ABSTRACT  Background: Defense policy planners and countermeasure developers are often faced with vexing problems involving the prioritization of resources and efforts. This is especially true in the area of Biodefense, where each new emerging infectious disease outbreak brings with it questions regarding the causative agent’s potential for weaponization. Recent experience with West Nile Virus, Severe Acute Respiratory Syndrome, Monkeypox, and H1N1 Influenza highlights this problem. Appropriately, in each of these cases, the possibility of bioterrorism was raised, although each outbreak ultimately proved to have a natural origin. In fact, determining whether an outbreak has an unnatural origin can be quite difficult. Thus, the questions remain: could the causative agents of these and other emerging infectious disease outbreaks pose a future weaponization threat? And how great is that threat? Should precious resources be diverted from other defense efforts in order to prepare for possible hostile employment of novel diseases by belligerents? Answering such critical questions requires some form of systematic threat assessment.   Methods: Through extensive collaborative work conducted within NATO’s Biomedical Advisory Council, we developed a scoring matrix for evaluating the weaponization potential of the causative agents of such diseases and attempted to validate our matrix by examining the reproducibility of data using known threat agents. Our matrix included 12 attributes of a potential weapon and was provided, along with detailed scoring instructions, to 12 groups of biodefense experts in 6 NATO nations. Study participants were asked to score each of these 12 attributes on a scale of 0–3; Infectivity, Infection-to-Disease Ratio (Reliability), Predictability (Incubation Period), Morbidity & Mortality (Virulence), Ease of Large-Scale Production & Storage, Aerosol Stability, Atmospheric Stability, Ease of Dispersal, Communicability, Prophylactic Countermeasure Availability, Therapeutic Countermeasure Availability, and Ease of Detection. Reproducibility of scoring data was assessed by examining the standard deviations (SD) of mean scores. Results: Our results were unexpected. Several familiar biothreat diseases such as anthrax and tularemia were judged, by our experts, to be less threatening than many others owing to a number of factors including ease of detection, lack of communicability, and the ready availability of countermeasures. Conversely, several toxins were judged by experts to have very high potential as threat agents owing, in part, to their reliability, virulence, and a lack of available countermeasures. Agreement among experts, as determined by lower SD about a mean score, was greater for more familiar threats. Discussion: Our study was designed to provide a concise and easy-to-apply set of criteria that could be used by NATO nations to evaluate emerging infectious disease threats with respect to their weaponization potential. Our results were unexpected. We believe that a lack of appropriate weighting factors may explain these results and suggest that future studies weigh each of the 12 proposed criteria based on the intended use of the assessment data and other situational factors. We believe that the greatest value of our study lies in a codification of the attributes of a biological weapon.

INTRODUCTION  Defense policy planners and countermeasure developers are often faced with vexing problems involving the prioritization of resources and efforts. This is, perhaps, especially true in the arena of biodefense, where each new emerging infectious disease outbreak brings with it difficult questions regarding the causative agent’s potential for weaponization.
Recent experience with West Nile Virus,1 Severe Acute Respiratory Syndrome,2 Monkeypox, and H1N1 Influenza highlights this dilemma. Appropriately, in each of these cases, the possibility of bioterrorism was raised, although each outbreak ultimately proved to have a natural origin. In fact, determining whether an outbreak has an unnatural origin can be quite difficult.3,4 (although a scoring system proposed by Grunow and Finke5 provides a basis for such a determination). Thus, the questions remain: could the causative agents of these and other emerging infectious disease outbreaks pose a future weaponization threat? And how great is that threat? Should precious resources be diverted from other defense efforts in order to prepare for possible hostile employment of novel diseases by belligerents?

Answering such critical questions requires some form of systematic threat assessment. In the case of many oft-mentioned “classical” bioweapons, organized state-sponsored offensive bioweapons programs conducted such assessments. The proceedings of the Kirov symposium,6 as well as the writings of defector Ken Alibek,7 offer a glimpse into Soviet analysis and prioritization efforts. Similarly, one can somewhat safely presume that the 10 agents considered for inclusion in the U.S. arsenal8 during the 1943–1969 era of its offensive program constitute viable weapon threats. Civil organizations have likewise conducted assessments of risk for defensive purposes. Notably, the World Health Organization estimated downwind casualty effects in population centers of varying size following a theoretical release.9

A larger problem is presented, however, by the aforementioned “novel” or emerging diseases. In 1999, the U.S. Centers for Disease Control and Prevention (CDC) built upon an analysis conducted by the Johns Hopkins Center for Civilian Biodefense Studies10,11 and developed a list12,13 of “critical agents for health preparedness,” allowing that new and emerging diseases would likely constitute future threats. In a separate but related action taken in the aftermath of the terror attacks of September 2001, and especially the subsequent anthrax attacks of October 2001, the U.S. Congress passed the Public Health Security and Bioterrorism Preparedness Response Act. This action established the “Select Agent” program, designed to control the possession, use, and transfer of several dozen select agents and toxins felt to constitute “dual-use” threats. Furthermore, Homeland Security Presidential Directive 10 (“Biodefense for the 21st Century”),14 issued in 2004, mandated a biennial review of risk with an eye toward an update of the Select Agent List. Moreover, this risk assessment was to employ “rigorous and technically sound methodology for prioritizing biological threats that have the potential to cause catastrophic consequences.” The assessment considers four types of terrorist organizations and eight categories of attack scenarios. It employs a 17-step assessment process to build upon CDC’s list. Finally, Homeland Security Presidential Directive 21,15 issued in 2007, mandated that CDC’s Strategic National Stockpile, which contained medical countermeasures against a very small number of prominent threats, be reviewed annually in a systematic manner, utilizing risk assessment data in order to update Strategic National Stockpile contents.

Although these methodologies are potentially quite useful in gauging bioterror threats and in guiding civilian preparations, they present several problems that limit their usefulness to military medical planners. First, they pertain principally to terrorism, rather than state-sponsored warfare scenarios, and as such, examine factors that may not be relevant to biowarfare (e.g., ease of acquisition, ease of transport, and target selection). Second, the results of these analyses are often initially classified, which limit their usefulness in the training of battlefield medics. Third, they deal chiefly with agents rather than the diseases they cause. This is relevant in that an agent may be dangerous to handle, yet constitute a poor choice for weaponization. Finally, the cumbersome methodology limits flexibility in the rapid assessment of novel and emerging disease threats with respect to their potential for belligerent use. In order to circumvent these shortcomings, we propose here a simple scoring matrix for evaluating the weapons potential of the causative agents of such diseases.

METHODS
Our matrix includes 12 attributes of a potential weapon and scores each attribute on a scale of 0–3; agents can thus garner a score from 0 to 36 (the “ideal” weapon):

Infectivity
0 – Noninfectious
1 – Mildly infectious (ID50 > 1,000 organisms)
2 – Moderately infectious (ID50 10–1,000 organisms)
3 – Highly infectious (ID50 1–10 organisms)

Infection-to-disease ratio (reliability)
0 – Low (fewer than one case of clinically relevant disease for every 100 infected individuals)
1 – Moderate (1 case in 10 to 1 case in 100 infected individuals)
2 – High (greater than 1 case in 10 infected individuals)
3 – Certain (nearly all infected individuals develop clinically relevant disease)

Predictability (& incubation period)
0 – Very low (incubation period very lengthy and/or variable)
1 – Low
2 – Medium
3 – High (incubation period short and/or very predictable)

Morbidity & mortality (virulence)
0 – Minimal
1 – Low (incapacitating agents)
2 – Medium (high morbidity and/or some degree of mortality)
3 – High (lethal agents)
Ease of large-scale production & storage
0 – Nearly impossible to cultivate in quantity
1 – Difficult (requires embryos or other living systems for cultivation)
2 – Moderate (can be produced in cells via genetic techniques)
3 – Easy (can be propagated efficiently in artificial media)

Aerosol stability
0 – Very low (impossible to formulate in a homogenous aerosol)
1 – Low
2 – Moderate
3 – High (can be formulated in a homogenous aerosol of 2–3 μm particles)

Environmental stability
0 – Very low (decay rates of unstabilized organism in the environment >3%/min)
1 – Low
2 – Moderate
3 – High (relatively impervious to decay under normal atmospheric conditions)

Ease of dispersal
0 – Virtually impossible to disperse in quantity
1 – Low (requires sophisticated stabilization, aerobiology, and dispersal techniques)
2 – Moderate (requires spray techniques)
3 – High (can survive dissemination via ballistic weaponry)

Communicability
0 – Noncontagious
1 – Contagious via contact only
2 – Contagious via respiratory droplets
3 – Contagious via droplet nuclei

Prophylactic countermeasure availability
0 – Countermeasures readily available or unnecessary
1 – Antibiotics and/or vaccines readily acquired (most bacteria)
2 – Vaccines may be producible given adequate time; antibiotics ineffective (most viruses)
3 – No known countermeasures available (e.g., filoviruses)

Therapeutic countermeasure availability
0 – Countermeasures readily available or unnecessary
1 – Antibiotics readily acquired (most bacteria)
2 – Antibiotics ineffective or generally unavailable (most viruses)
3 – No known countermeasures available (e.g., filoviruses)

Ease of detection
0 – Point-of-care assays available
1 – Laboratory assays available
2 – Special laboratory capabilities required
3 – No assays available for detection

In order to assess the utility of our matrix, we asked experts affiliated with the biodefense establishments of member nations of NATO’s Biological Medical Advisory Panel to employ the instrument in scoring 33 different agents, assigning each agent an integer value of 0–3 in the 12 weaponization criteria categories. The 33 bacteria, viruses, and toxins studied include a combination of “classical” (i.e., “Dirty Dozen”), emerging, and endemic threats. Each of the biodefense experts was a doctoral-level scientist with a long history of involvement in his/her nation’s medical biodefense program. In all, 12 groups of scientists from six NATO nations with robust biodefense programs participated in the validation study.

RESULTS
Likert scores (integer values from 0 to 3, inclusive) obtained for each of the 12 weaponization criteria categories were totaled for each agent from each survey respondent. A mean score was thus obtained for each agent and standard deviations (SD) were examined (using Microsoft Excel) as a measure of agreement among experts. Agents and diseases were ranked from 1 to 33, based on these experts’ composite opinion as to their weaponization potential. Results are provided in Table 1 and are graphically depicted in Figure 1.

ANALYSIS
As might be expected, average results for the “familiar” biothreat agents (i.e., those included among the CDC’s Critical Agent Category A or among the “Dirty Dozen” [see text below]) were generally associated with lower SD (anthrax = 1.48, plague = 2.81, and ricin = 2.60) than those associated with more exotic, novel, or unfamiliar agents (Nipah = 5.00, glanders = 4.00, Eastern equine encephalitis = 3.99), indicating greater agreement among “experts” as to their weaponization potential. The same can be said about the familiar influenza viruses (H1N1 = 2.58, H3N2 = 2.23).

Conversely, our validation study yielded some unexpected results. The “familiar” biothreat diseases anthrax (rank = 21/33) and tularemia (rank = 23/33) were judged, by our experts, to be less threatening than many others owing to a number of factors including ease of detection, lack of communicability, and the ready availability of countermeasures. On the other hand, smallpox (rank = 2/33), the viral hemorrhagic fevers (Marburg rank = 4/33; Ebola rank = 8/33), plague (rank = 5/33), and botulism (rank = 10/33), all Category A agents, scored relatively high in terms of their weaponization potential. It is perhaps surprising that Marburg was felt to pose a greater threat than Ebola. This might be attributed to respondents’ cognizance of Soviet work on Marburg weapons, but our survey was conducted before the 2014–2015 West African Ebola
virus outbreak. It would be interesting to see whether this assessment might change in the aftermath of that outbreak.

Perhaps somewhat unexpectedly, several toxins were judged by experts to have very high potential as biothreat agents owing, in part, to their reliability, virulence, and a lack of countermeasures. Ricin (rank = 1/33), the trichothecenes (rank = 3/33), staphylococcal enterotoxin B (rank = 5/33) and the epsilon toxin of *Clostridium perfringens* (rank = 7/33) are examples. Given that neither prophylactic nor therapeutic countermeasures have been developed against the majority of toxins, it is possible that excessive weight is given in our matrix to these countermeasures (which, in contrast to our first nine characteristics, are not inherent properties of the agent), artificially elevating the threat that toxins pose. Conversely, it is precisely the development of countermeasures (a primary goal of NATO biodefense establishments) against bacterial, and some viral, diseases that has likely led to the diminishment of their threat.

The prominence of toxins at the top of our threat matrix results was also unexpected in light of our stated aim of concentrating on state-sponsored military weapons programs rather than terrorist threats. Although toxins, in the minds of many military planners, might be used by state actors in limited tactical situations, most agree that their instability makes them poor choices for operational or strategic military use.

**TABLE I.** Instrument Validation Survey Results (*n* = 12)

<table>
<thead>
<tr>
<th>Disease or Agent</th>
<th>Average</th>
<th>Rank</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax (<em>Bacillus anthracis</em>)</td>
<td>20.75</td>
<td>21</td>
<td>1.48</td>
</tr>
<tr>
<td>Botulinum toxin</td>
<td>22.62</td>
<td>10</td>
<td>3.28</td>
</tr>
<tr>
<td><em>Brucella</em> sp.</td>
<td>19.25</td>
<td>29</td>
<td>3.36</td>
</tr>
<tr>
<td>Crimean-Congo Hemorrhagic Fever virus</td>
<td>21.67</td>
<td>14</td>
<td>2.42</td>
</tr>
<tr>
<td>Cholera (<em>Vibrio cholerae</em>)</td>
<td>16.67</td>
<td>33</td>
<td>3.28</td>
</tr>
<tr>
<td>Ebola virus</td>
<td>23.08</td>
<td>8</td>
<td>3.06</td>
</tr>
<tr>
<td>Eastern Equine Encephalitis virus</td>
<td>20.42</td>
<td>24</td>
<td>3.99</td>
</tr>
<tr>
<td>Epsilon toxin</td>
<td>23.25</td>
<td>7</td>
<td>3.70</td>
</tr>
<tr>
<td>Glanders (<em>B. mallei</em>)</td>
<td>20.29</td>
<td>25</td>
<td>4.00</td>
</tr>
<tr>
<td>Hantaan virus</td>
<td>21.18</td>
<td>18</td>
<td>2.99</td>
</tr>
<tr>
<td>Influenza virus H1N1</td>
<td>18.58</td>
<td>31</td>
<td>2.58</td>
</tr>
<tr>
<td>Influenza virus H3N2</td>
<td>18.62</td>
<td>30</td>
<td>2.23</td>
</tr>
<tr>
<td>Junin virus</td>
<td>21.20</td>
<td>17</td>
<td>3.49</td>
</tr>
<tr>
<td>Kyasanur Forest virus</td>
<td>21.44</td>
<td>16</td>
<td>3.17</td>
</tr>
<tr>
<td>Lassa virus</td>
<td>21.82</td>
<td>t12</td>
<td>4.07</td>
</tr>
<tr>
<td>Machupo virus</td>
<td>22.18</td>
<td>11</td>
<td>4.09</td>
</tr>
<tr>
<td>Marburg virus</td>
<td>23.50</td>
<td>4</td>
<td>3.23</td>
</tr>
<tr>
<td>Melioidosis (<em>Burkholderia pseudomallei</em>)</td>
<td>20.71</td>
<td>22</td>
<td>3.58</td>
</tr>
<tr>
<td>Nipah virus</td>
<td>21.82</td>
<td>t12</td>
<td>5.00</td>
</tr>
<tr>
<td>Omsk virus</td>
<td>21.64</td>
<td>15</td>
<td>3.44</td>
</tr>
<tr>
<td>Plague (<em>Yersinia pestis</em>)</td>
<td>23.42</td>
<td>t5</td>
<td>2.81</td>
</tr>
<tr>
<td>Q-Fever (<em>Coxiella burnetii</em>)</td>
<td>19.72</td>
<td>27</td>
<td>4.27</td>
</tr>
<tr>
<td>Ricin toxin</td>
<td>25.25</td>
<td>1</td>
<td>2.60</td>
</tr>
<tr>
<td>Rift Valley Fever virus</td>
<td>19.82</td>
<td>26</td>
<td>4.12</td>
</tr>
<tr>
<td>Staphylococcal enterotoxin B</td>
<td>23.42</td>
<td>t5</td>
<td>3.87</td>
</tr>
<tr>
<td>Shiga toxin</td>
<td>22.79</td>
<td>9</td>
<td>3.94</td>
</tr>
<tr>
<td>Smallpox (<em>Variola major</em>)</td>
<td>24.58</td>
<td>2</td>
<td>3.09</td>
</tr>
<tr>
<td>Trichothecene mycotoxins</td>
<td>24.21</td>
<td>3</td>
<td>5.28</td>
</tr>
<tr>
<td>Tularemia (<em>Francisella tularensis</em>)</td>
<td>20.63</td>
<td>23</td>
<td>4.25</td>
</tr>
<tr>
<td>Typhoid fever (<em>Salmonella typhi</em>)</td>
<td>17.13</td>
<td>32</td>
<td>4.43</td>
</tr>
<tr>
<td>Typhus (<em>Rickettsia spp.</em>)</td>
<td>19.54</td>
<td>28</td>
<td>3.95</td>
</tr>
<tr>
<td>Venezuelan Equine Encephalitis virus</td>
<td>20.96</td>
<td>19</td>
<td>3.67</td>
</tr>
<tr>
<td>Western Equine Encephalitis virus</td>
<td>20.82</td>
<td>20</td>
<td>3.16</td>
</tr>
</tbody>
</table>

**FIGURE 1.** Mean weaponization scores ±1 SD.
Beyond the Dirty Dozen

The medical management of 10 potential diseases and/or agents of biological warfare: anthrax, cholera, plague, tularemia, Q-fever, Venezuelan equine encephalitis, the viral hemorrhagic fevers, botulism, staphylococcal enterotoxin B, and ricin.18 The second edition of the “Blue Book,” published in 1996, added smallpox and the trichothecene mycotoxins; the resulting 12 agents have sometimes been referred to colloquially as “The Dirty Dozen.” Although the number and identity of the agents described in subsequent editions of the Blue Book have changed slightly over time, the requirement (on the part of medical personnel, policy planners, and countermeasure developers) for a discrete and finite list of threat agents, upon which to focus policy, training, and countermeasure development, remains.

To be sure, several such lists already exist. USAMRIID’s “Dirty Dozen” provides a good starting point and is oriented toward a military threat. Additional military medical doctrine expands upon this list: U.S. Army Field Manual 8–28419 details the medical management of approximately two dozen diseases and NATO’s Allied Medical Publication 620 about a dozen-and-a-half.

CDC’s list of “critical agents for public health preparedness” (Table II) addresses the threat from a civilian bioterrorism perspective, as does a similar list prepared by the U.S. National Institute of Allergy and Infectious Diseases (NIAID). The aforementioned “Select Agent List” examines the issue from the perspective of the organism rather than the disease and seeks to control acquisition, possession, use, and transfer of agents listed therein. The “Australia Group” has derived a similar list for purposes of export control. Of note, some authors21 argue that such lists are potentially counterproductive, in that they are “taxonomy-based,” leading to unnecessary restrictions on exports and thereby hampering research and paradoxically increasing societal vulnerability.

Nonetheless, each of these existing lists is inadequate for our purposes of considering potential threats from a military medical perspective. Each exists for specific, often civilian, purposes. Moreover, most lack an evaluative tool with which to examine emerging threats and novel agents.

With that said, other authors have derived evaluative schemata. Casadevall and Pirofski22 reported the development of a relatively simple formula which one might apply to various microbial threat agents:

\[
WP = [V_{BW}SC/T]XD
\]

where WP denotes the “weapon potential,” \( V_{BW} \) denotes the “virulence” (defined by the authors as the fraction of symptomatic individuals among those infected), S denotes “stability,” C denotes the “communicability,” \( T \) is the “time to disease (i.e., incubation period, in days), \( X \) is a “terror modifier,” and \( D \) denotes the “deliverability.”

Although the Casadevall and Pirofski system offers scholarly insight into the factors relevant to microbial weapons potential, its usefulness is hampered by the fact that, in the authors’ own words, “we lack the information to accurately calculate the WP for the overwhelming majority of pathogenic microbes.”

Similarly, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) has developed a methodology23 with which to “rank order microbial hazards.” The USACHPPM methodology, however, is specifically designed for application to hazards of “normal clinical importance” in order to answer the question “how clean is safe?” The hazard probability considerations applicable to the USACHPPM methodology would not be relevant in the event of an intentional attack.

Finally, another NATO scientific working group, Task Group-186, focused their efforts on generic threat assessment and relative risk of biological threat agents and weapons.24 The group examined 15 established threat agents (the original “Dirty Dozen” plus the causative agents of glands,

### TABLE II. CDC’s Critical Agents for Health Preparedness

<table>
<thead>
<tr>
<th>Category A</th>
<th>Category B</th>
<th>Category C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Variola virus</td>
<td>a. C. burnetii</td>
<td>All other biological agents that may emerge as future threats to public health</td>
</tr>
<tr>
<td>2. B. anthracis</td>
<td>b. Brucellae</td>
<td></td>
</tr>
<tr>
<td>3. Y. pestis</td>
<td>c. B. mallei</td>
<td></td>
</tr>
<tr>
<td>4. Botulinum toxin</td>
<td>d. B. pseudomallei</td>
<td></td>
</tr>
<tr>
<td>5. F. tularensis</td>
<td>e. Alphaviruses</td>
<td></td>
</tr>
<tr>
<td>6. Filoviruses and arenaviruses</td>
<td>f. Rickettsia prowazekii</td>
<td></td>
</tr>
<tr>
<td></td>
<td>g. Certain toxins (ricin, staphylococcal enterotoxin B)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>h. Chlamydia psittaci</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. Food safety threat agents (Salmonellae, Escherichia coli O157:H7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>j. Water safety threat agents (Vibrio cholera, etc.)</td>
<td></td>
</tr>
</tbody>
</table>


Category A – Agents with high public health impact requiring intensive public health preparedness and intervention

Category B – Agents with a somewhat lesser need for public health preparedness

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meliodosis, typhus, and brucellosis, omitting that of cholera. Although they considered such agents from the perspective of state-sponsored programs, their focus was on non-state actors. As such, they emphasized a number of agent characteristics, which would be somewhat irrelevant to well-resourced weapons programs. Among these are availability of agent, “identifiability” (how well studied is the agent?), difficulty of culture, and difficulty of isolation (how readily might an organism be “lifted” from culture?). Moreover, they attempted to estimate the “technical probability of use.” We contend, however, that the motivations of non-state actors (i.e., terrorists) are often obscure and difficult to predict, thus rendering “probability” difficult to quantify. In this regard, many would-be terrorists have, in the past, utilized “weapons of opportunity” (i.e., those which were readily available) rather than agents that consensus determines possess more desirable characteristics. Perhaps no incident illustrates this concern more dramatically than previous use, as a “weapon,” of *Ascaris suum*, a porcine pathogen typically considered harmless to humans.  

Given these pitfalls inherent in determining “probability” (and owing to our focus on state-sponsored military weapons programs), we chose instead to examine agents in terms of “suitability” (for weaponization). We envisioned a system that would provide a simple, easy-to-use, unclassified military-oriented descriptive mechanism with which to rapidly evaluate the suitability of emerging and future agents as biological weapon threats. A validation study of this system, however, yielded some quite unexpected results and disagreement among experts (as evidenced by relatively wide SD in their average scores). Much more work is thus needed before this instrument might achieve its maximum potential for NATO medical defense use. Future work might well focus on the weight given to each of our 12 criteria, heretofore given equal weighting factors for these characteristics, we argue that our instrument might achieve its maximum potential for NATO medical defense use. Future work might well focus on the weight given to each of our 12 criteria, heretofore given equal weighting factors for these characteristics, we argue that our 12 “attributes” of a biological weapon.

Finally, although the original intent of this scoring system derived from the need to compare potential agents’ suitability as bioweapons in the context of NATO’s wartime role, the potential exists for such a system to be adapted to meet other needs. With weighting and other minor modifications to the 12 attributive criteria, the tool has the potential to be utilized in civilian bioterrorism threat characterization. Moreover, the tool might also be adapted by any nation or organization to assess risk under unique geographic or environmental conditions. In the end, although, perhaps the greatest value of our study is in reminding us of the extreme difficulties inherent in constructing any meaningful threat list.

**CONCLUSION**

We have developed a tool that uses a simple Likert scale applied to 12 characteristics in order to examine the weaponization potential of various biological agents. In attempting to validate the reproducibility of results obtained by the use of this tool in the hands of NATO biodefense experts, we obtained some surprising results. Although more work is required in order to arrive at meaningful and reproducible weighting factors for these characteristics, we argue that our study’s most important contribution lies in documenting the difficulties inherent in constructing a meaningful threat list.

**REFERENCES**

Beyond the Dirty Dozen