A Simple Approach to Assessing Potential Health Emergency Interventions

A Proof of Concept and Illustrative Application to the 2014–2015 Ebola Crisis

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During the response to the Ebola outbreak that surged in 2014 and continues into 2015 (hereafter, the *2014 Ebola outbreak*), several new and largely untested interventions were suggested by various political and other authorities in both West Africa and the United States. Some of these have been implemented, with unfavorable consequences (e.g., mandatory cremation in Liberia), while others have been hotly debated in largely political terms (e.g., travel bans). How can policymakers assess the value of new or existing interventions for both Ebola and future public health threats as they arise? How can they compare interventions in the context of alternatives with the same aim or in the context of an overall response? Using Ebola as an illustrative example, RAND has developed a simple, practical, proof-of-concept policy analysis tool that aims to fill gaps in a decisionmaker's ability to systematically assess potential interventions. This tool is flexible enough to allow evaluation of a single intervention, a few interventions with the same aim, and the entire landscape of interventions, as well as to be used to make decisions quickly when needed, or on the basis of more in-depth analysis and consultation when time permits.

Tool Development

The first step in the tool development process was to capture the range of health policy goals for interventions associated with a disease outbreak such as Ebola (Table 1). The policy goals suggested here are dervied directly from the goals in the Global Health Security Agenda, which was developed and released in February 2014 by the U.S. government in partnership with other countries, inter-

Table 1. Examples of Public Health and Medical Interventions, by Health Policy Goal

Health Policy Goal	Sample Public Health Interventions	Sample Medical Interventions
Prevent and reduce the likelihood of outbreaks	Travel ban, mandatory quarantine, vaccine, prophylaxis, mandatory cremation of Ebola decedents, regular Ebola alerts from the Centers for Disease Control and Prevention to state health officers	Personal protective equipment (PPE) and procedures
Detect threats or incidents early	Handheld polymerase chain reaction (PCR) tests in airports or other rapid diagnostics, airport fever screening (outbound, inbound)	Training for medical personnel in clinical presentation of Ebola
Respond rapidly and effectively	Deployment of Department of Defense field hospitals and laboratories	Deployment of clinical personnel to provide Ebola treatment and to help sustain normal health services

national organizations, and other public and private stakeholders (GlobalHealth.gov, 2014). Each intervention of interest would be classified into at least one of the following three goals:

- preventing and reducing the likelihood of outbreaks—natural, accidental, or intentional
- detecting threats or incidents early
- responding rapidly and effectively—including multisectoral, international coordination and communication.

For the Ebola response example, the RAND team further split these goals into (1) public health interventions targeting population health and (2) medical interventions targeting individual medical care. According to this simple typology, public health interventions address population health and thus target communities, populations, and the broad spectrum of interventions related to the environment, human behavior, and public health systems, whereas medical interventions place predominant emphasis on medical care, usually focusing on diagnosis, treatment, and care at the individual

level (Harvard School of Public Health, undated). These Global Health Security Agenda goals, and the further parsing of activities into public health and medical domains, are useful for this illustrative example and likely also applicable beyond Ebola to other emerging infectious diseases. The goals can also be modified as needed for application in a future public health emergency, ranging from a disease outbreak to a natural disaster or terrorist attack. For example, in the event of a major hurricane, prevention efforts could include actions to mitigate the impact of a hurricane, such as resilient building structures and placement of emergency generators in areas not likely to experience flooding; detection would be oriented more toward weather forecasting; and response would include a different set of activities. In addition, a policymaker may add areas of activity, such as those related to public safety, infrastructure, and environmental health.

Subsequently, we developed a set of criteria for assessing the extent to which a proposed intervention meets its stated goal. In

creating this list, we strove to identify criteria that were critical for policy decisionmaking and that added unique value independently. For example, two of the criteria we chose are *efficacy* (likelihood of producing desired results under ideal conditions) and *ease of implementation* (feasibility). We considered but ultimately decided against including *effectiveness* (likelihood of producing desired results in practice, under typical operational conditions) because we felt it would not add unique value. In a sense, effectiveness is the product of efficacy and feasibility, which are already included in the framework.

Table 2 provides the full list of proposed criteria, which are designed as rules for analyzing a single intervention or for comparing across different interventions. Based on current best evidence from the literature, media, and RAND subject-matter experts, we defined a subset of key evaluation considerations for each criterion. They address many of the questions raised in public debates about some of the interventions considered and/or applied during the 2014 Ebola outbreaks. For example: How effective is an intervention under ideal conditions? Are there major cultural or political hurdles to implementation? How feasible is it to implement the intervention? How quickly will it produce the desired impact? These considerations are intended to help a policymaker evaluate the key strengths or weaknesses of an intervention in a systematic manner.

The decision support tool itself is a two-dimensional color-coded scorecard depicting the relative performance of an intervention in relation to each criterion. The colors range from red, representing poor performance, to green, representing performance close to the stated goal. A policymaker should use best available evidence, subject-matter expertise, and professional judgment to characterize how well an intervention may or may not meet its stated goal across each of the eight criteria. For comparisons across interventions, the scorecard will align the performance judgments for each criterion and each intervention. The scorecard includes both the color and brief explanatory text for each criterion assessed, to enable rapid visual interpretation of the results.

The textual component of the tool should help a policymaker determine what would be most challenging to implement for a given intervention. This information is particularly important when the decision has been made to move forward with an intervention. A deeper understanding of the strengths and weakness will allow the policymaker to communicate effectively about that intervention as it is implemented and take actions to mitigate any potential weakness. For example, to ease implementation of an intervention that presents some cultural hurdles, policymakers could incorporate communication strategies into policy and implementation designs. These communications should be designed to be sensitive to social biases, linguistic differences, and cultural perspectives.

The decision support tool is a two-dimensional color-coded scorecard depicting the relative performance of an intervention in relation to each criterion. The colors range from red, representing poor performance, to green, representing performance close to the stated goal.

Table 2. Criteria for Assessing Potential Interventions

Criterion	Definition	Evaluation Considerations
Efficacy	Whether an intervention achieves its intended goal under best possible operational conditions	• How well does this intervention achieve its goal? • How much evidence do we have for the positive outcome(s) generated by this intervention? • If a specific technology is required to implement this intervention, does it exist or is it readily available?
Ease of implementation/ technical feasibility	The ease with which the proposed intervention can be implemented in terms of technical complexity, logistics, and resources	• Does the agency responsible for implementation have the needed authority to do so? • Are there mechanisms for coordination and partnerships between agencies and across different levels of government? • Does the agency have the resources to implement the proposed policy, in terms of staff, skills, financial resources, training, expertise, and so on? • Are the facilities, equipment, personnel, and other support available for the proposed intervention? • Is the intervention legal under current law, or will statutes have to be amended or enacted?
Cost	Intervention costs in terms of financing and labor, in relative terms within each country context	• What are the direct and indirect costs to implement the intervention? Are there any intangible costs—for example, damage to reputation, loss of credibility and trust? • What are the one-time fixed costs—new capital expenditures, equipment, training, and so on—required for executing the intervention? • What are the operations and maintenance costs (ongoing costs)? • What are the opportunity costs (other things that could have been done instead with the same resources)?
Risk of unintended negative outcomes	Likelihood of intervention to have additional, unintended, and negative effects outside the stated goals	• Will allocation of resources toward the proposed intervention limit the agency's ability to deliver standard services or its readiness to face other emergencies? • Will implementation of proposed intervention carry third-party risks (to other countries or communities)? • Will the intervention alter internal or external relationships or processes?
Political viability	The extent to which the intervention will be acceptable to relevant powerful groups, decisionmakers, legislators, and administrators	• Is the proposed intervention acceptable to policymakers, government decisionmakers, legislators, and other relevant stakeholders?

Table 2—Continued

Criterion	Definition	Evaluation Considerations
Social/cultural feasibility	The extent to which the intervention will be acceptable to relevant private stakeholders, citizens, neighborhoods, unions, or others	• Is the proposed intervention acceptable to the general public, community stakeholders, and other relevant groups? • Is the intervention aligned with the values of subpopulations within the community? • Will the intervention meet the real or perceived needs of the target group, the public, and other relevant groups?
Equity	The degree to which the implementation or effect of the intervention is distributed fairly across the population	• Is an intervention likely to be discriminatory? • Which groups are likely to be burdened by the intervention? • Which groups are likely to benefit most and least from the intervention? • How may the intervention change the distribution of burdens and benefits in society?
Time frame	Relative time for intervention to be implemented and to produce desired results	• How long will it take it to roll out the proposed intervention? • Does implementation require investment in infrastructure, legislation, and so forth that could delay its implementation? • How long will an intervention take to achieve predetermined milestones and eventually its ultimate goal?

Tool in Practice—Examples from the Ebola Response

The tool proposed here builds upon traditional policy analysis methods. The novelty presented in this report stems from using this tool to analyze emergency response measures in a simple and timely manner, illustratively applying it to the 2014 Ebola outbreak. To demonstrate this, we applied it to a subset of interventions proposed or applied in the ongoing Ebola response. The sample interventions were selected to be representative of a range of the health policy goals shown in Table 1. To demonstrate the tool's flexibility, we provide examples of how it could be used for different types of evaluation. First, we apply the tool to assess a single intervention, to illustrate a "go/no-go" decision. We then apply it to a set of interventions with the same broad health policy goal, with the intention of demonstrating decisionmaking among alternatives aimed at achieving the same goal (note that alternative interventions are not inherently mutually exclusive—more than one can be implemented). Finally, we apply the tool to a varied set of interventions that simulate decisionmaking among alternatives across different overarching goals. This is intended to demonstrate decisions related to an entire response portfolio for a given type of incident. For these proof-of-concept examples, we rely on data from published reports (e.g., media, government, professional journals) and the judgment of subject-matter experts within RAND to populate a common matrix framework, using proposed interventions as column headers and the criteria described in Table 2 in each line (see Tables 3–5). In practice, populating the tool should be done

by the decisionmaker and should draw from all available data, such as from published reports, internal situational reports, operational updates, views of subject-matter experts, and so on. When decisions are needed quickly, this process can involve rapid review of available data and/or consultation with a small number of experts; when time permits, decisionmakers may wish to undertake more in-depth review and consultation.

The underlying assumptions of each intervention, circumstances under which an intervention might be effective (geographic, economic, cultural, etc.), and foreseeable roadblocks and mitigation strategies for each intervention assessed are described in a brief narrative that accompanies the tool results. Policymakers can use the combined power of the rapid visual tool and the contextual explanation to determine whether to pursue a single proposed intervention or to compare multiple interventions at once.

Go/No-Go Decision

Over the course of the 2014 Ebola outbreak, several interventions to limit Ebola's spread were proposed and debated in the public media in both the United States and West Africa. One such proposed intervention was banning entry to the United States by travelers from affected countries. We use this sample intervention to demonstrate how a go/no-go decision could be made using this decision tool.

Policymakers can use the combined power of the rapid visual tool and the contextual explanation to determine whether to pursue a single proposed intervention or to compare multiple interventions at once.

Taking the perspective of a U.S. policymaker asked to decide whether to move forward with travel bans, we began by assessing the overarching public health goal of this intervention—preventing spread of the disease into the United States. For purposes of our illustration here, we relied on information existing in open-source materials and expert opinions of RAND researchers from various disciplines (e.g., health, security, economics, behavioral sciences). We then scored travel bans against each of the criteria specified in the tool. In practice, a government decisionmaker could determine the number and type of sources to provide similar expertise. The resulting table (Table 3) allows a decisionmaker to quickly determine whether the intervention shows significant promise.

In reality, the proposal to entirely ban travelers from affected nations was not a winning intervention and it did not come to pass. Key issues, including social acceptability, significant implementation challenges, lack of evidence, and risk for negative outcomes, ultimately made travel bans a "no-go," as reflected in the scorecard depicted in Table 3.

Decision Among Alternatives—Single Policy Goal

A decision about which intervention to support among alternatives aimed at achieving the same policy goal is a natural extension of the go/no-go decision, particularly for interventions such as travel bans and mandatory cremation, which were ultimately not pursued or were quickly discontinued. Decisionmakers may be looking to substitute other, more viable interventions for the same goal. This tool provides a consistent framework for comparing across proposed interventions that target the same policy goal.

For our comparison example, we took the perspective of a policymaker from a heavily affected nation and used the tool to

Table 3. Go/No-Go Decision: Evaluation of Travel Bans

Criteria	Intervention
	Travel Bans **(Goal: Prevent)**
Efficacy	• Assuming perfect information, banning entry would limit contact with potentially exposed persons. • Limiting contact is efficacious and supported by evidence.
Ease of implementation/ technical feasibility	• It is not clear exactly what a travel ban would entail, because there are no direct flights from any of the affected countries to the United States. • Travel bans would be difficult to coordinate in practice, requiring significant changes to day-to-day functioning of airport and border personnel. • Bans would require new processes to decide who may travel despite the ban, such as volunteer personnel.
Costs	• Travel bans require changes to personnel and procedures (associated with the implementation issues).
Risk of unintended negative outcomes	• Bans are likely to have negative economic impact on affected nations (limited travel, including volunteers, trade). • They may have negative impact on diplomatic relations and the international opinion of the United States. • They may also discourage volunteers by adding to the burden they face in traveling back home to the United States.
Political viability	• Political opinion on travel bans is divided. For example, though initially proposed by several politicians, this intervention was strongly opposed by the White House (and by respected health leaders in the United States and around the world) on grounds of risk of negative consequences, such as evasive behaviors, and therefore not politically feasible.
Social/cultural feasibility	• Public opinion on this intervention is not uniform. Media polls taken in October 2014 showed that the U.S. public expressed broad support for such control measures as travel bans. However, there was division among opinions when considering returning health volunteers.
Equity	• Travel bans are not equitable in a global context. • For instance, they exacerbate existing inequalities in access to care. • In addition, such bans restrict movement of individuals from certain countries but not from others.
Time frame	• Travel bans could be implemented and produce effects very quickly.

explore a hypothetical decision between two interventions intended to prevent the spread of disease through different approaches to fatality management: mandatory cremations and safe and dignified burials. Fatality management became prominent in the Liberian Ebola response after several reports of disease transmission associated with traditional burial practices for Ebola victims. In August 2014, Liberia imposed and tried to enforce mandatory cremations of all Ebola fatalities. This was met with significant community

The tool allows policymakers to make a "quick and simple" decision based on examining the color-coding of the criteria and to scrutinize the key issues that establish one intervention as less feasible than another.

resistance for cultural and religious reasons and was ultimately discontinued in favor of guidance for safe and dignified burials. This guidance provides instructions for how to properly bag, disinfect, transport, and bury persons who have died of Ebola. Evaluations of both of these alternatives are presented in the scorecard in Table 4.

In the case of deciding between two interventions with the same goal—mandatory cremations versus safe and dignified burials, both intended to prevent the spread of Ebola—the tool proves useful in two meaningful ways. First, it allows a "quick and simple" decision based merely upon examining the color-coding of the criteria cells under each intervention. Under the mandatory cremation, only one of the cells is green, four are yellow, and three are red. Safe and dignified burials, on the other hand, exhibits three green cells and five yellow, without any red. This color-based analysis in itself points out the relative advantage of the safe and dignified burials over cremations.

Moreover, this comparison allows scrutinizing the key issues that establish cremations as less feasible than safe and dignified burials in the case of Africa. These issues are social and cultural feasibility, risk of unintended consequences, and equity. These are all related to one another: In much of Africa, traditional beliefs include burial because the chief missionary religions in colonial times were Islam, Catholicism, and Protestantism, all of which opposed cremations. The difficulty that certain religions and cultures face in adopting this policy option makes it inequitable. Further, individuals and groups that fear cremations may deliberately avoid reporting Ebola deaths, thus elevating the risk of transmission.

On the other hand, if we were to take the perspective of a policymaker from a heavily affected non-Muslim nation in Asia, the analysis would have produced different results. In Asia, cremation is extremely common, and in many countries, most bodies are cremated—in Japan, more than 99 percent; in India, Singapore, South Korea, Taiwan, and other countries, more than 80 percent; and in China, approximately 50 percent (McNeil, 2014). This example illustrates that the tool is context-dependent and that decisionmakers need to consider the issues most relevant to their circumstances.

Decision Among Alternatives—Across Policy Goals

A decision among alternatives with different overarching goals builds further on decisions among alternatives with the same policy goal. In some cases, a policymaker will be asked to choose a portfolio of interventions that achieve all or most of the public health policy goals. For this example, we return to the perspective of a decisionmaker in the United States who must decide whether to implement several potentially contentious interventions in consideration of how these interventions work together to achieve overall national health security.

For this example, we expanded upon the evaluation of travel bans to include three other proposed interventions. Mandatory quarantines are included because of the events of fall 2014, when such quarantines were imposed by several state governors upon volunteers returning from Ebola-affected countries, with one case

Table 4. Decision Among Alternatives with the Same Policy Goal: Evaluation of Fatality Management

Criteria	Intervention	
	Mandatory Cremation (Goal: Prevent)	**Safe and Dignified Burial (Goal: Prevent)**
Efficacy	• This intervention is very effective (minimal handling, incineration temperatures effectively destroy Ebola virus). There is a strong evidence base.	• This intervention is very effective if properly implemented (empiric evidence from past outbreaks in other countries).
Ease of implementation/ technical feasibility	• In small numbers, cremation is very easy to implement. It may result in insufficient crematoria capacity and personnel.	• Somewhat more tedious to implement (compared with traditional burials or cremation).
Costs	• Costs are low if equipment is available but high if equipment must be procured.	• Relatively minimal for training and ongoing supplies (but more than for purely traditional burials).
Risk of unintended negative outcomes	• There is a risk of evasion. Failure to refer patients for care could result in otherwise preventable disease transmission.	• Relatively little risk of evasion.
Political viability	• This intervention is politically divisive between government and community/religious leaders. The nature of the crisis might be a strong motivation for mandating cremations.	• This intervention is not controversial and is likely to be consistent with political leadership values.
Social/cultural feasibility	• Cremations are strongly antithetical to social values and cultural traditions.	• This alternative burial practice is more consistent with social values.
Equity	• Intervention has inequitable consequences for different faiths.	• Intervention is generally equitable.
Time frame	• Cremation is quick to implement if equipment and facilities, such as crematoria, are available. There may be some delays if equipment must be procured, facilities are overloaded, or bodies need to be transported. Once implemented, the effects would be immediate.	• This intervention is quick to implement if supplies are available and trained burial teams are in place. • Supply availability and training of personnel may slow down implementation. • Once implemented, the effects would be immediate.

in Maine even being brought to court for adjudication. Key issues raised in the debate about this intervention were the degree of evidence to support such an action and the level of infringement upon personal rights. In the wake of Thomas Eric Duncan's diagnosis in the United States, the concept of deploying handheld PCR diagnostic tests for Ebola to airports was raised as a way to immediately recognize and isolate Ebola patients. However, several technical and logistical hurdles may have made this suggested intervention infeasible. By comparison, airport temperature screening of outbound and inbound passengers from affected countries was proposed and implemented as a way to determine which individuals needed to be evaluated further and monitored for a full 21 days.

Evaluations of all four of these alternatives are presented in the scorecard in Table 5.

Compared with the previous example (a decision between interventions with the same goal), this example goes further, showing how a broader decisionmaking process can also be supported by a "quick and simple" analysis made possible by this tool. For example, temperature screening was scored with six green and two yellow cells. As seen in practice, this intervention won out over the proposal to put handheld PCRs in airports, which was scored with four green, one yellow, and three red cells. This color-based analysis in itself points out the relative advantage of temperature screening (ease of implementation and lower costs), as well as its disadvantages (overall efficacy). However, we recognize that other persons could judge the criteria differently than we have and reach a different conclusion. The tool is designed to facilitate consistent judgments by a decisionmaker in a specific context. The examples in this perspective are intended as a proof-of-concept and not definitive analyses of these interventions.

Furthermore, the text elements in the tool allow the decisionmaker to dive more deeply into the criteria that would make implementation of a given intervention less desirable. This is useful when comparing across policy goals because it allows decisionmakers to balance the strengths and weaknesses of the interventions selected

The text elements in the tool are useful when comparing across policy goals because they allow decisionmakers to balance the strengths and weaknesses of the interventions selected for implementation.

for implementation. With this tool, a policymaker can also expand the decisionmaking process to consider how the decision between PCR-based screening and temperature screening may affect a decision to implement certain other proposed prevention measures. For example, if a decisionmaker chose to implement temperature screening before airline travel, the results of this intervention could be used to create decision rules for limiting travel of those suspected to be infected, which would make blanket travel bans unnecessary. Similarly, accurate temperature readings could be used as a basis for determining when quarantine is appropriate, which would significantly ameliorate the issues related to equity, risk of unintended consequences, and political viability for that intervention.

Discussion

This perspective uses Ebola as an illustrative example to introduce a proof-of-concept policy analysis tool that allows evaluation of a single intervention, a few interventions with the same aim, or the entire spectrum of potential interventions. To demonstrate the usefulness of this tool, we analyzed the feasibility of several new and largely untested interventions that have been suggested by stakeholders in both West Africa and the United States in response to the 2014 Ebola outbreak. These examples represent only a small subset of intervention options; future iterations may benefit from applying the tool to test additional interventions, including but not limited to the following:

- *Personal protective equipment (PPE) training.* This intervention seeks to train all health care providers involved in the care of Ebola patients (prior to providing care) to ensure their competency in performing all Ebola-related infection control practices and procedures, specifically donning and doffing proper PPE.

Table 5. Decision Among Alternatives Across Policy Goals: Evaluation of Four Interventions

Criteria	Intervention			
	Mandatory Quarantine (Goal: Prevent)	**Travel Bans (Goal: Prevent)**	**Handheld PCR Testing of Inbound Airline Passengers (Goal: Detect)**	**Temperature Screening of Outbound or Inbound Airline Passengers (Goal: Detect)**
Efficacy	• This intervention should be effective if enforced perfectly (i.e., applied to all exposed persons). • Applying quarantine to all returning volunteers (not just those showing symptoms) is not supported by evidence.	• Assuming perfect information, banning entry will limit contact with potentially exposed persons. • Limiting contact is efficacious and supported by evidence.	• Depending on test characteristics, this intervention should effectively detect infected persons at point of entry; enables both safe case management and prevention of disease transmission.	• This intervention has imperfect sensitivity (may miss a person who has taken medicine to reduce fever; and fever is just one of many Ebola symptoms) and imperfect specificity (elevated temperature is also a symptom of many other conditions).
Ease of implementation/ technical feasibility	• Quarantines are fairly easy to implement and require minimal personnel and other resources.	• It is not clear exactly what a travel ban would entail, because there are no direct flights from any of the affected countries to the United States. • Travel bans would be difficult to coordinate in practice, requiring significant changes to day-to-day functioning of airport and border personnel. • Bans would require new processes to decide who may travel despite the ban, such as volunteer personnel.	• The technology required for this intervention is either not available or very expensive. • Full implementation would also require a significant additional level of effort from personnel who are technically proficient in both blood sampling and PCR testing. • The time required for test results would likely cause major delays for arriving international passengers.	• Temperature-taking requires minimal additional resources and can be administered by untrained personnel.

Table 5—Continued

Criteria	Mandatory Quarantine (Goal: Prevent)	Travel Bans (Goal: Prevent)	Handheld PCR Testing of Inbound Airline Passengers (Goal: Detect)	Temperature Screening of Outbound or Inbound Airline Passengers (Goal: Detect)
		Intervention		
Costs	• Quarantines are inexpensive to implement, particularly as they apply to a limited population.	• Travel bans require changes to personnel and procedures (associated with the implementation issues).	• It would be costly to buy the PCR technology and fully implement it in airports.	• Resources (noncontact thermometers) are inexpensive and no specialized personnel are required.
Risk of unintended negative outcomes	• This intervention has a risk of evasion. • There is a long-term risk of negative effects on personal freedoms in other emerging infectious disease scenarios (e.g., early in the HIV epidemic).	• Bans are likely to have negative economic impact on affected nations (limited travel, trade). • They may have negative impact on diplomatic relations and the international opinion of the United States.	• May cause significant delays for arriving international passengers.	• Risk of false positives (taking action on those not sick with Ebola) • Risk of false negatives (mistakenly clearing someone with Ebola who is not febrile and making them less likely to be aware as symptoms develop).
Political viability	• This intervention is strongly opposed by respected health leaders in the United States and around the world and was (in one case) ultimately struck down in court.	• Political opinion on travel bans is divided. For example, though initially proposed by several politicians, this intervention was strongly opposed by the White House (and by respected health leaders in the United States and around the world) on grounds of risk of negative consequences, such as evasive behaviors, and therefore not politically feasible.	• No known political obstacles.	• No known political obstacles unless in response to potential public outcry.

Table 5—Continued

Criteria	Intervention			
	Mandatory Quarantine (Goal: Prevent)	**Travel Bans (Goal: Prevent)**	**Handheld PCR Testing of Inbound Airline Passengers (Goal: Detect)**	**Temperature Screening of Outbound or Inbound Airline Passengers (Goal: Detect)**
Social/cultural feasibility	• The U.S. public has expressed broad support for such control measures as mandatory quarantine. However, there has been division among opinions, with some strongly opposed to the infringement upon individual freedoms.	• Public opinion on this intervention is not uniform. Media polls taken in October 2014 showed that the U.S. public expressed broad support for control measures like travel bans. However, there was division among opinions when considering returning health volunteers.	• No expected social/cultural hurdles.	• No known social/cultural hurdles.
Equity	• Quarantines are not equitable to the affected population.	• Travel bans are not equitable in a global context. • For instance, they exacerbate existing inequalities in access to care. • In addition, such bans restrict movement of individuals from certain countries but not others.	• Intervention is applied to travelers only as warranted by initial screening.	• Intervention is applied to all travelers equitably.
Time frame	• This intervention could be implemented and produce effects very quickly.	• Travel bans could be implemented and produce effects very quickly.	• Time may be an impediment if there are delays (more than a few minutes) between testing and results. • The testing could be implemented and produce effects quickly only if the technology exists and is in place with trained users and standard procedures.	• Screening could be implemented and produce effects very quickly.

- *Vaccination*. Experimental Ebola vaccine trials are carried out in the United States and/or in the field, primarily in heavily affected areas. If appropriate regulatory authorities approve the trials, the efforts are scaled up to provide the vaccine to those at risk for Ebola.
- *Field hospitals*. For example, U.S. Department of Defense hospitals could be leveraged, with changing numbers of beds and staff designed to either treat health care workers affected by Ebola or augment domestic and international efforts to assist in treating the local population affected.
- *Rapid training of health care worker volunteers*. Training is provided to licensed clinicians (e.g., nurses, physicians, and other health care providers) intending to work in an Ebola treatment unit in Africa. Such training may include, for instance, information on epidemiology and transmission, as well as basic principles of clinical care and management of Ebola-infected patients.
- *Ebola treatment centers within hospitals*. As of January 15, 2015, 49 hospitals in the United States have designated Ebola treatment centers (Centers for Disease Control and Prevention, 2015). This list continues to grow and is updated weekly.
- *Regionwide curfews*. Nationwide or areawide curfews, or "lockdowns," imposed overnight or for several days can halt the spread of the disease.

The conceptual approach and types of decisions in this report are not unique to Ebola. We believe that the value of this tool includes but also extends well beyond its applicability to this public health emergency.

- *Technological applications for mitigating the risk of being infected*. For example, a new smartphone application is currently under development to detect a user's risk for exposure to the Ebola virus.

In addition, even though the content of this report focuses largely on Ebola, the conceptual approach and types of decisions are not unique to this public health emergency. Thus, we believe that the value of this decision support tool includes but also extends well beyond its applicability to Ebola. This tool could be particularly useful in planning for or making decisions during response to different kinds of disasters, including both naturally occurring and manmade. Finally, the tool is flexible enough to accommodate decisionmakers' time constraints: It could be successfully used to make decisions quickly when needed, by populating the cells on the basis of quick review of published reports and consultation with just a few people in a short meeting; or it could be applied using more in-depth data collection, consultation, and analysis, if time permits.

While this tool is useful for assessing the shortcomings and advantages of different interventions either singly or in a comparative manner, implementation is key to success. Whichever intervention is selected, policymakers need to incorporate communication strategies into policy and implementation designs. Effective communication can ease implementation hurdles, but, if designed to be sensitive to social biases, linguistic differences, and cultural perspectives, it can also make the intervention more politically and culturally acceptable. Such communication strategies should extend beyond basic dissemination of information about an intervention to consider the entire life cycle of an intervention, from decision, to implementation, and, finally, to evaluation of effectiveness.

Once policymakers decide to proceed with an intervention with a limited evidence base, as is the case for many of these situations, it is crticial that they immediately launch an accompanying effort to track data on the progress of the intervention. Transparency and credibility are highly valued attributes in such endeavors; therefore, lessons learned should be communicated in a timely manner.

Finally, the proof-of-concept tool introduced here has some important limitations. First, while the criteria presented are all important, they are not all of equal weight. On one hand, this lack of weighting offers flexibility—decisionmakers using this tool apply their own judgment and weight the criteria as they see fit. For instance, certain stakeholders and individuals may value cost more than other factors, while others may not be concerned at all with equity. On the other hand, lack of weighting—at least its absence in the example presented here—poses a limitation. For example, efficacy is arguably more important than time frame— an intervention that is speedy but ineffective should not have the same score as one that is more time-consuming but effective solely because of matrix color frequency. In addition to unequal weights, it is important to recognize that the meaning of the ordinal ranking for each criterion—green, yellow, and red—is not always the same for different interventions or criteria. Not all green boxes will mean the same thing. Three items may all be efficacious given their goals, and therefore be scored green, but one may ultimately have a much greater potential for impact in fighting the disease. This nuance may change how one considers trade-offs and impediments for some interventions. Lastly, some readers may disagree with the judgments reflected in the illustrative tables presented here. The purpose of this paper is more to present a proof-of-concept framework than to argue strongly for the color-coded judgments made.

Opportunities for Future Development

Rigorous policy analysis was beyond the scope of this perspective. Policymakers who may wish to use the proof-of-concept tool introduced here should follow traditional steps in policy analysis, the first of which would be to translate more-elusive goals into objectives that express more concretely desired end states, considering timeline, resources, and so forth. Subsequently, rather than only raise issues for consideration, policymakers ought to select measurable dimensions of objectives, used to assess the extent to which different interventions are likely to meet their broader goals. Such an assessment would benefit from metrics that are unambiguous, relatively straightforward, and simple to measure—and that produce uniform results.

Furthermore, this tool provides a strong base for developing a more complex decision support tool for such disease-related disasters as Ebola or pandemic influenza, as well as for other preparedness efforts, such as those related to hurricanes, earthquakes, and bioterrorism attacks. The complex decisions required during public health and other emergencies would benefit from this type of analytic tool. This more complex tool could be applied to model the trade-offs inherent to decisionmaking, either during or in advance of emergencies, to inform preparedness—that is, to help decide what types of interventions to include in preparedness plans. When policymakers are choosing among policy options, such a model would apply the results of existing scientific and empiric evidence to support public health emergency decisionmaking. Further, the model would be tailored for easy use by decisionmakers, with the intention of facilitating more-informed decisions in future emergencies.

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About This Perspective

This perspective is intended to help decisionmakers systematically assess potential interventions in the event of a public health emergency. Using Ebola as an illustrative example, this perspective builds upon traditional policy analysis methods and introduces a simple, practical, proof-of-concept tool that allows evaluation of a single intervention, a few interventions with the same aim, or the entire spectrum of potential interventions.

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