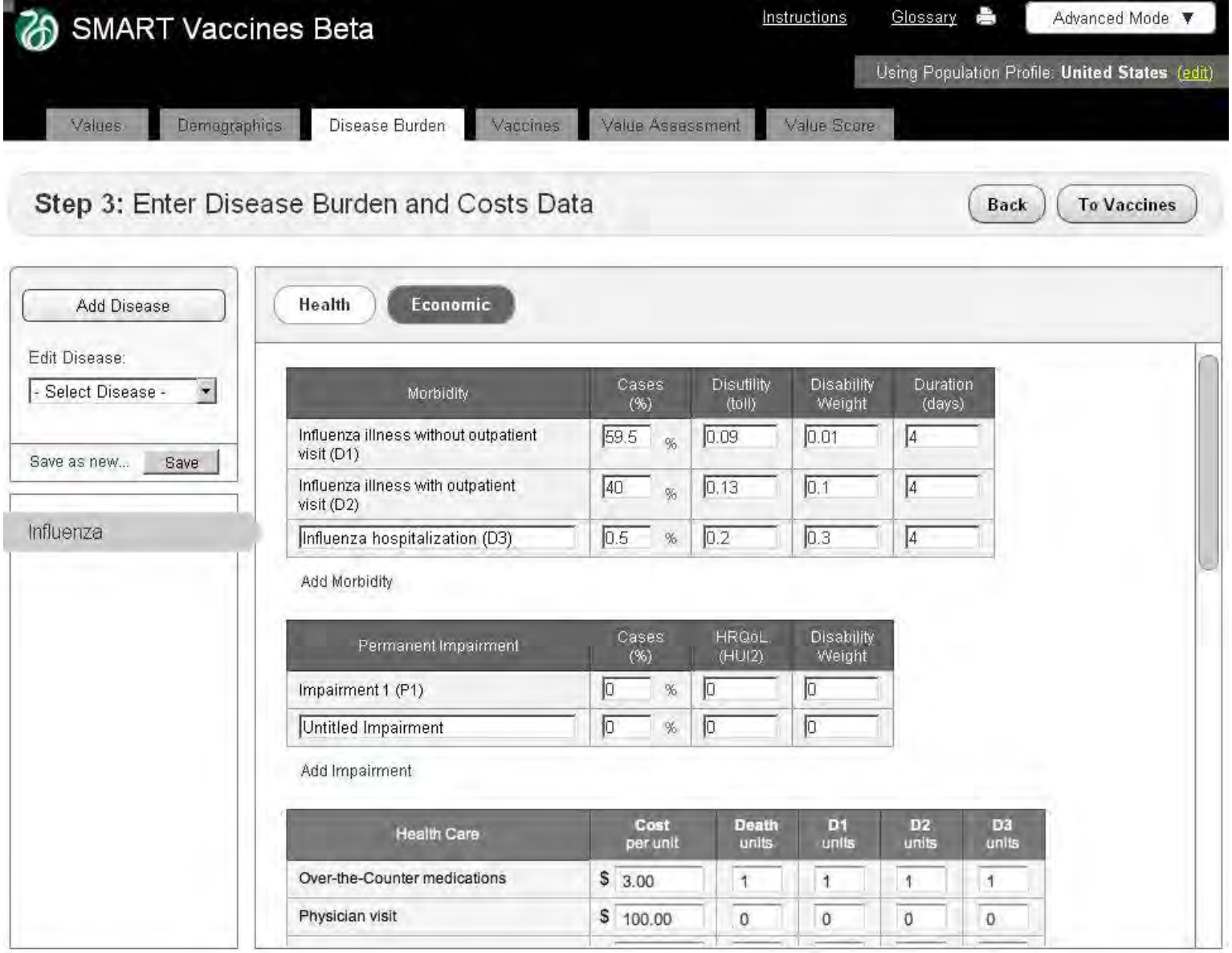

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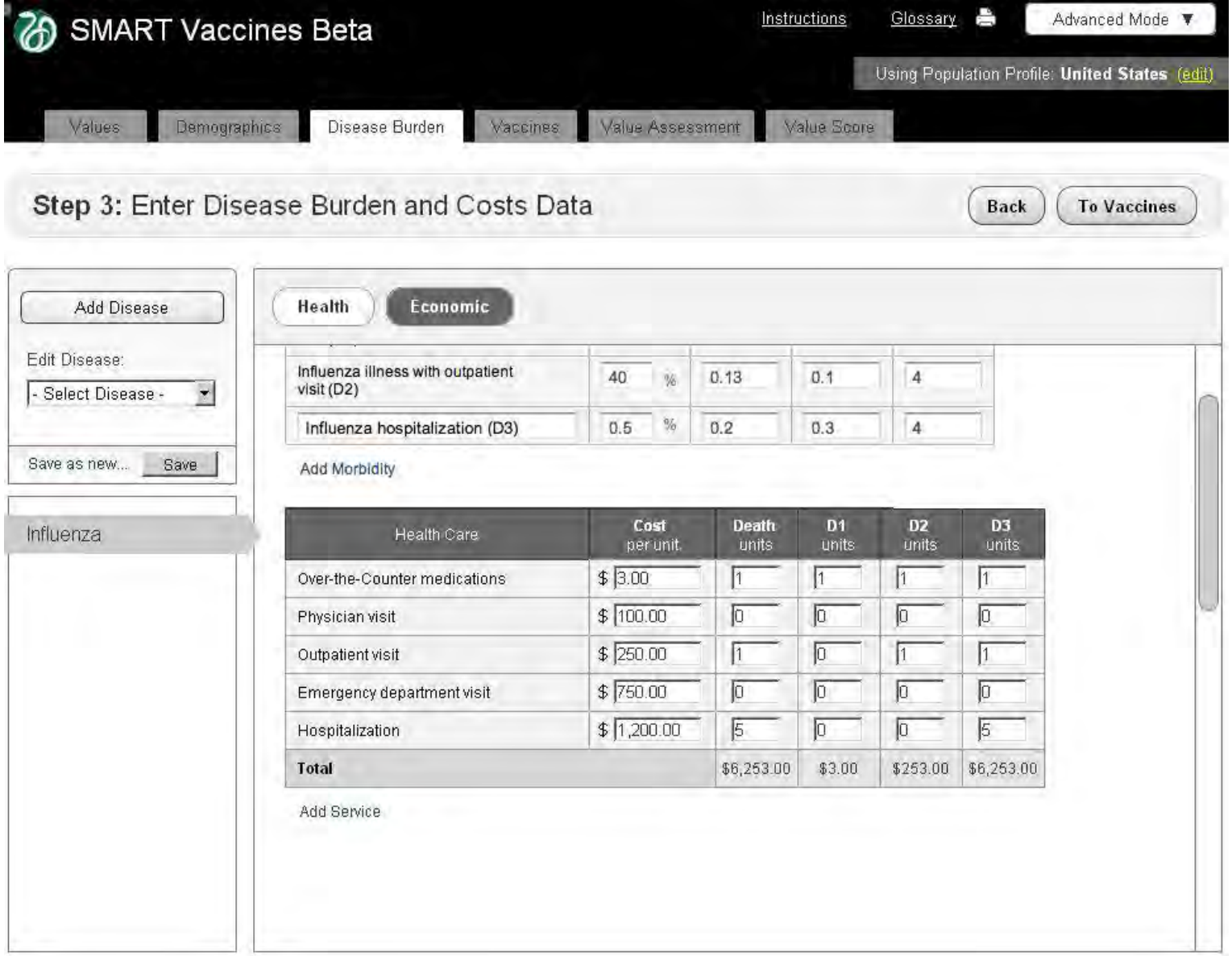
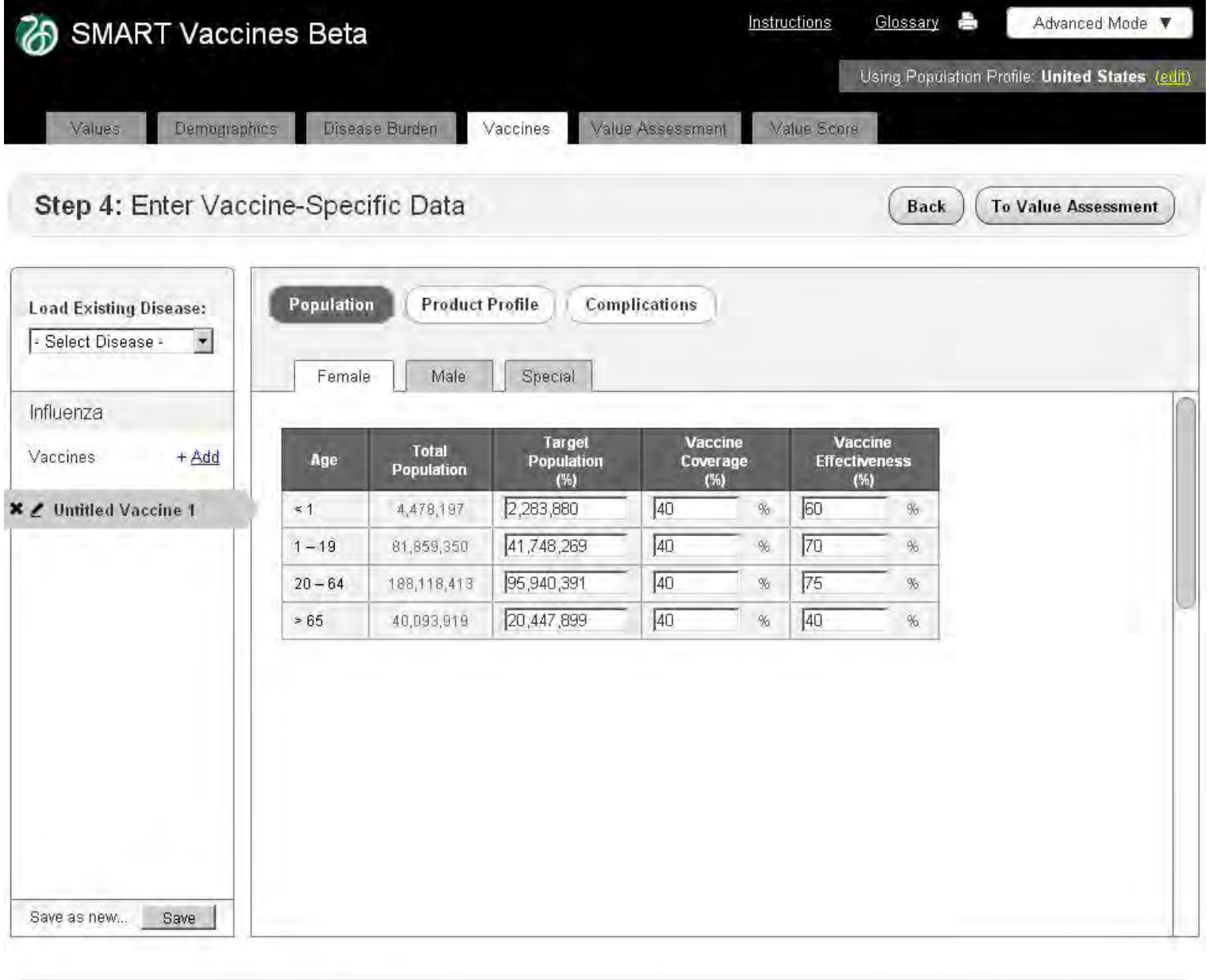
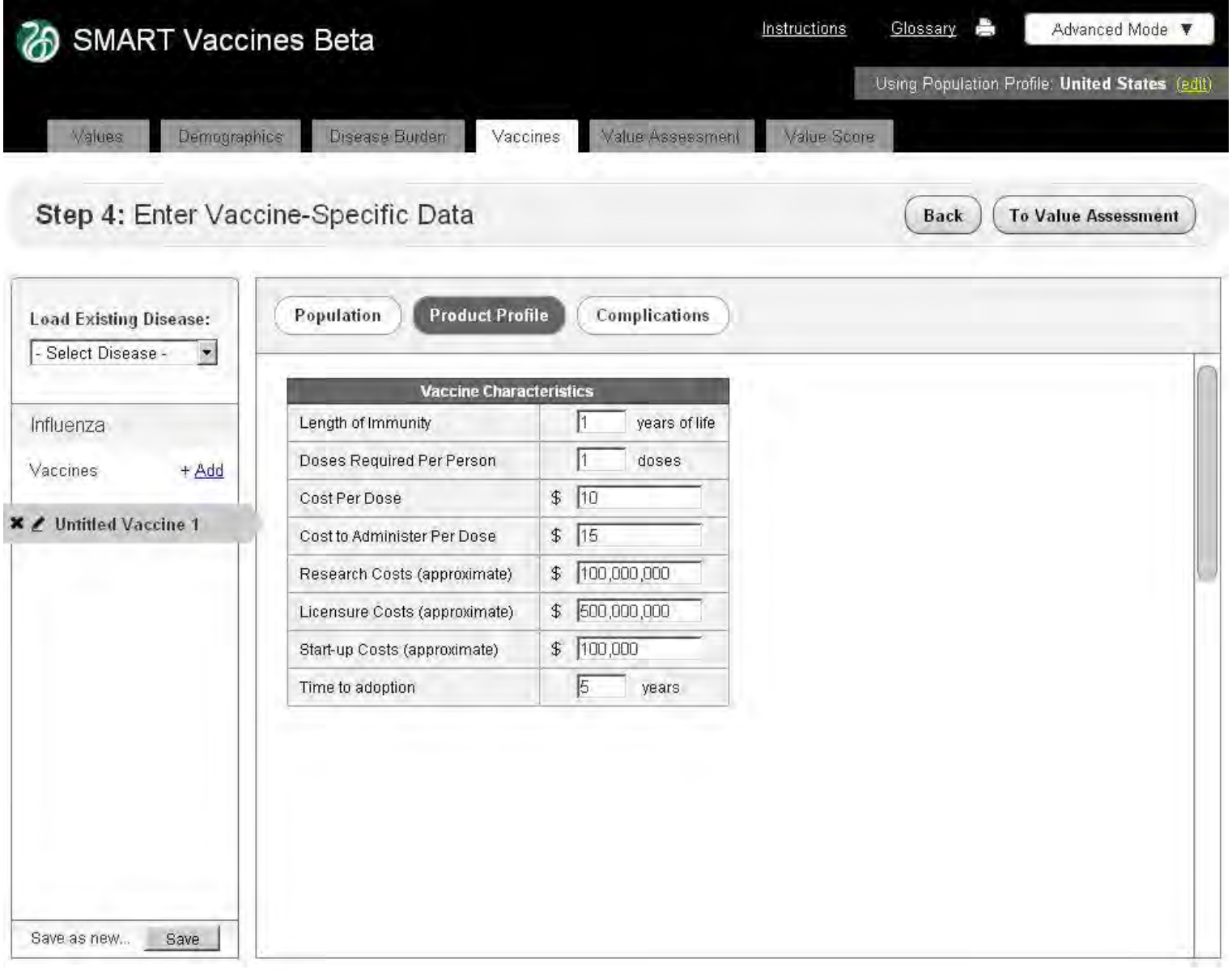


SMART Vaccines Beta

Step 4 of 7

Vaccines Profile





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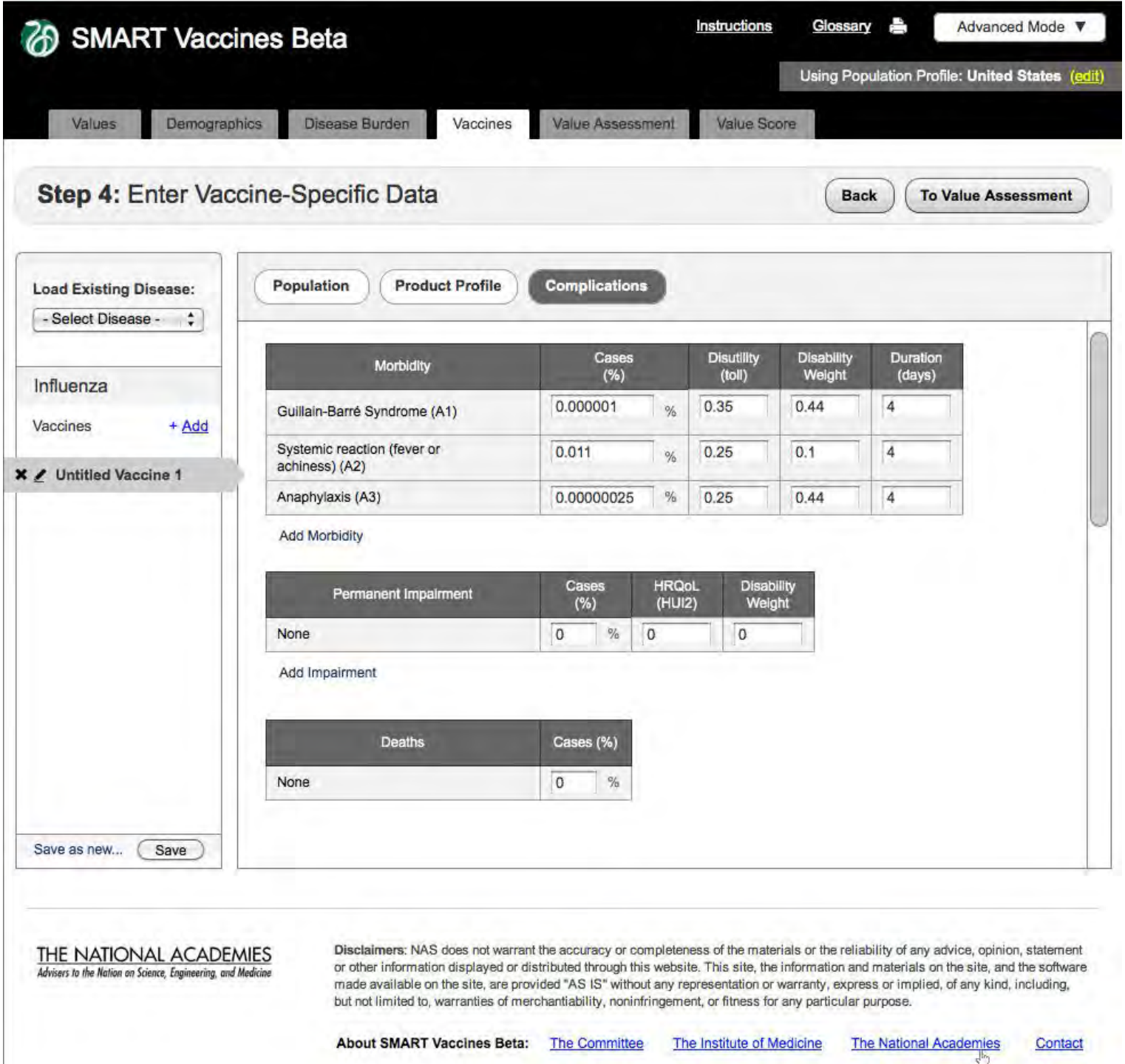
SMART Vaccines Beta
Instructions
Glossary
Advanced Mode
Using Population Profile: United States (edit)
Values
Demographics
Disease Burden
Vaccines
Value Assessment
Value Score
Step 4: Enter Vaccine-Specific Data
Back
To Value Assessment
Load Existing Disease:
- Select Disease -
Influenza
Vaccines
+ Add
Untitled Vaccine 1
Save as new...
Save
Population
Product Profile
Complications
Morbidity
Cases (%)
Disutility (toll)
Disability Weight
Duration (days)
Guillain-Barré Syndrome (A1)
0.000001 %
0.35
0.44
4
Systemic reaction (fever or achiness) (A2)
0.011 %
0.25
0.1
4
Anaphylaxis (A3)
0.00000025 %
0.25
0.44
4
Add Morbidity
Permanent Impairment
Cases (%)
HRQoL (HUI2)
Disability Weight
None
0 %
0
0
Add Impairment
Deaths
Cases (%)
None
0 %
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SMART Vaccines Beta

Instructions Glossary Advanced Mode ▼

Using Population Profile: **United States** (edit)

Values | Demographics | Disease Burden | Vaccines | Value Assessment | Value Score

Step 4: Enter Vaccine-Specific Data

Back | To Value Assessment

Load Existing Disease:

- Select Disease -

Influenza

Vaccines + Add

✖ Untitled Vaccine 1

Save as new... Save

Population | Product Profile | Complications

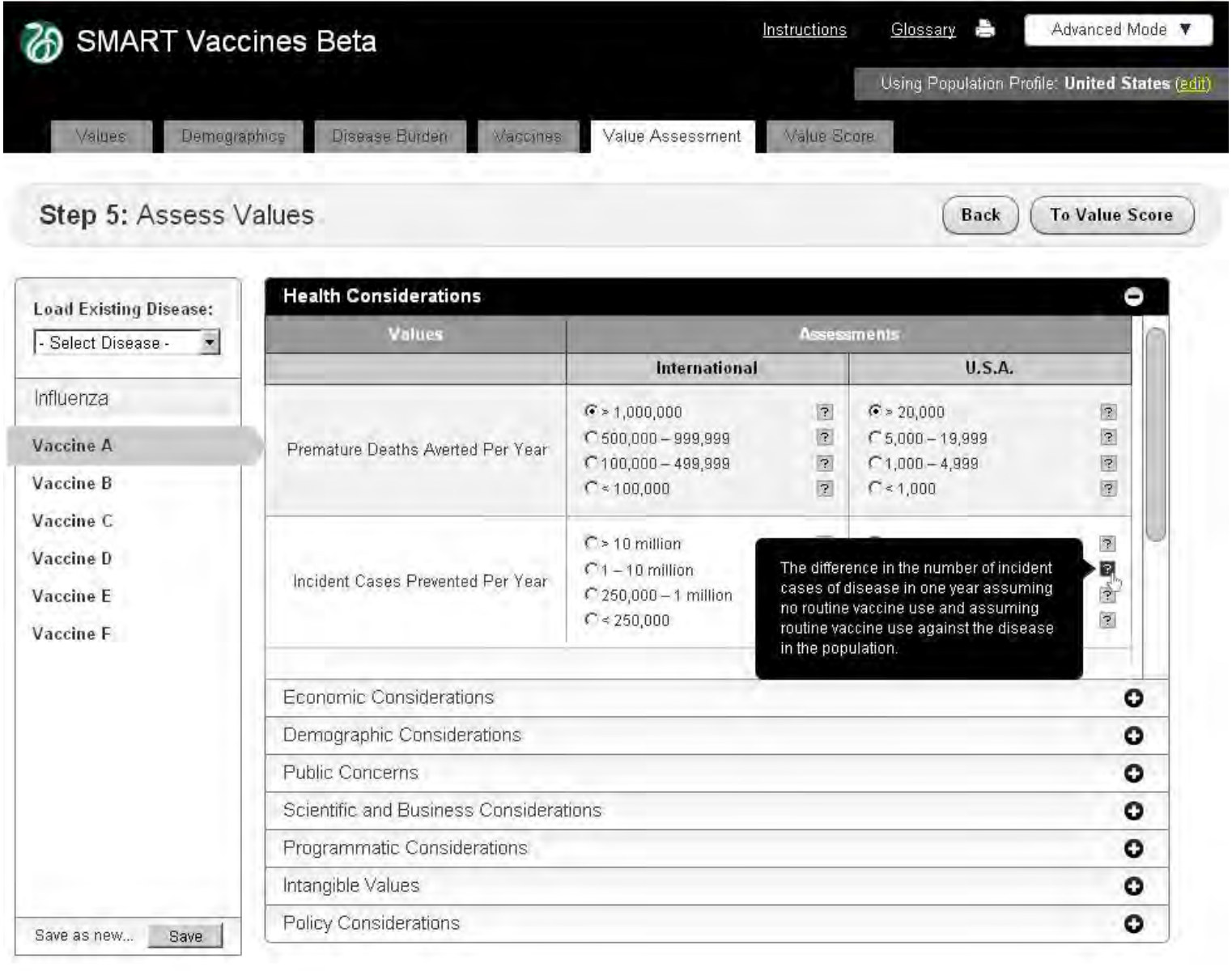
Health Care	Cost per unit	A1	A2	A3
Over-the-Counter medications	$ 3.00	0	0	0
Physician visit	$ 100.00	0	1	0
Outpatient visit	$ 250.00	0	0	0
Emergency department visit	$ 750.00	0	0	1
Hospitalization	$ 1,200.00	40	0	0
Total		$48,000	$100	$750

Add Service

SMART Vaccines Beta

Step 5 of 7

Qualitative Attributes




SMART Vaccines Beta
Instructions
Glossary
Advanced Mode
Using Population Profile: United States (edit)
Values
Demographics
Disease Burden
Vaccines
Value Assessment
Value Score
Step 5: Assess Values
Back
To Value Score
Load Existing Disease:
- Select Disease -
Influenza
Vaccine A
Vaccine B
Vaccine C
Vaccine D
Vaccine E
Vaccine F
Save as new...
Save
Sum of development plus licensure plus start-up costs. This attribute represents the magnitude of financial barriers to bringing the vaccine to use in the population.
Assessments
International
U.S.A.
One-Time Costs
< $100 million
$100 – $500 million
$500 million – $1 billion
> $1 billion
Annual Net Direct Costs Savings of Vaccine Use
>10 million
1 – 10 million
250,000 – 1 million
< 250,000
Demographic Considerations
Public Concerns
Scientific and Business Considerations
Programmatic Considerations
Intangible Values
Policy Considerations
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Step 6 of 7

Computed Results

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Instructions Glossary Advanced Mode

Using Population Profile: **United States** (edit)

Values | Demographics | Disease Burden | Vaccines | Value Assessment | Value Score

Step 6: Compare Your Candidate Vaccines

Back | Rank Vaccine Values

Model Unit Values

Discounting 3 %

DALY Age Weight ON OFF

Vaccine List

Check two or more vaccines to compare.

Influenza
☑ Vaccine A

Tuberculosis
☑ Vaccine B

Group B Strep
☑ Vaccine C

	Vaccine A	Vaccine B	Vaccine C
Health Considerations			
Premature Deaths Averted Per Year	100	100	100
Incident Cases Prevented Per Year	101,833,848	101,833,848	101,833,848
QALYs Gained or DALYS Averted	2,352,850	2,352,850	2,352,850
Economic Considerations			
One-Time Costs	$600,000,000	$600,000,000	$600,000,000
Annual Net Direct Costs of Vaccine Use	$100,000,000	$100,000,000	$100,000,000
Annual Net Workforce Productivity Gained	$500,000,000	$500,000,000	$500,000,000
Cost Effectiveness	$100,000	$100,000	$100,000
Demographic Considerations			
Benefits Infants and Children	Yes	Yes	Yes
Benefits Women	Yes	Yes	Yes
Benefits Socioeconomically Disadvantaged	Yes	Yes	Yes
Benefits Military Personnel	Yes	Yes	Yes
Benefits Other Priority Population	No	No	No

SMART Vaccines Beta

Step 7 of 7

Priority Score

Value Score: Results of Your Comparison

Back

Candidate Vaccines	Disease	Value Score
Vaccine A	Influenza	51.1
Vaccine B	Tuberculosis	27.8
Vaccine C	Group B Streptococcus	11.1

Drag Vaccine Values to Rank and Update Value Score

- Premature Deaths Averted Per Year
- One-Time Costs
- Vaccine Raises Public Health Awareness
- Benefits Infants and Children
- Demonstrates New Production Platforms
- Serious Pandemic Potential

Sample Scenarios

- **Same attributes but different *values***
  - **A Health Minister vs. PAHO**
  - **NIH vs. A Vaccine Manufacturer**

- **Same values but different *attributes***
  - **One dose vs. Three dose Vaccines**
  - **Risk of Development vs. Cold-Chain Requirements**

Additional Considerations

Data Demands and Quality

Subjective Weights (approximated)

Distribution Around Data

Steady-State Population

Disease Interactions (e.g., HIV+TB)

Phase II: SMART Vaccines 1.0

Public Feedback (Workshop)

Model Refinement

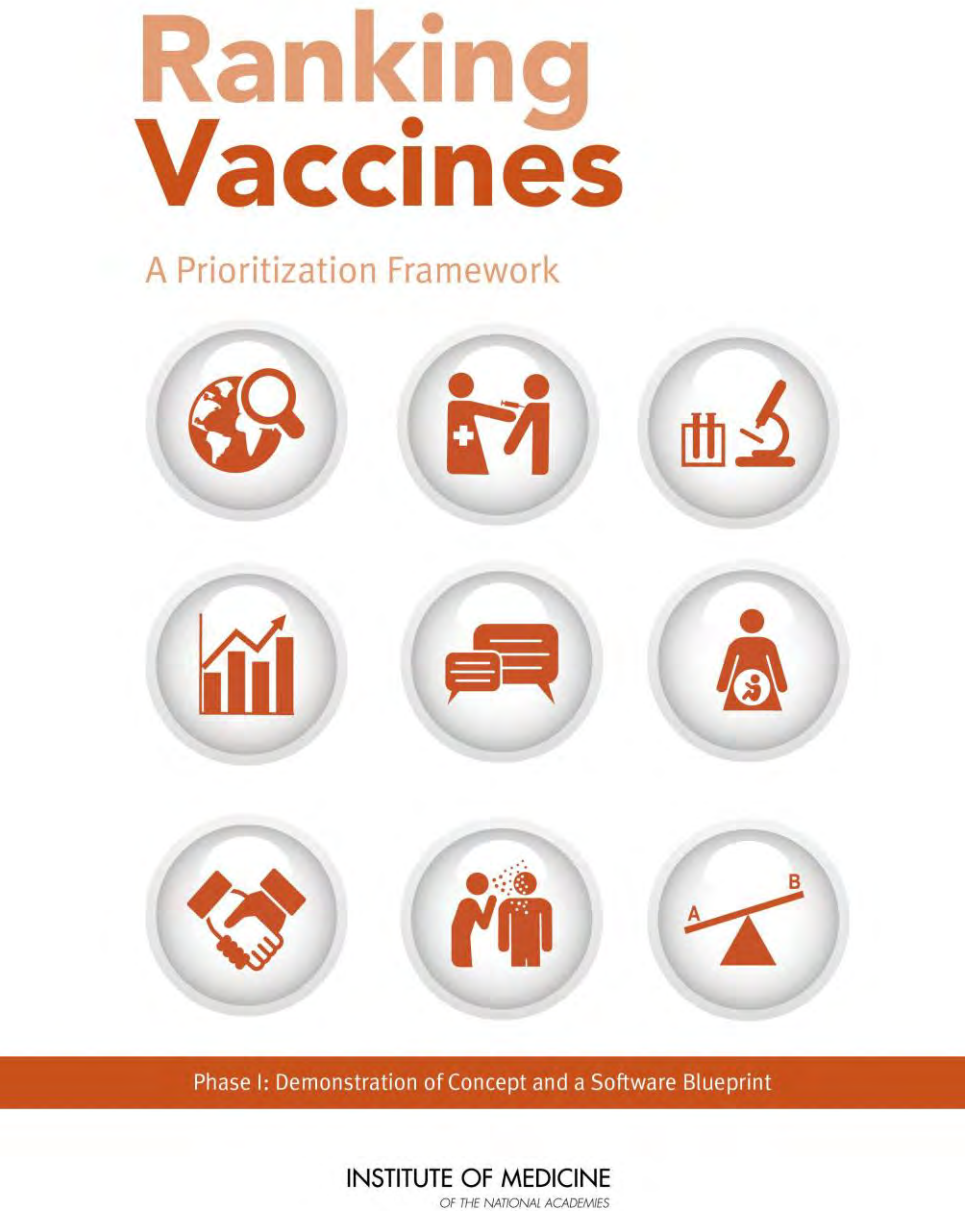
Software Enhancement

Additional Vaccine Candidates

Sensitivity and Uncertainty

Usability Evaluation

Recommendations



Report PDF available at

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Feedback

SMARTVaccines@nas.edu

Thank you