Harnessing innovative technologies for clinical trials involving emerging and re-emerging infectious diseases

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Introduction: The rise of the super-bug

In today’s world, the biodiversity of vital ecosystems is threatened by factors, such as overpopulation, deforestation, mass migrations, war, famine, depletion of natural resources and animal-human interactions. These elements are increasing the sharing of microbial agents and antimicrobial resistance, which can facilitate the emergence of new or previously recognized disease agents.

The damaging effects of antimicrobial resistance are increasingly being seen around the world. This issue recently hit the headlines with an industry declaration on combating antimicrobial resistance at the World Economic Forum in Davos, Switzerland.

Eighty-five biopharma and diagnostic companies signed the Declaration by the Pharmaceutical, Biotechnology and Diagnostics Industries on Combating Antimicrobial Resistance, along with nine industry associations in 18 countries. The signatories call on governments to work with them to develop market structures that provide more dependable and sustainable models for antibiotics, and to commit the funds needed to implement them.

The issue of antimicrobial resistance is nothing new, however. As far back as 1945, Sir Alexander Fleming raised the alarm about potential resistance due to antibiotic misuse, and the first strain of methicillin-resistant Staphylococcus aureus (MRSA) was identified in 1962 in the UK and 1968 in the U.S. While the development of new antibiotics is decreasing, the list of antibiotic resistant microbes is growing. Such “superbugs” include MRSA, vancomycin-resistant Staphylococcus aureus (VRSA); vancomycin-resistant Enterococcus (VRE); multi-drug and extensively drug-resistant tuberculosis (TB); drug-resistant Streptococcus pneumoniae, gonorrhea and malaria; and antibiotic-resistant Salmonella Kentucky. Such pathogens are emerging and spreading more rapidly than in previous decades, and treatment may be hampered by the prohibitive cost of “new generation” agents or by a lack of effective antimicrobial agents.
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Antimicrobial resistance is a worldwide problem, affecting both developed and emerging economies, and spreading rapidly through international travel. Antibiotic-resistant bacteria are estimated to cause 99,000 deaths per year in the U.S. and to cost Euros 1.5bn/year in the European Union. A World Health Organization (WHO) report, “Antimicrobial resistance: global report on surveillance 2014,” concluded that “a post-antibiotic era – in which common infections and minor injuries can kill – far from being an apocalyptic fantasy, is instead a very real possibility for the 21st Century.” The WHO reported that:

- Gonorrhea resistant to third-generation cephalosporins had been confirmed in several countries
- Fluoroquinolone resistant E. coli, which causes urinary tract infections (UTIs), is very widespread
- Resistance to first-line drugs to treat infections caused by Staphylococcus aureus – a common cause of severe infections acquired both in healthcare facilities and in the community – is also widespread
- Resistance to the treatment of last resort for life-threatening infections caused by common intestinal bacteria – carbapenem antibiotics – has spread to all regions of the world.
- In 2012, the WHO reported a gradual increase in resistance to HIV drugs, albeit not reaching critical levels. Since then, further increases in resistance to first-line treatment drugs were reported, which might require using more expensive drugs in the near future.
- In 2013, there were approximately 480,000 new cases of multidrug-resistant tuberculosis (MDR-TB). Extensively drug-resistant tuberculosis (XDR-TB) has been identified in 100 countries. MDR-TB requires treatment courses that are much longer and less effective than those for non-resistant TB.
- In parts of the Greater Mekong sub-region, resistance to the best available treatment for falciparum malaria, artemisinin-based combination therapies (ACTs), has been detected. Spread or emergence of multidrug resistance, including resistance to ACTs, in other regions could jeopardize important recent gains in control of the disease.

**Figure 1: Spread of antibiotic-resistance bacteria (ARB)**
Misuse of antibiotics
In many developing countries, antibiotics are readily available from hospitals, pharmacies, patent medicine stalls, roadside stalls and hawkers. In addition, Internet and mail order pharmacies present an easy and little-regulated way to obtain over-the-counter (OTC) antibiotics. Issues such as substandard quality, sub-therapeutic doses and improper self-medication can contribute to development of antibiotic-resistant bacteria.

Potential future antimicrobial products
Promising sources of future antimicrobials include avian antibodies and ethnopharmacology, the interdisciplinary scientific exploration of biologically active agents traditionally employed or observed by humans.10 Avian antibodies (IgY) hold promise in Pseudomonas aeruginosa infections in cystic fibrosis patients.11 Hens are immunized with Pseudomonas, and the IgY is found in the egg. Patients gargle with a dilute suspension of the egg. These antibodies appear to increase the time between infections and improve lung function. Ethnopharmacology is a source of substances with antimicrobial activity, such as manuka honey, tea tree oil and alicin, derived from garlic. Many valuable existing drugs (such as atropine, ephedrin, digoxin and reserpine) originated from indigenous remedies, and chemists continue to use plant-derived drugs (e.g., morphine, quinidine and emetine) as prototypes to develop more effective and less toxic medicines.

Whole genome sequencing and next generation sequencing of bacteria also have potential in enabling a fuller understanding of microbial genetics, including DNA and RNA analysis. Structural analysis may help in the development of efflux pump inhibitors, which stop bacteria from removing antibiotics from their cells. Auxiliary targets may include inhibition of the waxy coat protein of M. tuberculosis that protects it from many drugs, and targeting of RNA helicase proteins required for proper folding of RNA molecules.12 Virulence factors may also be targeted, for example, eliminating the lipid A component of Gram-negative microorganisms, which is responsible for much of these microbes’ toxicity.13

The “-omics” revolution
The various “-omics” disciplines promise to help in development of future antimicrobials when considering the threat posed by the emergence of previously unknown or uncommon infectious diseases. Diseases caused by pathogenic bacteria that were not previously a cause for concern are now receiving more attention. This is the case for the virulent Escherichia coli strains causing extraintestinal infections (ExPEC, extraintestinal pathogenic E. coli). These bacteria are becoming more involved in a diverse spectrum of diseases, including UTIs, newborn meningitis (NBM), and abdominal sepsis and septicaemia. Combating ExPEC infections is difficult because of the high incidence of drug resistance often transmissible by plasmids.

These “-omics” disciplines include:

- **Genomics**, the study of human genes and their function, which determines patterns in RNA/DNA sequencing and assembly, and analyzes the structure of genomes gene function. This also includes similar analysis of human pathogens such as bacteria, fungi and viruses, and characterization of the microbiome

- **Proteomics**, the large-scale study of proteins, including human tissue and soluble protein biomarker and microbial proteins

- **Pharmacogenomics**, the use of DNA and amino acid sequence data to inform drug development and testing, allowing analysis of genetic variations and the choice of drugs that are most likely to be effective for an individual

- **Functional genomics**, the study of gene products, such as microRNA, messenger RNA, resulting proteins and the role played by the proteins the body’s biochemical processes; this improves understanding of dynamic aspects such as gene transcription (Exomics), regulation of gene expression and protein-protein interactions, potentially enabling improved diagnosis, earlier detection of genetic predispositions and rational drug design

The National Institute of Allergy and Infectious Diseases’ (NIAID) current list of emerging diseases is shown in Panel 1,14 while Panel 2 illustrates relevant Q² Solutions capabilities for addressing these diseases.

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“If we are not careful, we will soon be in a post antibiotic era... and for some patients and some microbes, we are already there!”

–Tom Frieden, director, CDC
Panel 1: NIAID emerging disease list 2016

**Category A:** Priority pathogens, defined as those organisms/biological agents that pose the highest risk to national security and public health because they can be easily disseminated or transmitted from person to person; result in high mortality rates and have the potential for major public health impact; might cause public panic and social disruption; and require special action for public health preparedness. In this category are:

- *Bacillus anthracis* (anthrax)
- *Clostridium botulinum* toxin (botulism)
- *Yersinia pestis* (plague)
- *Variola major* (smallpox) and other related pox viruses
- *Francisella tularensis* (tularemia)
- Viral haemorrhagic fevers
  - Arenaviruses (Junin, Machupo, Guanarito, Chapare, Lassa, Lujo)
  - Bunyaviruses
  - Hantaviruses causing Hanta Pulmonary syndrome, Rift Valley Fever, Crimean Congo
  - Flaviviruses: Dengue
  - Filoviruses: Ebola and Marburg

**Category B:** The second highest priority organisms/biological agents, which are moderately easy to disseminate; result in moderate morbidity rates and low mortality rates; and require specific enhancements for diagnostic capacity and enhanced disease surveillance. In this category are:

- *Ricin toxin* (*Ricinus communis*)
- *Typhus fever* (*Rickettsia prowazekii*)
- Food- and waterborne-pathogens
- Mosquito-borne encephalitis viruses

**Category C:** The third highest priority includes emerging pathogens that could be engineered for mass dissemination in the future because of availability, ease of production and dissemination, and potential for high morbidity and mortality rates and major health impact. This category includes:

- TB
- SARS
- Antimicrobial-resistant infections

Panel 2: Q² Solutions capabilities

- **Tailored solutions.** Q² Solutions delivers end-to-end laboratory services, from biomarker discovery and assay development, central laboratory, through precision medicine solutions and companion diagnostics development.
- **Delivery excellence.** Q² Solutions enhances the drug, medical device and diagnostic development process, with global reach that provides superior customer access and an industry-leading footprint.
- **Shaping outcomes.** We use advanced methods and technologies to help customers turn clear insights into confident decisions.

Q² Solutions capabilities applicable to infectious diseases include:

- **Extensive Laboratory Network**  
  - Europe (UK), North America (USA), South America (Brazil, Argentina), Asia-Pacific (China, India, Japan, Singapore) and South Africa
- **Microbiology**  
  - Isolation and identification using manual or automated methods  
  - Susceptibility testing (disc diffusion, E-test or broth dilution)
- **Mycobacteriology**  
  - Isolation and identification using manual or automated methods  
  - Genotyping and drug resistance
- **Serology and Immunology**
- **Viral load testing**
- **Vaccine testing**
- **Nucleic acid amplification tests (NAAT)**  
  - Polymerase chain reaction (PCR) and reverse transcription PCR (RT-PCR)  
  - Next Generation Sequencing/RNA Sequencing
- **DNA and RNA extraction**  
  - Genomic studies
Several case studies are discussed below, involving resistant staph infections, TB and Ebola.

Case study: Community acquired MRSA in Pakistan

A small study was carried out at the Shaukat Khanum Memorial Cancer hospital in Lahore, Pakistan. The study looked at cases of MRSA and methicillin-sensitive *Staphylococcus aureus* (MSSA), finding that 13 out of 126 samples testing positive showed that the MRSA had been acquired in the community, with six of these individuals having taken non-prescribed antibiotics (Figure 2). This represents methicillin resistance in around 10 percent of patients with community-acquired *Staphylococcus aureus* treated at this institution. Community-associated MRSA strain USA300 nearly always carries genes for the Panton-Valentine leukocidin (PVL) and the staphylococcal cassette chromosome mec (SCCmec) type IV; this became the predominant strain type of MRSA circulating in the United States by 2011. Soon after it began spreading in the community, USA300 became a common cause of infections in the healthcare setting as well, blurring the epidemiologic distinction between community-associated (CA-MRSA) and healthcare-associated MRSA (HA-MRSA).

Today, CA-MRSA is increasing worldwide, including in young, otherwise healthy patients with no recent hospitalizations. CA-MRSA predominantly causes skin and soft tissue infections, posing the greatest risk to people who are frequently in crowded places, those with weak immune systems, those living or working in a healthcare facility for an extended period of time, food handlers, veterinarians and pet owners, and those who have had prior antibiotic therapy.

Spread of staph infections can be reduced by improved hygiene, including frequent washing; keeping cuts, scrapes, and wounds clean and covered until healed; and avoiding sharing personal items such as towels and razors. There is a need for improved education on the correct use of antibiotics, and for screening and reporting procedures to be put in place at clinics.

Case study: TB studies in South Africa

For studies of potential TB therapies, the primary clinical outcome is typically driven by laboratory results. From the laboratory perspective, such studies pose several challenges, including the need to:

- Ensure the standardization and quality control of highly technical and time-consuming assays;
- Navigate issues related to trial logistics, data management, proposal development, study set-up, and biosafety requirements; and
- Contend with the rising prevalence of multidrug-resistant strains (requiring more advanced assays with shorter turnaround time) and strategies involving TB-HIV co-infection.

### Table 1: Case study of MSSA and MRSA in Pakistan

<table>
<thead>
<tr>
<th></th>
<th>MSSA</th>
<th>MRSA</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td>Hospital</td>
<td>120</td>
<td>74.1</td>
<td>42</td>
</tr>
<tr>
<td>Community</td>
<td>113</td>
<td>89.7</td>
<td>13*</td>
</tr>
<tr>
<td>Total</td>
<td>233</td>
<td>80.9</td>
<td>55</td>
</tr>
</tbody>
</table>

The Fisher exact test statistic value is 0.000827. The result is significant at p < 0.05 (* 6 (46%) had evidence of non-prescribed antibiotic therapy. Source: Mortlock S. ‘Suspected Community Acquired MRSA at a Cancer Hospital in Pakistan.’ Scholars Journal of Applied Medical Sciences (2014); 2: 3293-3296

The CA-MRSA was usually USA300, while HA-MRSA were distributed across several strains (Figure 3).

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**Figure 2:** Case study of MSSA and MRSA in Pakistan

<table>
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<tr>
<th></th>
<th>MSSA</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
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The CA-MRSA was usually USA300, while HA-MRSA were distributed across several strains (Figure 3).

**Figure 3:** Case study MRSA: PFGE results of isolates

<table>
<thead>
<tr>
<th></th>
<th>USA 100</th>
<th>USA 200</th>
<th>USA 300</th>
<th>USA 400</th>
<th>USA 600</th>
<th>USA 800</th>
<th>Unique</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA-MRSA</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HA-MRSA</td>
<td>21</td>
<td>3</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>3</td>
<td>21</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

The Chi-square test statistic value is 13.489. The result is not significant at p < 0.05. Source: Mortlock S. ‘Suspected Community Acquired MRSA at a Cancer Hospital in Pakistan.’ Scholars Journal of Applied Medical Sciences (2014); 2: 3293-3296

For studies of potential TB therapies, the primary clinical outcome is typically driven by laboratory results. From the laboratory perspective, such studies pose several challenges, including the need to:

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**Case study:** TB studies in South Africa

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**Case study:** Tuberculosis (TB) in South Africa

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**Case study:** Spread of MRSA in South Africa

For studies of potential MRSA therapies, the primary clinical outcome is typically driven by laboratory results. From the laboratory perspective, such studies pose several challenges, including the need to:

- Ensure the standardization and quality control of highly technical and time-consuming assays;
- Navigate issues related to trial logistics, data management, proposal development, study set-up, and biosafety requirements; and
- Contend with the rising prevalence of multidrug-resistant strains (requiring more advanced assays with shorter turnaround time) and strategies involving MRSA-HIV co-infection.

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**Case study:** Ebola in South Africa

For studies of potential Ebola therapies, the primary clinical outcome is typically driven by laboratory results. From the laboratory perspective, such studies pose several challenges, including the need to:

- Ensure the standardization and quality control of highly technical and time-consuming assays;
- Navigate issues related to trial logistics, data management, proposal development, study set-up, and biosafety requirements; and
- Contend with the rising prevalence of multidrug-resistant strains (requiring more advanced assays with shorter turnaround time) and strategies involving Ebola-HIV co-infection.
Panel 3: The Q² Solutions focus on TB testing

- All TB-related testing takes place in a single facility
- State-of-the-art biosafety measures are used with absolute redundancy (there are two fully operational rooms, so that a back-up is always available)
- Extensive validation and quality control of research-based client-specific assays; one example is a quantitative colony forming unit (CFU) TB culture from sputum (plate based).

When a local laboratory is required that is geographically close to trial participants to enable rapid access to results, this can complicate clinical trial management and sponsor oversight (Figure 4).

If multiple local laboratories are employed, considerable complexity in logistics and data collection can result (Figure 5). The bigger the trial, the more complex the situation can become (Figure 6).

Figure 4: When a local laboratory is required

Complicates clinical trial management and sponsor oversight
Figure 5: Local laboratory data management

Significant burden on Clinical Research Associates (CRAs), sites and sponsors

Sponsors and CROs spend disproportionately on local lab data – contracting entire teams

Cost multiplies as complexity grows:
• x # of regions
• x # of patients
• x # of local labs
• x # of analytes

Figure 6: Challenges amplified by trial size

Sponsor burden, cost grows with trial complexity, size
To minimize this complexity, Q2 Solutions has implemented a solution where the company manages the data on behalf of the sponsor, taking charge of vendor management and reducing the need for sponsor oversight. Q2 Solutions works with the local laboratories so that data is sent to a central repository within Q2 Solutions (Figures 8 and 9). Here, consistency is checked, and the data is uploaded. The fact that site staff no longer have to enter data manually reduces the site burden, and the CRA can focus on protocol compliance. Laboratory-trained personnel are used to handle the data, which is available to the sponsor within a couple of hours of being entered.

**Figure 7: Local laboratory issues**

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Situation</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vendor Management</strong></td>
<td>• Each investigator site uses a different lab (and possibly more than one)</td>
<td>• Requires additional staff to oversee hundreds of labs in addition to sites</td>
</tr>
<tr>
<td></td>
<td>• Large global studies may use several hundred local labs</td>
<td>• Translation of local lab results and reference ranges is difficult</td>
</tr>
<tr>
<td></td>
<td>• Reference ranges and units are gathered separately from results</td>
<td>• Testing methodologies are inconsistent globally</td>
</tr>
<tr>
<td><strong>Site personnel and CRA time</strong></td>
<td>• Site personnel must enter lab results into the database or CRF</td>
<td>• Increased burden on sites and CRAs</td>
</tr>
<tr>
<td></td>
<td>• CRAs required to follow up on ranges &amp; unit updates</td>
<td></td>
</tr>
<tr>
<td><strong>Data consistency</strong></td>
<td>• Site personnel may not have lab/scientific knowledge; not trained to catch errors</td>
<td>• Results inaccurate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Additional queries, delays in data lock</td>
</tr>
</tbody>
</table>

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**Figure 8: Q² Solutions local laboratory data solution**

Simplifies transmission for site, reduces variances and hassles
Panel 4: Q² Solutions: leading transformational change

In addition to our dedication to patients, we’re also dedicated to helping our customers mitigate risks that might otherwise keep them from pursuing the development of innovative therapies. Here’s how we’re doing it:

**Portfolio risk:** We help manage portfolio risk by investing our own financial resources in our customers’ programs, as well as finding and managing interested capital partners. Optimizing pipeline value with innovative alliances limits your exposure to portfolio or product risk.

**Operational risk:** By focusing our integrated expertise on your business challenges, we help limit operational risk. Aligning our intellectual capital with your goal reduces variability, timelines, cost, oversight — and your exposure.

**Resource risk:** We invest our human capital to help reduce your resource risk. With thousands of experts across the therapeutic spectrum working in integrated teams, we can function in tandem with you — or assume full functional resourcing responsibilities — to optimize drug development and drive commercial success. The result? Leveraging our human capital for flexible staffing of your variable needs reduces fixed costs.

Our approach focuses on ways to circumscribe, share, rebalance and hedge these drug development risks in order to transform cost and productivity. You benefit by having a partner with the resources and experience necessary to find solutions to your complex problems.
Case study: Tools to assess immunogenicity in the human Ebola vaccine trials

The recent African Ebola outbreak in March 2014 to October 2015 had its epicenter in Sierra Leone, Guinea and Liberia (Figure 10). There were some 28,600 cases, with 11,300 deaths (Figure 11), with relatively few cases outside of the epicenter (Figure 12).

Figure 10: Epicenter of the Ebola outbreak

March 2014 to October 2015

Figure 11: Ebola cases

Cases per CDC – October 27, 2015

<table>
<thead>
<tr>
<th>Countries</th>
<th>Total cases (suspected, confirmed)</th>
<th>Laboratory confirmed</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinea</td>
<td>3,804</td>
<td>3,351</td>
<td>2,536</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>14,122</td>
<td>8,704</td>
<td>3,955</td>
</tr>
<tr>
<td>Liberia</td>
<td>10,675</td>
<td>3,160</td>
<td>4,809</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28,601</strong></td>
<td><strong>15,215</strong></td>
<td><strong>11,300</strong></td>
</tr>
</tbody>
</table>

Vaccines are at the forefront of efforts to prevent future Ebola outbreaks, with approximately 15 vaccine candidates being tested in North America, Europe, Russia and China. These are funded by the U.S. government, the European Union, Denmark, the Gates Foundation and the WHO. The most advanced vaccine candidates are being developed by Merck/NewLink Genetics, Johnson & Johnson and Crucell NV, GlaxoSmithKline and Novavax.

Key Ebola vaccine trials being carried out in the endemic zone include:

• A Liberia-U.S. clinical research partnership, PREVAIL, which is studying people in Liberia who have survived Ebola virus disease within the past two years. The goal is to better understand the long-term health consequences of Ebola, determine if survivors develop immunity that will protect them from future Ebola infection, and assess whether previously infected individuals can transmit infection to close contacts and sexual partners. The study, sponsored by the Ministry of Health of Liberia and the NIAID, is taking place at various sites in Liberia and is expected to enroll approximately 7,500 people, including 1,500 people of any age who survived Ebola and 6,000 of their close contacts.

• A ring vaccination trial in Guinea of a Canadian-developed Ebola vaccine, which showed that the vaccine was 100 percent effective in people who received it soon after possible exposure. The vaccine, called rVSV-EBOV, is based on an Ebola protein spliced into a vesicular stomatitis virus (VSV). It was developed in Canada and is licensed by NewLink Genetics and Merck.
• The Sierra Leone Trial to Introduce a Vaccine against Ebola (STRIVE), which is a candidate Ebola vaccine trial organized jointly by the College of Medicine and Allied Health Sciences (COMAHS), University of Sierra Leone, the Sierra Leone Ministry of Health and Sanitation (MoHS), and the U.S. CDC. This is a combined Phase II and Phase III trial to assess the safety and efficacy of the rVSV-ZEBOV candidate Ebola vaccine.

Additional studies outside of the outbreak’s epicenter include trials at some eight African sites, multiple U.S. sites (Phase I and II) and multiple European sites (Phase I and II).

A current challenge for all these trials is that now that the outbreak is over, vaccine efficacy – which was the primary endpoint for all trials in the endemic zone – is no longer a measurable endpoint. The immunogenicity assessment of each vaccine candidate was also included in all trials. The probable route forward for vaccine licensure will be to apply the Animal Rule, demonstrating correlation of immunity in non-human primates (NHP) via the immunogenicity data and viral challenge, and then correlating human and NHP immunogenicity. The immunogenicity data and establishment of correlates of immunity now are primary endpoints for vaccine licensure.

Immunogenicity tools
Tools for measuring immunogenicity of Ebola vaccine candidates include:

• Immunoassays to assess immunoglobulin titers to the glycoprotein (GP)
• Viral neutralization assays to assess antibody function
  – Ebola/filoviruses are biosafety level 4 (BSL-4) agents, meaning that there is only limited, low throughput testing capacity for large volume Phase III studies, and alternative, non-wild type (WT) virus technology is required
• Standardized assay platforms, as examined by the WHO Collaborative Study to Assess the Suitability of an Interim Standard for Antibodies to Ebola Virus, from the WHO Expert Committee on Biological Standardization. Issued in October 2015, this involved 17 laboratories and sets an interim standard (convalescent plasma).

Looking ahead, immunogenicity assessment for Ebola vaccines will include both immunoassay (ELISA) and functional (viral neutralization) antibody assessment. National (U.S. Army Research Institute of Infectious Diseases [USAMRIID]/Joint Vaccine Acquisition Program [JVAP]) and International (WHO/UK National Institute for Biological Standards and Control [NIBSC]) efforts are ongoing to standardize assays used for the multiple vaccine candidates. At present, the Filovirus Animal Non-clinical Group (Fang) ELISA is a leading candidate for a standardized ELISA. Viral neutralization has several non-WT options available.

Conclusion
Emerging diseases and antibiotic resistance place a considerable burden on healthcare systems around the world. Experts predict that it is just a matter of time until the next pandemic occurs. Long-term strategies are needed to strengthen infectious disease surveillance and response programs; integrate new technologies to create quantitative, predictive models of infectious disease; develop new anti-infective agents; and educate patients and healthcare providers about appropriate antibiotic use.
About the authors

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Dr. Pany is currently the Medical Laboratory Director, South Africa. His broad responsibilities include both administrative and technical management of the laboratory and its employees. He also oversees Developmental activities for TB and microbiology at Q² Solutions. Dr. Pany started with Quintiles Clinical Trials Laboratory Mumbai as Manager – Medical Laboratory, in charge of the setting up and operation of bacteriology/molecular biology and mycobacteriology laboratories at Mumbai and Centurion facilities, respectively. Dr. Pany has an MD in microbiology from Bangalore Medical College and Research Institute and an MBBS from MKCG Medical College, Berhampur, Odisha. With more than 15 years of experience in the medical field in various capacities – scientist, academician, clinician and surgeon – his areas of special interest are clinical trials, laboratory management, research science, biosafety, assay development and diagnostics. He has experience as a Research Scientist and coordinator for R&D services at R&D Division (advanced genomics, proteomics and molecular biology), Super Religare Laboratories Ltd., Mumbai, and as Lecturer, Mycobacteriology Section, Department of Microbiology, St. John’s National Academy of Health Sciences, Bangalore. He has presented and published original research and reviews in reputed conferences and journals. Dr. Pany also served as a College of American Pathologists (CAP) inspector in the fields of microbiology, immunology and molecular biology.

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Sorika van Niekerk is senior director of laboratory operations for Sub-Saharan Africa with a special interest and specific strategy to increase the infectious disease footprint for the laboratory. Sorika joined the clinical research industry in 1999 as a junior CRA. Throughout her years as a CRA, clinical team lead and clinical trial manager, she was involved in various studies including several Phase III flu vaccine trials, specifically focused on pediatrics and geriatrics. Her experience in monitoring Phase II and III trials covers a variety of therapeutic areas, including ophthalmology, infectious diseases as well as in the respiratory field. Sorika has held many leadership positions at Quintiles throughout her career including her role as executive director within Quintiles’ Clinical Operations organization, overseeing all clinical functions for Sub-Saharan Africa. Sorika has a Master of Science degree specializing in medical microbiology.

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