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Diagnostic Medicine: Low Resource Environments

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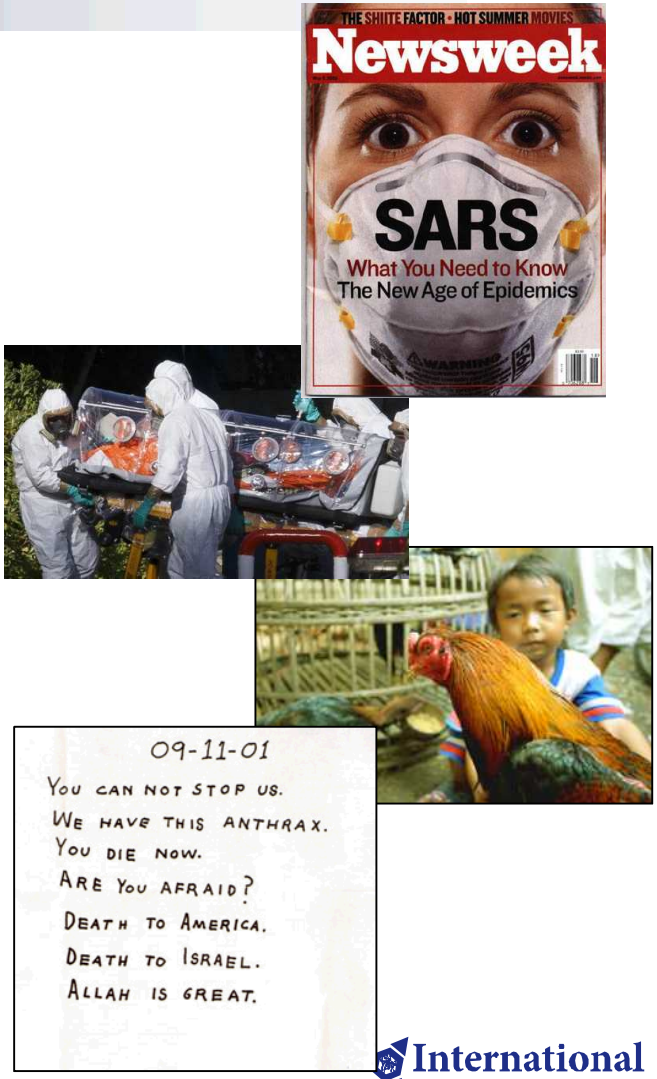
International BIOLOGICAL THREAT REDUCTION

Why Do We Need Diagnostic Medicine?

- **Diagnostic medical tests are needed to help diagnose diseases**
  - Communicable diseases spread from one person to another or from an animal to a person
    - **Infectious Diseases that are caused by viruses, bacteria, fungi, yeast, and parasites**
  - Non-Communicable diseases are chronic diseases that are not spread from person to person
    - **The four primary non-communicable diseases are cancer, diabetes, heart disease, and stroke**

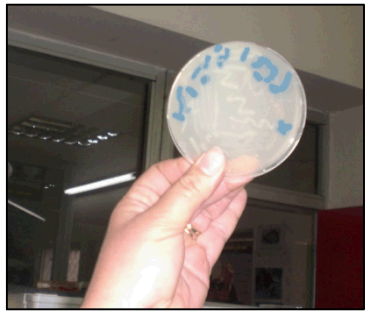
Communicable Diseases: The Biological Threat

- **Biological threats are ubiquitous worldwide and exist largely because of our inability to eliminate/control naturally occurring infectious diseases**
- **Biological threats include:**
  - Naturally occurring outbreaks of common infectious diseases
  - Naturally occurring outbreaks of emerging infectious diseases
  - Naturally occurring outbreaks of re-emerging infectious diseases
  - Intentional dissemination of infectious organisms that result in an outbreak



Mitigating the Biological Threat

- **Mitigation of the biological threat is enormous**
  - Worldwide, infectious diseases are the leading cause of death of children and adolescents, and one of the leading causes in adults
- **Mitigation strategies are multifactorial**
  - Controlling infectious diseases (natural and intentional):
    - **Early detection: astute clinicians, biosurveillance, accurate and rapid diagnostic tools**
    - **Prevention: vaccinations, quarantine, nutrition and healthy life style, strong immune system, and prevention of bioterrorism**
    - **Control: antimicrobials against viruses, bacteria, fungi, yeast, parasites, and strong health care systems**



Early Detection of Infectious Diseases: Diagnostic Testing Low Resource Environments

- **Early Detection is largely the responsibility of public and animal health care workers and laboratory diagnosticians to diagnose infectious diseases**
  - Clinical signs can be ambiguous, and therefore diagnostic testing is required to confirm the diagnosis
    - **Differentiate infectious from non-infectious diseases**
    - **Identify the organism causing the infection**
    - **Determine the most appropriate method of treatment**
  - Diagnostic medicine is a rapidly growing field with the emergence of highly pathogenic avian influenza, the re-emergence of Ebola virus in western Africa, and the anthrax attacks of 2001
    - **Sophisticated tools are available in many regions of the world that can rapidly and accurately determine a diagnosis**
    - **Severe diagnostic challenges exist in low resource enviroments**

Afghanistan

- **Afghanistan is country that has been troubled by conflict for decades**
- **Health and animal health infrastructure is severely limited by expertise and lack of infrastructure**
- **Anthrax, among other diseases, is a significant problem in animals and humans**
  - Diagnostic challenge because of limited clinical expertise and laboratory methods for diagnosis
  - Laboratory biosafety and biosecurity issues

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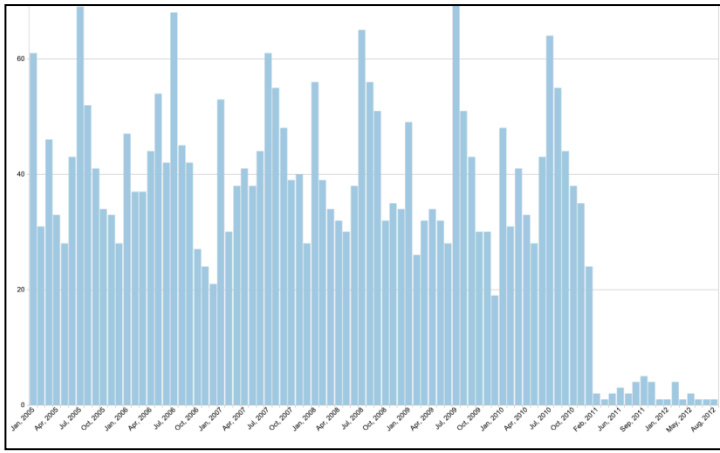
Tool to Detect Anthrax in Low Resource Environments

- **Requires a device that is easy to use, cost effective, accurate, requires limited infrastructure, and promotes laboratory safety and security**
- **Laboratory staff and stakeholders may be convinced that the gold standard is the only option**

Bacillus anthracis Detection Requirements

- **Between 2005 - 2012, 3057 *B. anthracis* outbreaks were reported**
- **Testing ensures infected animals do not enter the food supply and human exposure is limited**
  - Gold standard is isolation/culture
    - **Isolation/culture is costly, dangerous, and potentially creates a repository of *B. anthracis* that is stored at a given facility**
  - PCR is not widely used
- **A device that provides a sensitive diagnostic assay that is self-contained, self-sterilizing, easy to use, inexpensive, and limits reliance on isolation/culture**
  - Supports biosafety and biosecurity



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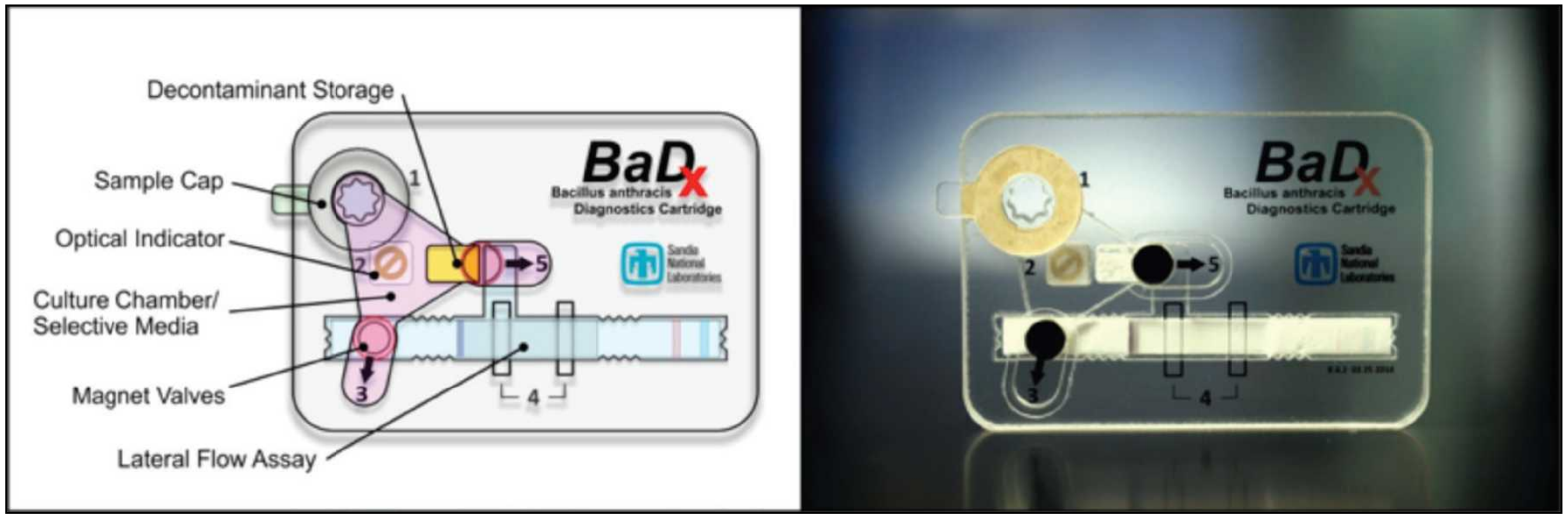
International BIOLOGICAL THREAT REDUCTION

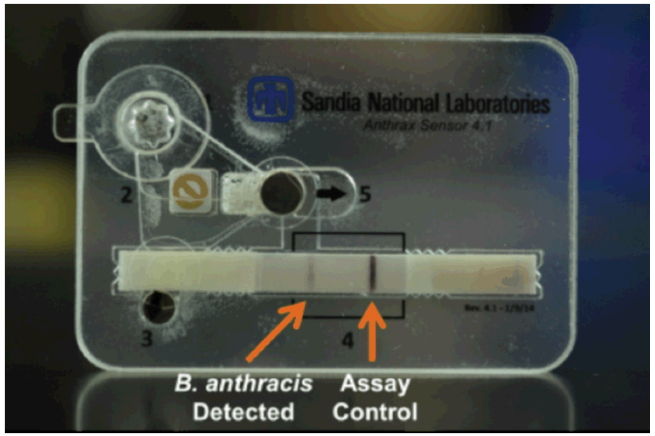
Tool to Detect Anthrax in Low Resource Environments

- **Requires a device that is easy to use, cost effective, accurate, and safe**
- **Laboratory staff and stakeholders may be convinced that the gold standard is the only option**
  - As was the case in Afghanistan
- **Development of BaDx**



BaDx Applications

- BaDx has been tested in a laboratory environment and promising results have been obtained
- Next step is validation by a diagnostic laboratory using real diagnostic samples
- Has the potential to provide low resource environments with a sensitive, cost-effective tool that can be used with limited infrastructure



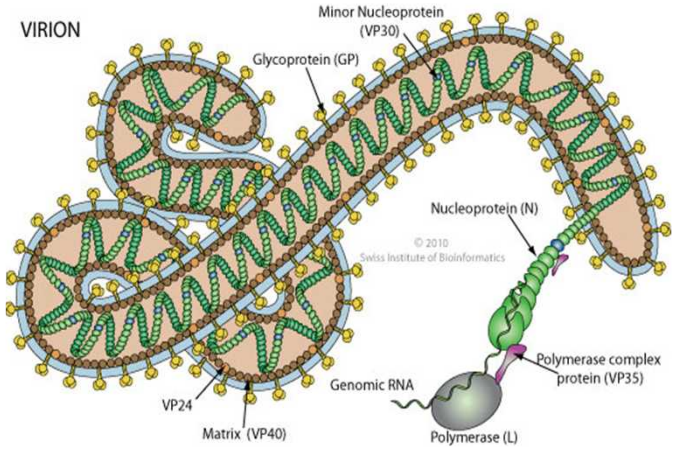
Applications of the Platform

- **Microculture chamber allows for cultivation of other bacterial pathogens**
  - Enteric pathogens
  - Pulmonary and skin pathogens
  - Food safety

- **Applications for viruses?**
  - Viral pathogens of humans and animals require a mammalian cell line for propagation
  - Propagation of cell lines requires a controlled laboratory environment for growth
  - Could have laboratory uses

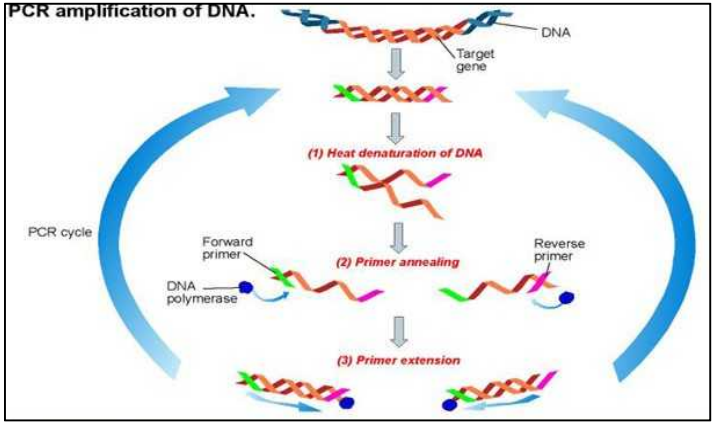
Ebola Applications?

- **Ebola virus is in a group of viruses that cause hemorrhagic fevers**
- **Ebola virus is an enveloped virus**
  - The envelop makes if very sensitive to drying, degradation, and disinfectants
- **Ebola virus survives in an animal reservoir**
  - Fruit bat
  - Primates

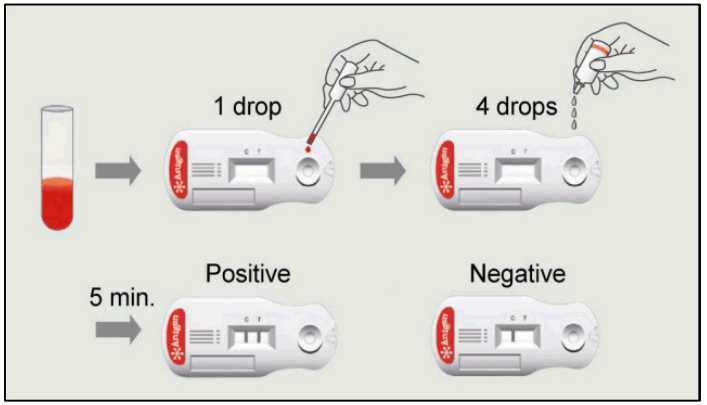


Ebola Virus Diagnostic Testing

- **Currently use polymerase chain reaction assays (PCR)**
  - PCR is standardized and optimized by the World Health Organization
    - **PCR is rapid and reliable**
    - **PCR is safer than virus isolation because the virus is inactivated prior to starting the testing**



- **Antibody based testing**
  - Enzyme Linked Immunosorbent Assay (ELISA)
    - **Antigen and detection**
  - Rapid assays for bedside diagnosis



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Questions?

Engagement of Women in Afghanistan

- **Moore, et. al. (2013) applied opinion dynamics to social networks to model how opinions related to international forces evolved in a community, and investigated how engagement teams of men or women interacted with gender networks**
  - Women's networks are far more robust than men's networks, and when a female engagement team member interacted with another women, that one Afghan woman could influence the entire women's network
    - **Those women would subsequently influence the opinion of their husbands**
  - They found that the influence of the male engagement teams were not as robust, and men's interactions were limited
  - Men did not interact in the same fashion, did not have as robust of networks, and did not have the same influence over opinions
- **Apply this concept to animal health and agriculture in Afghanistan and other low-resource environments**

Veterinary Medicine in Low-Resource Environments

- **Veterinary services are weak or inadequate**
  - Especially true in Afghanistan
- **Veterinary care is typically limited to livestock and working animals**
  - Large and small ruminants
    - **Sheep and goat flocks/herds predominate**
  - Poultry
  - Donkeys, and horses
- **Dogs may require care if used as working animals**
- **Focus should be on improving animal production**
  - Extension
  - Establishing herd health programs
    - **Disease prevention, reproduction, nutrition**

Livestock in Low-Resource Environments

- **Livestock provide food security, economic development, socio-economic status, and utility for work and sport**
- **In developing regions, livestock contribute approximately one-third of total agricultural output**
  - In Afghanistan, approximately 80% of families rely on livestock for food and/or income and agriculture contributes to one-half of GDP
  - 45 and 25 percent or the world's poor livestock keepers reside in South Asia and Africa, respectively ***(FAO 2011)***
- **Livestock are kept as individual animals or as small or large flocks/herds**
  - Nomadic pastoralists in exist in many regions and comprise a large fraction of the livestock sector; the Kuchis reside in Afghanistan and Pakistan
- **Food and Agriculture Organization for the UN (FAO) anticipates that the demand for animal source food (ASF) will increase**

Benefits of Improving Animal Health

- **Improved animal health, well-being, and nutritional status will increase production capabilities and quantities, and economic returns**
  - Increased milk and egg production
  - Increased weight gain improves meat production
  - Enhanced food safety
- **Increased food supply and opportunities for economic development will improve public health and well being**
- **Elimination of specific livestock pathogens will allow countries to resume international trade, and will reduce zoonotic diseases**

Egypt – Dairy Directive Project (DDP)

PROMOTING IMPROVEMENTS IN THE DAIRY SECTOR TO PREVENT CHILD MALNUTRITION & ILLNESSES

From 2001 to 2004, ACDI/VOCA's Dairy Directive Project (DDP) worked throughout Egypt to prevent child malnutrition and the illnesses associated with contaminated and spoiled dairy products by promoting improvements in the dairy sector.

Women in Livestock Rearing

- **Women significantly contribute to livestock production in low-resource environments**
- **Women are largely responsible for raising sheep, goats, poultry, and caring for and milking milk producing animals including cattle**
- **FAO reported that in some rural livestock based economies, women comprise two-thirds (400 million) of the low-income livestock keepers**
- **Women's roles differ because of different economic, social, cultural, and even religious contexts**
  - In Afghanistan women care for animals in the small farm setting, the larger herds/flocks are cared for by men

Gender Inequalities in Agriculture: Challenges Faced by Women

- **Women farmers are less productive, own fewer livestock units, and generate less income**
- **FAO found that women have less access to:**
  - Natural resources for animal housing, grazing, and water
  - Extension services to help improve livestock health and management
  - Fewer marketing opportunities
  - Limited financial services with less credit
  - Unable to make important herd decisions
  - ***Veterinary services***
- **These challenges limit women's success in the livestock sector when compared to men**

Veterinary Access and Gender Inequalities in Livestock Sectors and Veterinary Medicine

- **Men and women are unable to interact freely**
  - Male veterinarians are unable to communicate with women regarding animal health
  - Women livestock holders have limited access to veterinary advise when veterinary services are dominated by men
  - Women have limited resources to obtain relevant husbandry information and/or training because most resources are male
- **Few women to help reduce the gender gap by providing support to women**
  - Based region, women have less access to educational opportunities than men in low resource environments
  - Women, are therefore, are under represented in the veterinary profession

Impact of Closing the Gender Gap in Livestock Rearing

- **Closing the gender gap would help promote economic development and enhance food security**
  - Improvement of nutritional status positively impacts communities: childhood development, resistance to infectious diseases, and increased work output
- **Creating equality between men and women in would increase agricultural output by 2.5 – 4 percent, resulting in 12 – 17 percent fewer undernourished (FAO 2013)**
  - One billion extremely poor people living in rural areas depend directly or indirectly on agriculture for livelihoods
- **Livestock contribute to one-third of total agricultural output**
  - Important in South Asia and Sub-Saharan Africa

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Using Women Veterinary Professionals to Close the Gender Gap in Afghanistan

- **Empowerment of women veterinary or animal health professionals to provide sustained support to women farmers**
  - Provide women veterinary professionals with advanced training emphasizing extension services
  - Invest in women in higher education
  - Develop incentives for women to join veterinary field
- **Develop women community animal health workers**
- **Women veterinary professionals can provide:**
  - Extension services
  - Improvement of animal health and development of herd health program
    - **Enhance animal production, and therefore, increase marketing opportunities**
    - **Higher financial gains**
    - **Increase economic resources**
    - **Economic development would help women improve herds and/or flocks**

Potential Impact of Engaging Women and Closing the Gender Gap in Afghanistan

- **Perception of Western forces might improve if women veterinary professionals engage women livestock owners and provide services that improve production**
  - Models of the social networks show that women may have more influence than men in influencing community perceptions
  - Improved perception may result fewer sympathizers
- **Women livestock owners/caretakers will have access to services, which improve animal health and production**
  - Improved production results in higher yield, meat, milk, eggs
  - Families will have food security, suffer less malnourishment, and have a source of income making them less vulnerable to coercion by the insurgency
- **Production increases at the community, district and provincial levels**
  - Communities with food security are more productive, and may therefore, be more stable
- **Potential to improve public health through promotion of food safety and reduction of zoonoses**

Summary

- **Engaging women in agriculture in Afghanistan could have many positive outcomes**
- **Positively influence the perception of western forces through social networks**
- **Reduce sympathizers to the insurgency through economic development**
- **Reduce vulnerability to coercion through provision of food security**
  - Food security is critical in conflict situations
    - **Media reports indicate that religious leaders have instructed people to consume dogs to prevent malnourishment**