



The Bill and Melinda Gates Foundation-Sponsored Workshop on

ACCELERATING BTB CONTROL IN
DEVELOPING COUNTRIES

8-10 December 2015 • Rabat, Morocco

After Action Report



The University of Georgia®



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Executive Summary

The workshop on Accelerating bTB Control in Developing Countries, held on 8-10 December 2015 in Rabat, Morocco, brought together veterinarians, epidemiologists, and other bovine tuberculosis (bTB) specialists from 16 countries. The three-day intensive workshop explored the many challenges and opportunities for controlling bTB in humans, livestock, and wildlife. Prompting participants to think creatively about the many issues related to bTB, the Global Knowledge Initiative (GKI) designed a hands-on, interactive, and iterative two-day experience, guided by the leadership of a planning committee.

Among the guiding objectives of day 1, workshop planners sought to build a shared knowledge base among the nearly 40 participants in attendance whose dominance in the field of bTB is illustrated by the fact that approximately 50% of the academic publications on the topic were produced, in part, by them. Kicking off day 1, seven expert presentations covered a range of key topics. Presenters delivered facts, figures, anecdotes, and personal experiences that provoked lively discussion and thoughtful insights on vaccines and diagnostics, zoonotic impact, bTB control efforts that have worked to date, historical overview / OIE perspective, wildlife implications, the Africa perspective, and the India and China perspectives.

Listening intently to these presentations, participants recorded their top questions and top ideas pertinent to each, resulting in 175 insights and 154 questions. Through a facilitated exercise, groups engaged directly with the insight/question clusters in a round-robin exercise geared toward enhancing the robustness of the knowledge base that the presentations offered. Invited to then vote upon the top questions and ideas deemed most critical to addressing each topic area, a number of areas emerged that guided priority setting. These insights are further detailed in the section titled “Idea Sorting” on pp.9-13.

After completing this exercise, those questions / ideas with the greatest number of votes served as a springboard for the next workshop activity: Challenge Mapping. Ready and eager to use this new design thinking tool, participants formed two groups in which they dissected the key bTB control challenges to better understand both bottlenecks to action and rationales for pursuing solutions. In total, the participants ideated an enormous 155 related challenges, or “sub-challenges”, which are all listed in Annex III on pp.37-42. Taking the group to the end of workshop Day 1, the Challenge Mapping exercise (detailed on pp. 14-17) pushed participants to uncover not only the many pieces of the complex bTB puzzle, but also how those many pieces fit together. The activity highlighted several actionable steps forward. To end the day, participants voted on the top six key challenges most crucial for controlling bTB in developing countries:

1. How might we understand the impact and risk pathways of TB?
2. How might we produce advocacy tools, including economic and social evidence?

3. How might we use market-based incentives for bTB control?
4. How might we get human and animal health authorities interested in developing / sharing / using accurate prevalence estimates of TB?
5. How might we determine the level of vaccine efficacy and efficiency experimentally and in the field to control the spread of TB?
6. How met we set standards and ensure access to tools?

Day 2 commenced with a focus on the top 6 challenges, parsing participants into one working group per challenge. Within these small groups participants turned their attention to the many resources needed to tackle those challenges. The GKI team expanded participants' view of resources, using the "[THICK Methodology](#)" to prompt participants to identify and categorize resources such as Technologies, Human resources, Institutions / Infrastructure, Communication, and Knowledge into two buckets: "Haves" and "Needs." Using a GKI systems design tool called a Network Ecosystem Diagram (discussed in further detail on p. 19), teams identified a total of 276 resources, 193 of which were still needed, or not yet obtained. As groups visited one another's Network Ecosystem Diagrams, they had the opportunity to offer resources on behalf of themselves or their organizations. The participants offered a grand total of 109 resources, demonstrating the amazing ability of this small, but powerful network, to tackle the major challenges to bTB control in developing countries.

With a solid sense of the resources both available and needed to solve their focal challenge, each group began to think of the other components needed to build a strategy for action: activities, actors, and outputs/outcomes. Together with their list of resources, these four components formed the building blocks of six "Strategy Maps," or temporal roadmaps built iteratively and in real-time. As groups visited one another's strategies, they offered insightful tips and questions, allowing their colleagues to identify risks, gaps, feedback loops, critical junctures, and more. Detailed descriptions of all six strategies are on pp.22-27.

After visiting each of the Strategy Maps, groups found a startling amount of overlap and integration between distinct strategies. This realization prompted the next and final workshop activity, in which the groups merged to further discuss integration. Participants found that Strategies 1-3 flowed quite naturally together, as did Strategies 4-6 and they used the discussion to determine the risks, opportunities, and methods of marrying those distinct strategies (discussed further on pp.29-30).

By the end of the two-day process, participants attained a clearer picture of the problem of bTB control in developing countries, they forged the building blocks necessary for constructing a solution, and they developed an integrated timeline for action. Our hope is that this After Action Report can serve as both a reminder and a call to action for this brilliant group of leaders to turn ideas into steps forward on the complex, but much needed path to controlling bovine Tuberculosis in developing countries.

Section I: Accelerating bTB Control in Developing Countries Workshop Overview

Participants discuss key ideas and insights on the topic of bTB vaccines and diagnostics.



This Workshop on Accelerating bovine Tuberculosis (bTB) Control in Developing Countries was sponsored by The Bill & Melinda Gates Foundation with the aim of convening a diverse and global group of bTB experts to clarify a bTB research agenda, unpack major bottlenecks to delivering effective bTB control strategies, and develop integrated and innovative strategies for tackling this disease in developing countries.

About the Sponsors: Bill & Melinda Gates Foundation Agricultural Development Livestock Strategy

Livestock is a key part of farming in developing countries and is crucial to the livelihoods of more than 900 million people in Sub-Saharan Africa and South Asia. The Bill & Melinda Gates Foundation supports efforts to improve the health and productivity of livestock—particularly chickens, goats, and cows—by improving animal genetics and veterinary care. To ensure that farmers can benefit from animal health and genetics technologies, the Foundation tests models for providing farmers with the knowledge and tools they need to increase their on-farm production and connect to stable markets. The Gates Foundation's work particularly aims to increase income-generating opportunities for women, who may have little control over productive resources such as land but sometimes own and control livestock, especially poultry and goats.

About the Facilitators: The Global Knowledge Initiative

The premier challenges of today—minimizing food and water insecurity in arid landscapes, supporting human, plant, and animal health—are complex and multi-sectoral. Solving these and other problems demands that the global community create bold new ways of organizing people and resources that cut across traditional sectoral, disciplinary, and geographic divides. Collaborative innovation networks offer a way to align resources and partnerships toward shared goals. Building and supporting such networks represents a cornerstone of the [Global Knowledge Initiative's](#) (GKI) work. Guided by our partners' challenges, we help scientists, researchers, entrepreneurs, policymakers, and others **locate** resources critical for problem solving; **enable** effective collaboration by building skills and designing shared agendas; and **connect** resources and partners to form durable networks; all to **solve** development challenges pertinent to science, technology, and innovation. Dubbed one of the world's 100 most innovative organizations, GKI has worked with partners in some 50 countries to date in challenges as diverse as post harvest food loss, coffee taste defects, and rainwater harvesting.

GKI'S VISION FOR IMPACT:

Empowering diverse stakeholders to create **bold, integrated solutions** to complex challenges affecting the world's poorest and most vulnerable people. We do this by engaging diverse actors in a structured innovation design process that enables them to envision creative solutions and build the partnerships needed to create lasting change.

Section II: Accelerating BTB Control in Developing Countries Workshop Activities and Outputs

A portion of a Challenge Map produced by participants at the workshop in Rabat, Morocco.
Photo Credit: GKI

HMW Identity
vaccine delivery
systems

HMW
find any
other disease
with wildlife
which could
inform us.

HMW
the w
reservoir
mainten
hosts

Idea Sorting



The Accelerating bTB Control in Developing Countries workshop began with expert presentations on seven topic areas delivered by workshop participants with particular expertise on key dimensions of bTB control, each described in the following pages. To ensure engagement with the facts and ideas presented, the Global Knowledge Initiative team asked all participants to actively listen and write down answers to any of the following questions that spark critical thinking and reflection on the content shared. Prompt questions included: (1) What facts do we know that emerge from the presentation? (2) What might we be assuming? (3) What risks do we face? (4) What are the key takeaways?

Participants recorded their useful insights on pink sticky notes and their key questions on yellow sticky notes. After assembling all of the participants' many insights and questions on flip chart paper corresponding to the seven topic areas, groups completed a round-robin exercise. During the round-robin small groups discussed the findings recorded on the flip chart paper, added any missing ideas, and then voted on those insights and questions they found most critical to each of the seven topic areas. This section highlights the Top Questions and Top Ideas elicited on each topic.

Topic 1: Vaccines and Diagnostics, presented by Bryce Buddle

Top Questions

- How can we overcome the world shortage of BCG?
- Which other antigens could be combined into a bTB vaccine to make it relevant to smallholders?
- Do we know enough and have enough data about BCG and vaccines for strategic use in cattle?
- What is the effectiveness of BCG against transmitted bTB?
- Is there a cost benefit/production benefit of vaccination?

Top Ideas

- The international standard for bovine tuberculin is running out and needs to be addressed urgently.
- There is a need for more economic, practical, and specific tools to find solutions to reduce false positive reactions.
- Vaccination of cattle may have repercussions on human TB rates (positive or negative).
- Vaccinations may take decades to demonstrate full efficiency in areas with high prevalence.
- Defined alternative skin test reagents would be advantageous in terms of production and standardization.

Topic 2: Zoonotic Impact, presented by Fred Quinn

Top Questions

- Is controlling bTB in wildlife essential?
- What drives zoonotic infection?
- How much of the reduction in zoonotic TB is due to pasteurization and how much is due to control in cattle?
- What are the risk factors and pathways for zoonotic TB?
- Will a better human TB vaccine mean no need to control bTB in animals?

Top Ideas

- We must know the influence of humans in some countries and incidence/TB localization (e.g., lymph nodes).
- Increased research and surveillance to understand TB zoonosis is required. We need accurate numbers.
- Diagnostic labs need to differentiate m-tuberculosis from m-bovis.
- Anti-microbial resistance could be used in bTB treatment.
- Test and slaughter is NOT an option in developing countries.

Topic 3: What has Worked To Date? presented by Paul Livingstone

Top Questions

- How do we establish buy-in from all stakeholders?
- Do we have a good estimate of the benefits of control program to smallholder farmers?
- How do you decide to control, eliminate, or eradicate?
- Are there calculations on ROI for control in New Zealand?
- How strong of a surveillance system should be used to achieve eradication?

Top Ideas

- Cooperation between industry and government is essential.
- Cooperatives can serve as intermediaries in bTB control.
- bTB is driven by intensification, especially of dairy farms.
- There is a need to understand the epidemiology of TB in the particular environment.
- Needs assessments are necessary to identify both the appropriate control and the appropriate funding source.

Topic 4: Historical Overview of the OIE, presented by Patrick Bastiaensen

Top Questions

- How do we incentivize surveillance and reporting to make it notifiable?
- How much power does OIE, WHO, and FAO have for bTB control? Where does the power fall short?
- Is bTB endemic and stable, or in an epidemic, increasing phase?
- Why is there a lack of interest in reporting?
- What do we need in order to increase the percentage of countries embracing the four control methods?

Top Ideas

- There is a lack of reliable population-based estimates of the scale of bTB.
- OIE has information on the performance of veterinary services for most countries.
- If a disease is not notifiable, there is likely no control measure in that country.
- There is a knowledge gap between current prevalence and incidence, especially in each production system.
- More than 40% of developing countries have no legal measures in place to control bTB.

Topic 5: The African Perspective, presented by Gobena Ameni

Top Questions

- Can we take advantage of programs that are designed to control other diseases?
- Who will pay for control?
- How can we incorporate non-financial incentives?
- What is the within-herd prevalence vs. the between-herd prevalence? Can we separate smallholder herds?
- Does consumption of raw meat play a role in transmission (e.g., Ethiopia)?

Top Ideas

- Infrastructure and capacity/capability needs to be in place for TB control.
- There is a need for more basic epidemiology to understand the African situation and diversity of situations.
- There are natural transmission experimental systems available to study vaccination.
- The highest prevalence is in intensive dairy farms.
- Any bTB control measures need to transcend changes in national government.

Topic 6: Wildlife Implications, presented by Paul VanHelden

Top Questions

- How can TB in wildlife be controlled?
- What is the hierarchy of control (e.g., human, livestock, wildlife)?
- What can BCG vaccines do to control bTB in wildlife?
- Can we prevent contact between wildlife and cattle (hence transmission)?
- Is bTB a result of spillover to African wildlife from livestock, or are there wildlife maintenance hosts?

Top Ideas

- We need to understand risk pathways and mechanisms of transmission and sub-types.
- Success of bTB control/eradication is associated with control of the disease in other reservoirs.
- bTB is one of the most promiscuous microbacteria; it will go anywhere.
- More field trials about efficacy of vaccination are needed.
- Control of TB in wildlife may differ significantly depending on epidemiological conditions, logistics, and traditions.

Topic 7: India and China Perspectives, a summary of presentations from V. Maroudam and Kianghemi Zhou presented by Vivek Kapour

Top Questions

- Given the utility of standard definition, what factors for control must be contextualized/differentiated vs. constant?
- Can we tackle bTB without slaughter/control of movement of animals? Perhaps an ID system?
- How can we prevent infection in the face of rapid intensification?
- What are the economic drivers of the growing dairy industry in developing countries, and are these industries concerned about bTB?
- Given that some control options are off the table for cultural reasons (e.g., no slaughter in parts of India), how effective are non-slaughter control methods?

Top Ideas

- Cooperatives have promised to drive some social behaviors favorable to control.
- Different settings need different approaches.
- We need more standardized definitions to provide cross-country comparisons of data.
- We need to clarify what we are testing with diagnostic tests.

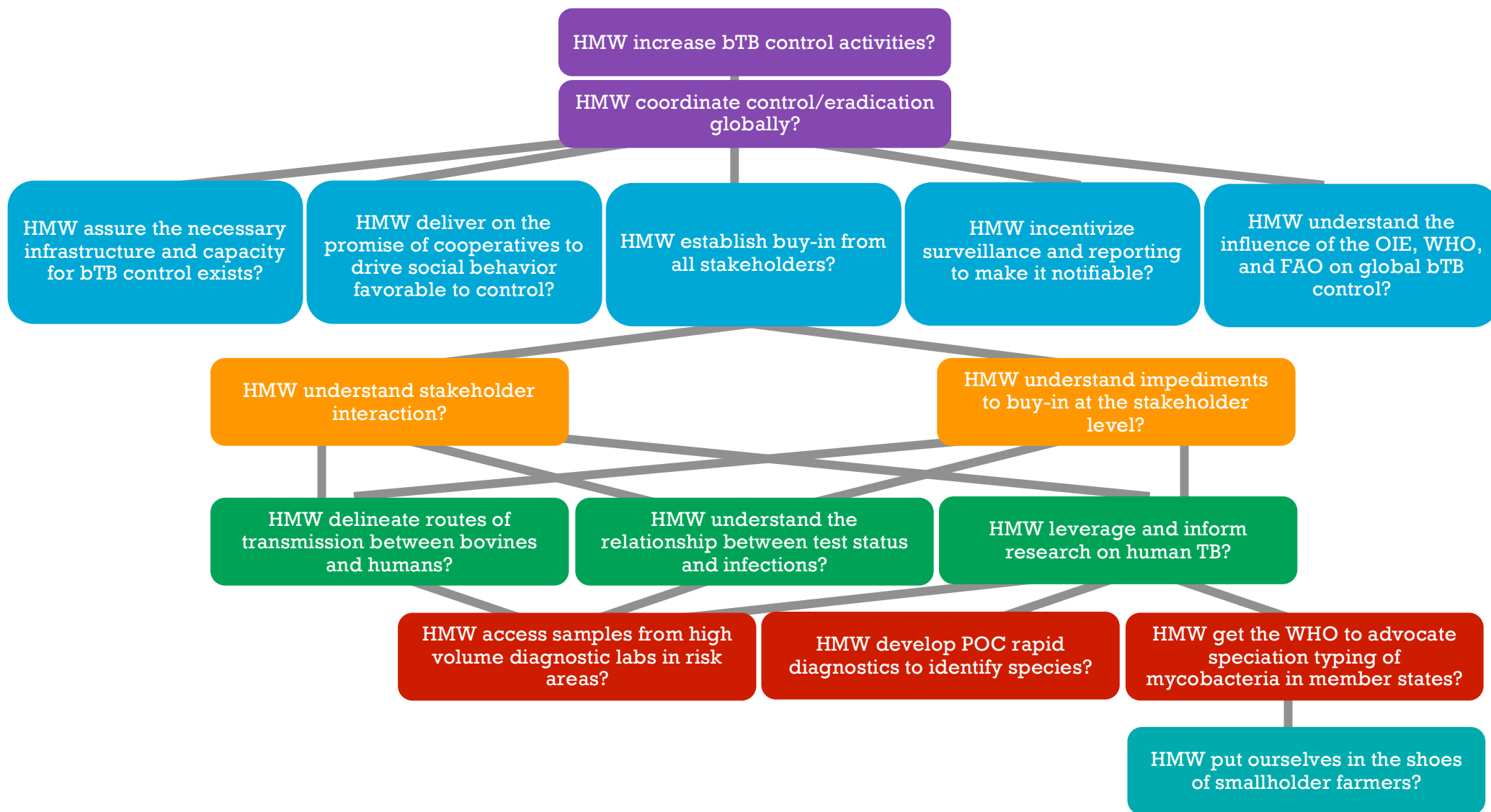
Challenge Mapping

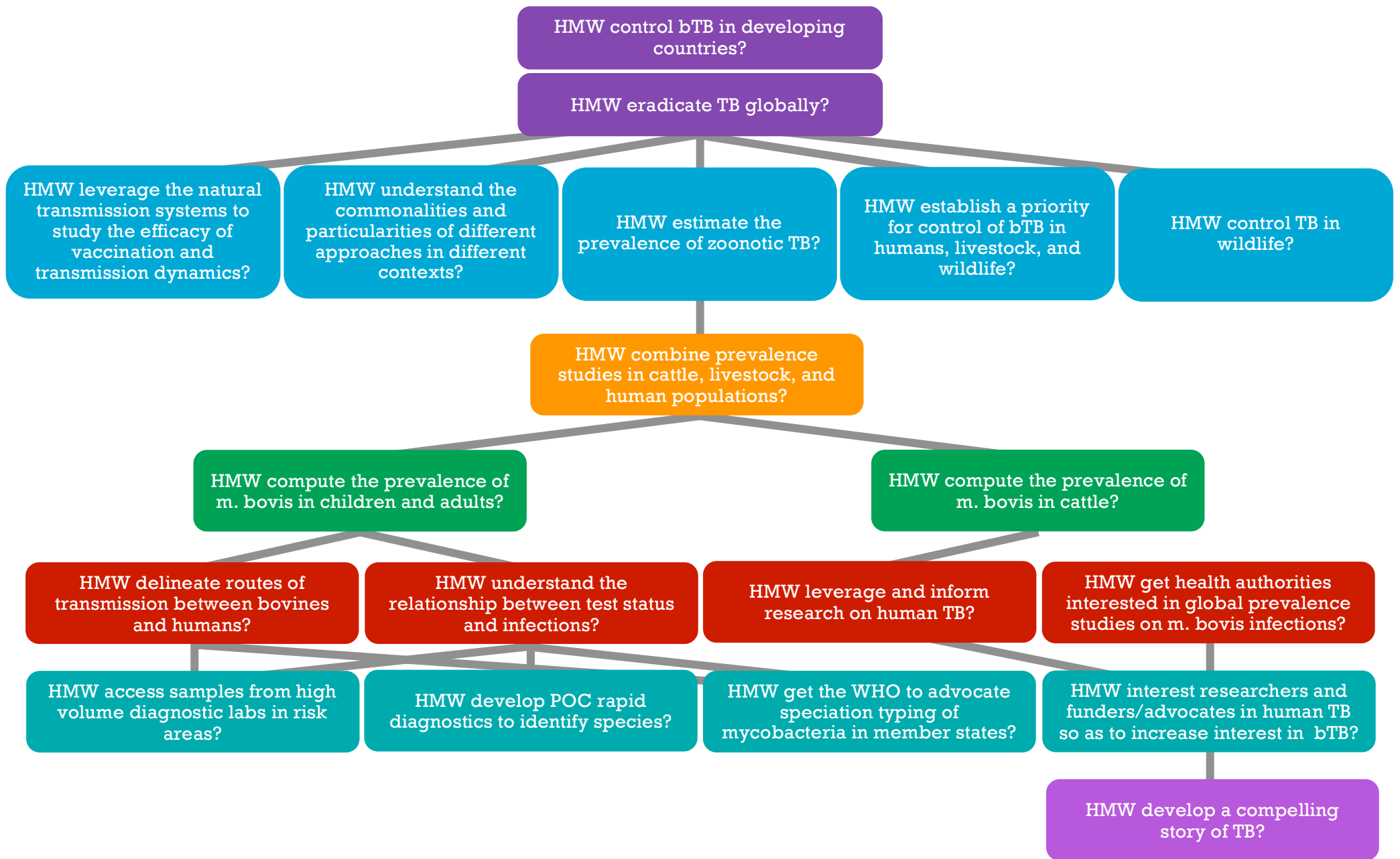
Workshop participants learned how to use a design tool called Challenge Mapping to identify high potential challenges that they would focus on over the following two days. Challenge Mapping offers a way to deconstruct complex challenges by continuously exploring the bottlenecks to problem solving, and rationales for action. Voting allows groups to choose the highest potential challenges on which to focus.

Starting with prompt challenges that emerged through the Idea Sorting exercise, participants split into two groups, developing large, detailed Challenge Maps. Each map spurred the generation of new challenges by building off of the selected “seed challenges” through the use of guiding prompts posed by the facilitators. Once the Challenge Maps were fully populated (with a total of 155 challenges), participants voted on the top five challenges believed to be most essential for controlling bTB in developing countries. The following pages offer a digitized portion of each Challenge Map. A list of all challenges included within both Challenge Maps is provided in Annex III on page 36.

II

CHALLENGE MAPPING





From the 155 challenges developed during Challenge Mapping, participants voted to winnow the list to those top challenges they found most critical for controlling bTB in developing countries. The following Top Challenges elicited the highest number of votes:

1. **HMW understand the impact and risk pathways of TB?**
2. **HMW produce advocacy tools including economic and social evidence?**
3. **HMW use market-based incentives for bTB control?**
4. **HMW get human and animal health authorities interested in developing / sharing / using accurate prevalence estimates of TB?**
5. **HMW determine the level of vaccine efficacy and efficiency experimentally and in the field to control the spread of TB?**
6. **HMW set standards and ensure access to tools?**

These top six challenges anchored the action planning and roadmapping that constituted the remainder of the time spent together at the workshop. At this juncture in the workshop, participants had successfully progressed from discussing the various aspects of the challenge of bTB control in developing countries to parsing it and framing it into these six strategic priorities for action. Defining the resources, partners, activities, and sequence of steps needed to meet these priorities guided selection of the following two tools featured in the workshop: Network Ecosystem Diagrams and Strategy Maps (described in the following section).

Network Ecosystem Diagrams



On Day 2 of the workshop, participants formed six groups focused on the Top 6 Challenges listed on the previous page that were determined at the end of Day 1. Once in their groups, participants used Network Ecosystem Diagrams (described in further detail on the following page) to ideate those resources that are available as well as those resources that are needed to address the group's focal challenge, writing each resource on a sticky note and placing it in the appropriate section of the diagram.

After completing this process, groups volunteered one of their members to serve as a rapporteur while groups rotated, visiting each of the Network Ecosystem Diagrams produced by other groups in the room. After the rapporteurs gave a brief overview of his/her group's diagram, participants had the opportunity to add sticky notes to the diagram, stating resources that the individual or organization could offer in support of addressing the given challenge. Each participant wrote his or her designated participant number on the sticky note for the purposes of tracking the many resource offerings that occurred during this round robin process. This exercise yielded 276 resources, 109 of which were offers, and 193 of which were resources designated as needed for the achievement of the given challenge. For a more thorough review of the resources accumulated through this exercise an Excel spreadsheet is available and can be accessed by contacting Vivek Kapur (Penn State University).

Network Ecosystem Diagrams visually capture those resources available and needed to address a network's shared challenge(s) and to meet strategic objectives. The tool helps network members clarify their resource needs such that they can reach out intelligently to potential partners who either have those resources, or the capacity to access them. Working in groups, teams developed Network Ecosystem Diagrams around each priority challenge. Two benefits enhanced the value that this tool brought to the workshop. First, the tool employs the novel THICK Methodology (described at right) to categorize resources into five essential buckets: technologies, institutional/infrastructural resources, human resources, collaboration/ communication resources, and knowledge resources. Nudging partners to look beyond money to those resources that may already exist within a given system enables formation of more focused partnerships with a higher probability of acquisition of needed resources.

Groups spent time exploring resources within each of the five THICK categories, follow this organizing principle:

- **Inner Ring:** We need this resource to address the challenge and we are not yet connected to it
- **Outer Ring:** We need this resource, but the team is not connected to it

For more information on THICK, which was developed by GKI experts for the World Bank and used to understand and map key resources needed to innovate on challenges to development, see GKI's Top 10 Collaborative Innovation Tools here: <http://globalknowledgeinitiative.org/news/top-10-collaborative-innovation-tools.html>.



Technology

Definition: Tools that individuals and organizations use, along with the knowledge to use them.

Examples: Lab and field equipment, office technology



Human Resources

Definition: The people who can solve problems and the opportunities to build their capacity.

Examples: Trained technicians, researchers, access to skills training



Institutions & Infrastructure

Definition: The policies, structures, and infrastructure that make innovation possible.

Examples: Policies, political will, infrastructure, financial support



Collaboration & Communication Resources

Definition: Resources allowing researchers, entrepreneurs, and others to exchange ideas & knowledge.

Examples: Access to mobile phones, conferences to disseminate research, reliable Internet connection



Knowledge-based Resources

Definition: The information, data, and indigenous knowledge that innovators require to innovate or produce as a function of innovating.

Examples: Technical reports, surveys, professional journals, access to indigenous knowledge

Network Ecosystem Diagrams by the numbers

Accompanying this After Action Report is an Excel document entitled “bTB Workshop Network Ecosystem Diagram Data.” This file tracks all of the resources that workshop participants ideated for each of the six focal challenges. While this Excel file allows for data sorting by challenge, by resource “haves” vs. resource “needs,” by resource itself, as well as by individual who offered that resource, a few of the high-line numbers are as follows:

276

Total Number of Resources Ideated

193

Total Number of Needed Resources

109

Number of Resource Offers Made by Participants

19%

Percent of Needed Resources that Elicited Resource Offers

17

Number of Resources Needed by at least Two Strategies

Strategy Shaping



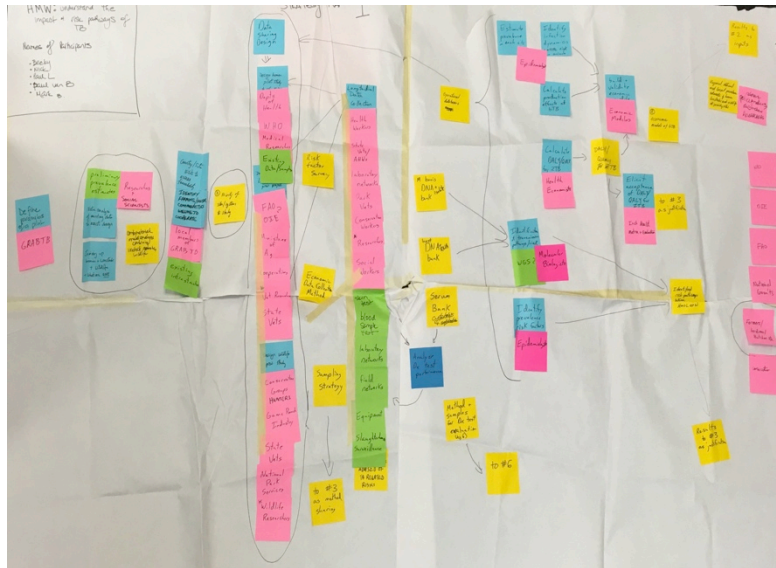
With so many specific resources needed for and available clarified for participants, the work of action planning commenced. The Global Knowledge Initiative facilitators used a tool called Strategy Shaping for this portion of the workshop. The objective of this exercise was to build logic models or “Strategy Maps” portraying integrated solutions to the focal challenges surrounding bTB control in developing countries. By using color-coded sticky notes that indicate Activities, Actors, Resources, and Outputs/Outcomes, teams were able to construct visualizations that demonstrated the many connected pieces, as well as feedback loops, required to deliver 5-year strategies aimed solving the six prioritized challenges. What follows are brief descriptions of the six strategies, as well as the “Key Priorities,” or critical combinations of Activities, Actors, and Resources, that groups described as the critical junctures in their road maps.



Strategy 1: How might we (HMW) understand the impact and risk pathways of TB?

Group Members: Rebecca Smith, Nick Juleff, Paul Livingstone, Paul van Helden, Mark Bronsvort

This strategy focused on bringing together a diverse set of researchers to identify the gaps in information on impact and risk pathways for human, livestock, and wildlife TB. The strategy proposes using the meta-analysis of the existing data to design a three-pronged pilot study through which a shared database can broadly disseminate information. The data analyses will focus on epidemiologic factors, economic factors, and risk pathways of TB in developing countries and the results will feed directly into action plans and communication materials to increase awareness of the health and economic impacts of TB among a variety of global stakeholders, including but not limited to WHO, FAO, OIE, and national governments. This strategy's key priorities (combinations of activities, actors, and resources), as defined by the group, are detailed below.



Year 1 Key Priorities:

- Define parameters of a pilot study to identify the impact and risk pathways of bTB in developing countries in different systems; Actor: GRABTB; Resources: meeting funding.
- Joining up of human, livestock, and wildlife researchers for gap analysis; Actor: researchers; Resources: travel funding.
- Meta-analysis of existing data to assist pilot design resources; Actors: research team, holders of gray literature; Resources: preliminary data, salaries for researchers.
- Identify and visit potential study sites; Actors: researchers, local hosts; Resources: travel funding.

Year 2 Key Priorities:

- Study design and initiation of all three arms of the study; Actors: research team, collaborators; Resources: funding, contracts, agreements.
- Database design and development of sharing protocols; Actors: research team, collaborators, stakeholders; Resources: HR capital, operating expenses.

Year 3 Key priorities:

- Epidemiologic data analysis; Actors: epidemiologists; Resources: salaries, database
- Economic data analysis and model building; Actors: economists, modelers, Institute for Health Matrix and Evaluation
- Risk pathway analysis; Actors: epidemiologists social scientists, molecular biologists.

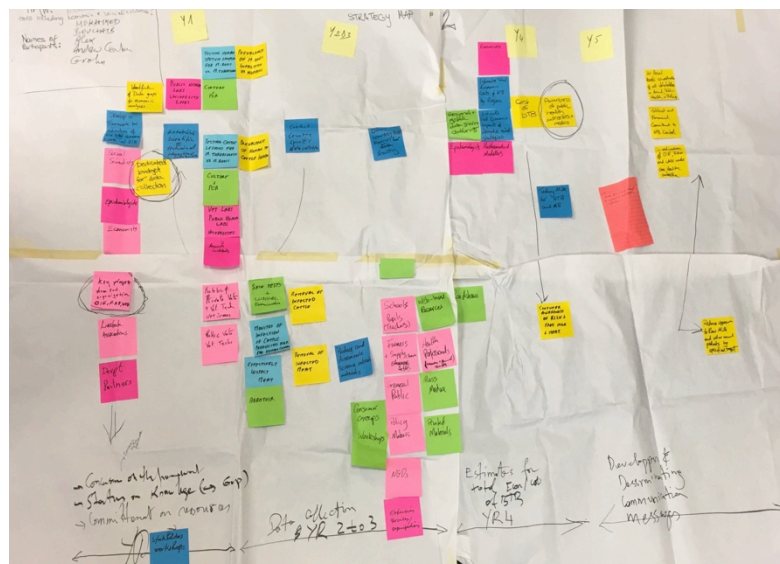
Year 5 Key Priorities:

- Integrating results into action plans and communication materials for dissemination to major stakeholders; Actors: communication experts, extension agents, community leaders; Resources: publication and travel funds

Strategy 2: How might we (HMW) produce advocacy tools, including economic and social evidence?

Group Members: Mohammed Bouslikhanne, Bouchaib Boulanouar, Alex Morrow, Andrew Conlan, Yrjo Grohn

This strategy was built on the shared understanding that there is a lack of data on the economic and social impacts of bTB in developing countries and that estimating the total costs of this disease on livelihoods is critical to increasing advocacy and support for bTB control in those countries. By convening social scientists, epidemiologists, and key international health organizations at a stakeholder workshop, the strategy begins with the development of a framework for estimating the total cost of bTB. Moreover, the workshop will push for commitment from key international stakeholders to fund field studies for data gathering. In Year 5, using data from regional frameworks and field studies, the group will use estimates of the total economic costs of bTB in specific regions to predict benefits of alternative bTB control strategies. Once a follow-up stakeholder workshop validates the robustness of the framework / estimates, the team will develop and integrate advocacy messages to disseminate to target audiences, raising global awareness of the importance of bTB control in developing countries. This strategy's key priorities (combinations of activities, actors, and resources), as defined by the group, are detailed below.



Year 1 Key Priorities:

- Stakeholders workshop to identify needs and requirements of a framework for estimation of total economic costs of bTB. Actors: social scientists, economists, epidemiologists, livestock associations, key players from OIE, FAO, WHO, donors
- Development of detailed framework and meta-analysis of total economic costs of bTB. Actors: subset of social scientists, epidemiologists, economists
- Stakeholder workshop to present framework and push for adoption and commitment from all actors. Actors: social scientists, economists, epidemiologists, livestock associations, OIE, FAO, WHO, donors

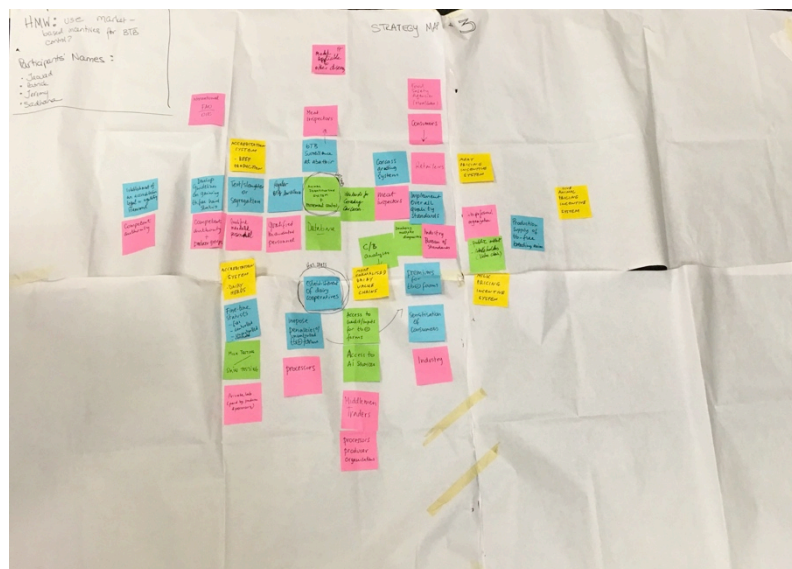
Year 5 Key Priorities:

- Estimate total economic costs of bTB in specific regions based on framework and field studies. Actors: economists, social scientists
- Predict benefits of alternative control strategies. Actors: economists, social scientists, modelers, field epidemiologists
- Stakeholder workshop on robustness and validation of economic framework/tool/estimates. Actors: social scientists, economists, epidemiologists, livestock associations, OIE, FAO, WHO, donors
- Develop and integrate key messages for dissemination using appropriate tools for different target audiences. Actors: social scientists, communication specialists.

Strategy 3: How might we (HMW) use market-based incentives for bTB control?

Group Members: Sadhana Sharma, Jeremy Salt, Patrick Bastiaensen, Jaouad Barrada

Recognizing the risk of contracting bTB in developing countries due to milk or meat consumption, this strategy focuses on developing a quality-based market for milk and meat in Sub-Saharan Africa for local consumption. By implementing an animal identification system and movement control at the regional level (and eventually at the national level), the group will develop accreditation systems for herds in which each animal in a given cooperative is marked with a status (e.g., TB free, controlled, uncontrolled, vaccinated). It will be necessary to establish screening tests and enforcement mechanisms to ensure consumers can depend on high quality milk and meat and to develop the incentives to pay for those safe food products. This strategy's key priorities (combinations of activities, actors, and resources), as defined by the group, are detailed below.



Year 1 Key Priorities:

- Develop animal identification system and movement control; Resources: legal framework, manual databases, reporting and managing systems; Actors: professional organizations, public officials, competent authority, private sector.
- Establishment of dairy cooperatives pilot. Resources: incentives, regulatory framework, services, milk collection; Actors: farmers, traders, processors, animal production officials, competent authority, community leaders.
- Establishment of accreditation system for herd; Resources: designing the status category, certification; Actors: farmers, competent authorities, vets.
- Enforcing bTB surveillance at farm and abattoir; Resources: screening protocols, standard procedures, training; Actors: competent authorities, testers, meat inspectors, private labs.
- Establishment of government entity to ensure enforcement of the bTB control program; Resources: efficient inspection services; Actors: ministry, producers, industry, stakeholders.

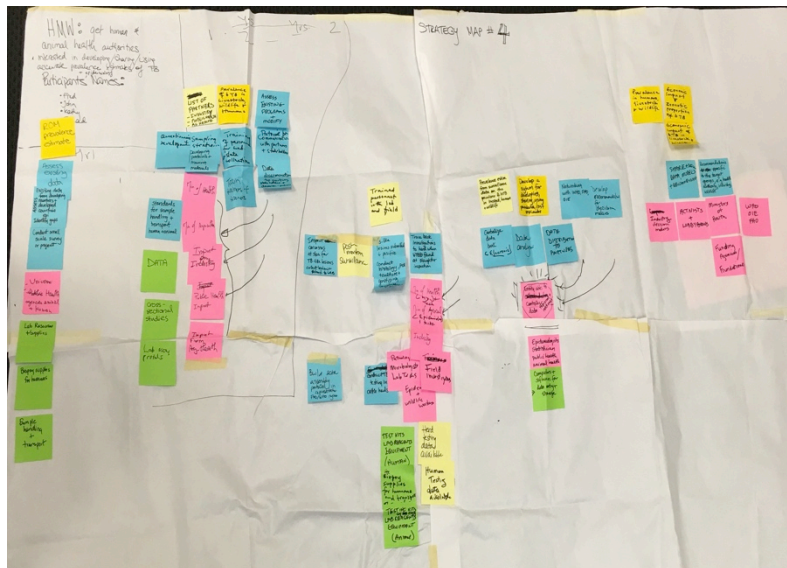
Year 5 Key Priorities:

- Developing quality-based market for meat in Sub-Saharan Africa for local consumption. Resources: standards for grading. Actors: inspectors, milk industry, consumers, milk industry professionals, traders.
- Ensuring supply of TB-free breeding animals for local need; Actors: breeding companies.
- Developing high herd status system; Resources: multiplex diagnostics; Actors: consumers, industry, management.
- Developing fully integrated and formalized dairy value-chain for smallholder dairy farmers. Actors: smallholder farmers, cooperatives, processors, traders.

Strategy 4: How might we (HMW) get human and animal health authorities interested in developing/sharing/using accurate prevalence estimates of TB?

Group Members: Fred Quinn, John Kaneene, Kathy Orloski, Fouad Seghrouchni

This strategy focuses on assessing existing data and industry records as well as field capacity information to then fill the gaps by planning studies for collecting real-time data. The strategy calls for the use of prevalence data to assess the economic impact of bTB for broad dissemination. By year three, regional data sharing units will develop a process to share data with defined constituents, stakeholders, and funding agencies. This strategy's key priorities (combinations of activities, actors, and resources), as defined by the group, are detailed below.



Year 1 Key Priorities:

- Collect and assess existing data; Resources: computers, phones, travel, salaries; Actors: PI's, students, epidemiologists, statisticians, economists.
- Begin to plan studies for collection of real-time data. Choose first round sites. Develop surveillance structure. Conduct economic analysis structure and product; Resources: computers, phones, travel, salaries; Actors: PI's, students, epidemiologists, statisticians, economists.
- Build manuals, SOPs, plans, questionnaires, methodologies for including new diagnostics or vaccines in sites/protocols; Resources: computers, phones, travel, salaries; Actors: PI's, students, epidemiologists, statisticians, economists.
- Develop strategy to use prevalence data to assess economic impact. Begin planning for information dissemination. Identify centralized/coordinated reporting units/entities; Resources: computers, phones, travel, salaries; Actors: PI's, students, epidemiologists, statisticians, economists.

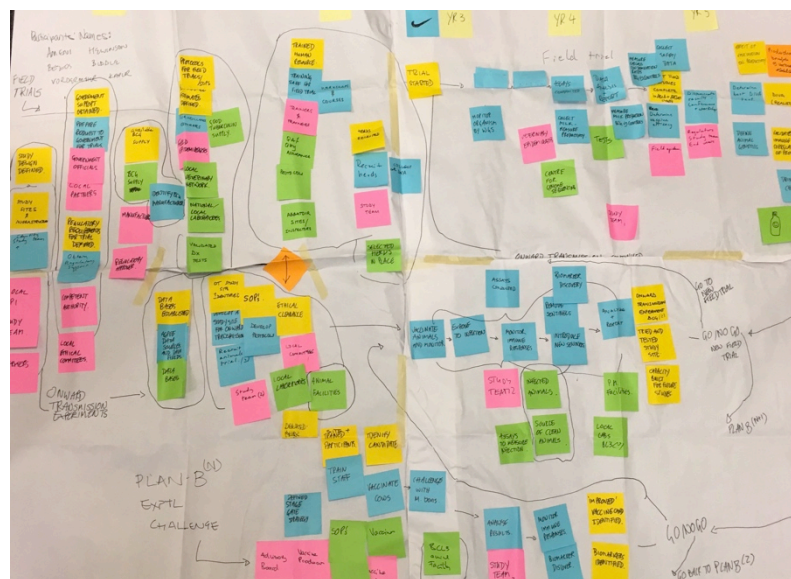
Year 3 Key Priorities:

- Build basic laboratory/surveillance capacity in first round sites. Hire personnel, train personnel, purchase equipment and reagents, organize information dissemination; Resources: equipment, supplies, training; Actors: students, technicians, field epidemiologists, pathologists, animal health technicians, human health technicians.
- Assemble and initiate regular reporting/meetings plan with coordinating/centralizing regional data sharing units; Resources: equipment, supplies, training; Actors: students, technicians, field epidemiologists, pathologists, animal health technicians, human health technicians.
- Develop and implement a plan to share data with defined constituents, stakeholders and funding agencies; Resources: equipment, supplies, training; Actors: students, technicians, field epidemiologists, pathologists, animal health technicians, human health technicians.

Strategy 5: How might we (HMW) determine the level of vaccine efficacy and efficiency experimentally and in the field to control the spread of TB?

Group Members: Vivek Kapur, Gobena Ameni, Glyn Hewinson, Javier Bezos, Bryce Buddle, Martin Vordermeir

This is a three-tiered strategy: the first tier consists of a set of field trials to identify new vaccine candidates; the second consists of a set of natural transmission model experiments to determine whether new vaccines have the ability to stop bTB transmission; and the third involves determining how the BCG vaccine works with different prevalences. The first year entails defining the study sites and completing study design, setting up the working groups, and selecting two study sites. By Year 5, the field trial will be complete as well as onward transmission experiments complete. However, there are numerous feedback loops that take place during that time in which learning and experimental outcomes determine the next step (e.g., new field trial, experimental challenge, etc.). This strategy's key priorities (combinations of activities, actors, and resources), as defined by the group, are detailed below.



Year 1 Key Priorities:

- Define study team, study sites, and infrastructure and complete study designs; Actors: local PI, study team, farmers, government.
- Prepare request for trials to government, obtain regulatory permissions; Actors: government officials, local partners, competent authorities, local ethics committee.
- Identify and secure BCG supply; Resources: BCG. Actors: manufacturers, regulatory authorities.
- Study design, database; Resources: veterinary network, databases, validated tests; Actors: study team.
- Protocols, training, study site agreements; Resources: farms, study sites; Actors: trainers, trainees, farmers, study team.
- Setting up working groups, define criteria; Resources: vaccines, human TB field research; Actors: vaccine developers, advisory board.
- Selecting two study sites, preparing the protocols, training 7 staff; Resources: facilities, animals; Actors: study team, local PI.

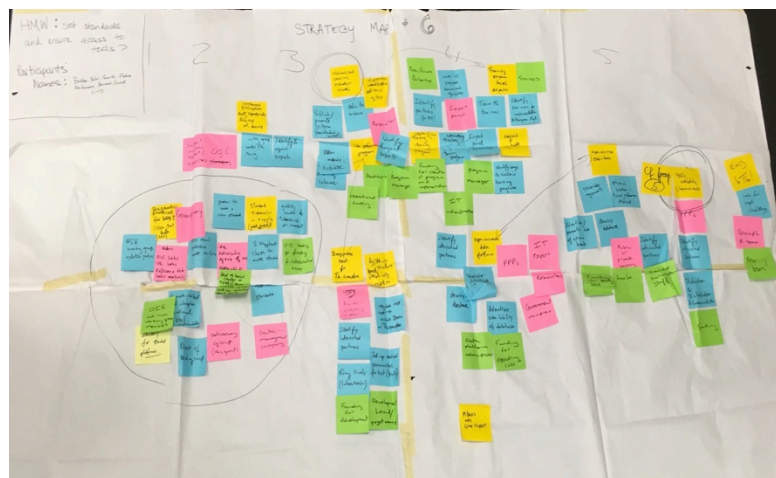
Year 5 Key Priorities:

- Field trial complete.
- Onward transmission experiment complete, protocols validated, capacity built.
- Experimental challenge sites and protocols validated, capacity built.

Strategy 6: How might we (HMW) develop standards for and increase access to tools?

Group Members: Marcel Behr, Josephus Fourie, Flabio Araujo, Stefan Kaufman, Bernardo Alonso, Vincent Guyonnet

This strategy begins with raising awareness on the importance of implementing standards, reaching a harmonized definition of m. bovis, and delivering data through open access principles. Within the first few years, the group plans to have a standard vaccine evaluation model and establish a broad database eliciting information from field data producers. Building public-private partnerships between IT experts, government ministries, and researchers will be crucial for delivering the open-access data platform. Ultimately, by the fifth year, the group plans to have a new standardized BCG vaccine industry. This strategy's key priorities (combinations of activities, actors, and resources), as defined by the group, are detailed below.



Year 1 Key Priorities:

- Advocacy workshop to raise awareness regarding the paucity of standards; Resources: labs vet services; Actors: OIE, national representatives.
- Standardization of tuberculin; Actors: OIE, veterinarians.

Year 2 Key Priorities:

- Use tuberculin model for new alternative diagnostics including milk; Resources: trial labs; Actors: OIE, veterinarians, food industry.
- Establish data base; Resources: human resource base; Actors: IT specialists, field data producers, World Bank, donors.

Year 5 Key Priorities:

- New standardized BCG vaccine industry; Resources: funding; Actors: OIE, Ministry of Agriculture, dedicated vet vaccine company.
- Database for strains of bTB and corresponding vaccine BCG.

After groups completed developed their strategies, they had the opportunity to visit other groups' maps, offering their input as well as asking critical questions. Upon doing so, the workshop participants quickly realized the large degree of overlap and potential for integration between them. As such, the GKI team asked the participants to split into two groups (Strategies 1-3 and Strategies 4-6). These large groups explored those features common across multiple strategies as well as the ways in which the distinct strategies might merge into a larger integrated strategy. For instance, many groups found that the outputs of their strategy would serve as key inputs to other groups' strategies. What follows is an overview of the proposed integration of Strategies 1-3 and Strategies 4-6, as well as some commonalities or overlaps between them.

Potential for Integration Between Strategies 1-3:

The groups all agreed that their strategies must begin with data and evidence on the many impacts of bTB (economic, social, health). After gathering evidence on bTB, the focus can then shift to gaining commitment and support for bTB control programs in developing countries. Specifically, Strategy 1 features Disability-Adjusted Life Years (DALYs) / Quality-Adjusted Life Years (QALYs), disease parameters (human, cattle, wildlife), risk pathways, and economic analyses. All of these features feed into Strategy 2, which furthers the economic analysis from Strategy 1 by adding modeling. There is a critical feedback loop between these two strategies in which the field data collection informs the economic analysis / modeling and vice versa. Strategies 1 and 2 have a joint output of communication / advocacy materials to broadly disseminate information on the economic, social, and health impacts of bTB in developing countries (with the goal of raising awareness and funds for control programs).

Strategy 3 depends on these advocacy materials successfully creating an environment with a shared understanding of the health benefits of developing quality-based markets for milk and meat in Sub-Saharan Africa. The disease parameters for cattle, risk pathways, and economic analyses relating to cattle all serve as inputs for Strategy 3. Thus Strategy 2 builds on, and continues the activities of, Strategy 1 and both of them have critical outputs that serve as inputs for Strategy 3.

Through the discussion, the three groups realized that because incentive structures are so essential for Strategy 3 (and the development of new markets), they must be included in the social science portion of Strategy 2's economic analysis.

Potential for Integration Between Strategies 4-6:

This group determined that the overall concept begins with the existing test, the challenge models, and existing vaccines (e.g., BCG) before optimizing new tools. While there are multiple options for integrating these three strategies, participants thought that the best option was to begin with a combination of Strategy 4 and Strategy 5, since both of them feed into and inform Strategy 6.

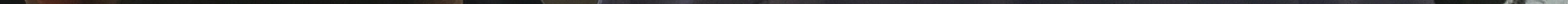
A common theme across all of these strategies is the question, “Who pays?” In order to gain support and funds for vaccine trials and human vaccines, there must be a strong economic case for the importance of bTB control. First, the vaccine manufacturers must buy in, and then the regulatory agencies must do the same. Only then can there be validation through field-testing. For all of these pieces to fall into place, standardization of reagents at the beginning is key.

Another theme that emerged through discussion is the lack of information on what the disease is doing in terms of economic, social, and health impacts. This theme was not only critical to Strategies 4-6, but to Strategies 1-3 as well. Both the lack of data and the need for buy-in should thus serve as key criteria for choosing geographies in which to launch field tests. Identifying the appropriate sites with favorable environments, national buy in, and engaged stakeholders is one of the major risks of these strategies.

The other major risk that affects a number of strategies is the issue of BCG supply. Since there is a scarcity of doses available at WHO, BCG availability serves as a limiting factor for running trials / experiments. However, the focus on clarifying the scope of the bTB problem and raising global awareness, featured in Strategies 1-2, might serve to increase resources needed for trials.

By the end of the action-packed, two-day workshop on Accelerating bTB Control in Developing Countries, participants not only developed strategies for action, but in doing so, greatly enhanced the number and clarity of the questions compelling action: How might we obtain data on the economic, social, and health impacts of bTB? How might we increase awareness on the importance of bTB control in developing countries? How might we develop new vaccines? The list goes on and on. However, by ideating 155 distinct challenges related to the overarching issue of bTB control, participants soared over the largest barrier to success: developing a shared understanding of the problem at hand.

Those challenges served as a springboard to launch detailed discussions on the activities, actors, and resources needed to meet short-term and long-term outcomes. Split into 6 groups, participants not only built integrated, complex strategies for addressing their bTB focal challenges, but they also helped one another identify the building blocks needed to construct those strategies. Approximately 40 participants offered up 109 distinct resources to help bring these six strategies to life. This generosity fueled the process that also elucidated the shared opportunities and shared risks surrounding this work, an observation that highlights the need for further strategy integration. Whether the focus was on field trials or advocacy, participants highlighted a great need for additional data sharing, economic/social/health impact studies, elucidation of risk pathways, and increased understanding of the importance of bTB control. With this After Action Report, we urge participants to continue these discussions, hone these strategies, and reconvene to take the next steps toward implementing bTB control in developing countries as imagined in this exciting convening.



ANNEX I: PARTICIPANTS OF THE ACCELERATING BTB CONTROL IN DEVELOPING COUNTRIES WORKSHOP



NAME	ORGANIZATION	COUNTRY
Bernardo Alonso	Gerencia de Laboratorios (GELAB) del Servicio Nacional de Sanidad y Calidad	Argentina
Gobena Ameni	Addis Ababa University	Ethiopia
Peter Andersen	Statens Serum Institut (SSI)	Denmark
Flabio Ribeiro Araujo	Embrapa	Brazil
Douwe Bakker	Private	Netherlands
Jaouad Barrada	Institut Agronomique et Vétérinaire (IAV)	Morocco
Patrick Bastiaensen	World Organisation for Animal Health (OIE)	Kenya
Marcel Behr	McGill University	Canada
Javier Bezos	Centro de Vigilancia Sanitaria Veterinaria (VISAVET)	Spain
Bouchaib Boulanouar	African Development Bank	Côte d'Ivoire
Jamal Bourekadi	Morocco TB Hospital	Morocco
Mohammed Bouslikhane	Institut Agronomique et Vétérinaire (IAV)	Morocco
Katie Bowman *Facilitator	Global Knowledge Initiative (GKI)	USA
Mark Bronsvort	The Roslin Institute- University of Edinburgh	UK
Bryce Buddle	Massey University	New Zealand
Andrew Conlan	Cambridge University	UK
Sara Farley *Facilitator	Global Knowledge Initiative (GKI)	USA
Josephus Fourie	Clinvet	South Africa
Yrjo Grohn	Cornell University	USA
Vincent Guyonnet	International Development Research Center (IDRC)	Canada
Glyn Hewinson	Animal and Plant Health Agency (APHA)	UK

Nick Juleff	Bill and Melinda Gates Foundation (BMGF)	USA
John Kaneene	Michigan State University	USA
Vivek Kapur	Penn State University	USA
Stefan Kauffmann	Max Planck	Germany
Rudovik Kazwala	Sokoine University	Africa
Paul Livingstone	TBFree	New Zealand
V. Maroudam	Tamil Nadu Veterinary and Animal Sciences University (TANUVAS)	India
Emily Moran *Facilitator	Bill and Melinda Gates Foundation (BMGF)	USA
Alex Morrow	Department for Environment, Food, and Rural Affairs (DEFRA)	UK
Kathy Orloski	US Department of Agriculture, Animal and Plant Health Inspection Service (USDA/APHIS)	USA
Fred Quinn	University of Georgia	USA
Jeremy Salt	GALVMED	Netherlands
Fouad Seghrouchni	Morocco Center for Disease Control (CDC)	Morocco
Sadhana Sharma	Biotechnology and Biological Sciences Research Council (BBSRC)	UK
Rebecca Smith	University of Illinois	USA
Paul van Helden	Stellenbosch University / Innovus	South Africa
Martin Vordermeir	Animal and Plant Health Agency (APHA)	UK
Xiangmei Zhou	China Agricultural University	China

ANNEX II: ACCELERATING BTB CONTROL IN DEVELOPING COUNTRIES WORKSHOP AGENDA



Time: 9:30 AM December 8, 2015 – 5:00 PM December 10, 2015

DAY ONE

9:30 AM

INTRODUCTIONS AND SETTING THE STAGE

Guiding Questions: What is driving this initiative? What are the major issues we are here to address?

10:00 AM

PARTICIPANT PRESENTATIONS OF ONGOING INITIATIVES: EXPERT PERSPECTIVES

Guiding Questions: What has been done up to this point to control bTB? What have been the biggest challenges and successes? How can we learn from past efforts?

- HISTORICAL OVERVIEW (PATRICK BASTIAENSEN)
- SUCCESS STORY: WHAT HAS WORKED TO DATE (PAUL LIVINGSTONE)
- VACCINES AND DIAGNOSTICS (BRYCE BUDDLE)

11:15 – 11:30 AM BREAK

- ZOONOTIC IMPACT (FRED QUINN)
- WILDLIFE IMPLICATIONS (PAUL VAN HELDEN)
- AFRICA PERSPECTIVE (GOBENA AMENI)

12:45 – 1:45 PM LUNCH

- INDIA PERSPECTIVE (V. MAROUDAM)
- CHINA PERSPECTIVE (XIANGMEI ZHOU)

2:45 – 4:00 PM

IDEA PRIORITIZATION

Guiding Questions: Based on the presentations, what do we know? What might we be assuming? What risks do we face? What are the key insights we have identified?

4:00 – 4:30 PM BREAK

4:30 – 6:00 PM **EXPLORING OPPORTUNITIES AND BOTTLENECKS TO ACCELERATING bTB CONTROL PROGRAMS: THE CHALLENGE MAP**
Guiding Questions: What key bottlenecks thwart efforts to control bTB in developing countries? What key opportunities are we not yet seizing?

DAY TWO

9:30 - 9:45 AM **RECAP OF DAY 1: SARA FARLEY**

9:45 – 10:45 AM **CATEGORIZING AVAILABLE AND NEEDED RESOURCES: NETWORK ECOSYSTEM DIAGRAMS**
Guiding Questions: What tools and resources do we have, and what do we need to address the bTB challenge? Where are there critical resource gaps? What tools or resources do we need to fill those gaps? Who can offer resources needed to address the bTB challenge?

10:45 – 11:15 AM BREAK

11:15 – 12:30 PM **FACILITATED RESOURCE SHARING TO SPUR JOINT ACTION: ROUND ROBIN RESOURCE MATCHING**
Guiding Questions: Which of the tools or resources that we need to fill gaps are already available? Which might we be able to access that we haven't yet accessed? How can we build strategic partnerships around resource needs?

12:30 – 1:30 PM LUNCH

1:30 – 3:00 PM **VISUALIZING THE PATHWAY FORWARD: STRATEGY SHAPING**
Guiding Question: What is our strategy for action? What actors / resources / activities will help us arrive at our desired outputs and outcomes? What are our next steps?

3:00 – 3:30 PM BREAK

3:30 – 5:30 PM **CONVERTING ACTION PLANS INTO NEXT STEPS AND PRIORITIZED NEEDS**

5:30 – 6:00 PM **CLOSING REMARKS**

DAY THREE

GLOBAL RESEARCH ALLIANCE FOR BOVINE TB (GRABTB) LAUNCH AND MEETING

SESSION 1

WELCOME AND INTRODUCTIONS

SESSION 2

BACKGROUND TO STAR-IDAZ (*ALEX MORROW*)

SESSION 3

BACKGROUND TO GRABTB (*GLYN HEWINSON*)

MEMORANDUM OF UNDERSTANDING AND MEMBERSHIP

SESSION 4

RESEARCH NEEDS: HOST-PATHOGEN INTERACTIONS (*STEFAN KAUFMANN*)

SESSION 5

PRESENTATION OF bTB RESEARCH GAPS FROM 2014 CARDIFF WORKSHOP (*SADHANA SHARMA*)

SESSION 6

ADDITIONAL RESEARCH GAPS RELATING TO GLOBAL ISSUES IDENTIFIED DURING BMGF WORKSHOP

SESSION 7

FOUR BREAKOUT GROUPS CONSIDERING:

- a. HOST-PATHOGEN INTERACTIONS
- b. VACCINE DEVELOPMENT
- c. DIAGNOSTICS
- d. EPIDEMIOLOGY AND CONTROL

(PRIORITISING RESEARCH NEEDS AND DEVELOPMENT OF ROADMAP)

SESSION 8

ROTATION OF FACILITATORS BETWEEN GROUPS TO PRESENT FINDINGS AND IDENTIFY MISSING TOPICS

SESSION 9

PLENARY SESSION

PRESENTATION OF ROADMAPS FROM BREAKOUT GROUPS AND IDENTIFICATION OF CURRENT ACTIVITIES AND RESEARCH GROUPS WORKING ON TOPICS

MEETING CLOSE

ANNEX III: FULL LIST OF CHALLENGES FROM CHALLENGE MAPPING EXERCISE



CHALLENGE MAP #1

HMW assure the necessary infrastructure and capacity for bTB control exists?
HMW elicit the commitment of government?
HMW define necessary infrastructure and capacity for bTB control?
HMW make bTB control attractive for industrial partners?
HMW produce educational materials suitable for distribution through cooperatives?
HMW develop next generation talent for bTB control?
HMW identify what is available?
HMW perform gap analysis of what is available and what we need?
HMW share resources (infrastructure) to ensure necessary capacity?
HMW deliver on the promise of cooperatives to drive social (sociocultural) behavior favorable to control?
HMW identify animals?
HMW avail or develop the control tools?
HMW control animal movement?
HMW understand the cost/benefit of control to stakeholders and cooperatives?
HMW show the benefit of controlling bTB to cooperative members?
HMW incentivize the formation of cooperatives?
HMW understand the incentives of stakeholders?
HMW quantify the effect of bTB control on stakeholders?
HMW identify costs of necessary infrastructure and capacity and identify who pays?
HMW identify the favorable social behaviors that correspond with membership in cooperatives?
HMW incentivize surveillance and reporting to make it notifiable?
HMW make bTB notifiable?
HMW share surveillance data?
HMW drive down time/cost of surveillance - drive up efficiency of efficacy tests?
HMW change the consequence of accurate reporting (update OIE manuals)?

HMW ensure quality in diagnostic testing labs?
HMW use the market to draw quality and wholesale products?
HMW increase the benefits of surveillance?
HMW organize local infrastructure for diagnosis?
HMW assure minimum performance standards in testing is achieved?
HMW increase available funding?
HMW demonstrate the costs and benefits of TB control and public health significance?
HMW show the benefit of surveillance and reporting?
HMW measure the economic impact of bTB on livestock productivity and public health?
HMW set standards and ensure access to tools?
HMW increase the awareness of the medical community of bTB as a health problem in humans?
HMW make PPPs work for bTB control?
HMW integrate human/animal/wildlife surveillance?
HMW understand the influence of the OIE, WHO, and FAO on global bTB control?
HMW increase trade?
HMW coordinate control/eradication of bTB globally?
HMW incentivize collective action between the FAO, OIE, WHO?
HMW clarify the distinct roles of the WHO, OIE, FAO, etc.?
HMW assure member states buy-in to international/regional structures?
HMW assure harmonization of diagnostic approaches?
HMW establish buy-in from all stakeholders?
HMW increase bTB control activities?
HMW avail funds?
HMW motivate vets in the field?
HMW ensure private businesses are incentivized economically to participate in bTB control?
HMW understand impediments to buy-in at the stakeholder level?
HMW put ourselves in the shoes of small stakeholders?
HMW provide incentives to stakeholders to buy in?

HMW determine who the most important stakeholders are?
HMW ensure private businesses are incentivized economically to participate in bTB control?
HMW understand stakeholder interaction?
HMW understand stakeholder's ability to interact?
HMW engage with farmers?
HMW increase the awareness of farmers?
HMW understand the impact of bTB on livestock holders?

Challenge Map #2

HMW leverage the natural transmission systems to study efficacy of vaccination and transmission dynamics?
HMW estimate the relative contributions of species to transmission?
HMW increase knowledge of transmission?
HMW design transmission experiments?
HMW use the knowledge on transmission to design/develop a better vaccine?
HMW understand mechanism underlying transmission?
Do infected animals always spread the disease?
HMW identify chains of transmission of bTB?
HMW know when an animal is a transmitter?
HMW know when milk is infectious?
HMW define rate of transmission required?
HMW design transmission studies for multiple hosts?
HMW decide what is a maintenance host and what is a spillover/dead end host?
HMW define vaccine efficacy?
HMW develop tools for different species?
HMW apply surrogates of disease?
HMW improve power of experimental studies with better statistical analysis?

HMW translate estimates from experimental studies to the field?
HMW estimate the prevalence of zoonotic TB?
HMW eradicate TB globally?
HMW control bTB in developing countries?
HMW compute the prevalence of m. bovis in children/adults?
HMW understand the relationship between test status and infections?
HMW prevent intensification?
HMW compute the prevalence of m. bovis in cattle?
HMW delineate routes of transmission between cattle and humans?
HMW combine prevalence studies in cattle and human populations?
HME develop POC rapid diagnostics to identify species?
HMW access samples from high volume diagnostic labs in risk areas?
HMW get human and animal health authority integrated on global prevalence studies of m. bovis infections?
HMW estimate the impact of bTB prevalence in livestock and wildlife on the local community?
HMW estimate the prevalence of m. bovis in each form of human tuberculosis?
HMW get the WHO to advocate speciation typing of mycobacteria by member states?
HMW develop a multispeciation laboratory tool that is simple and affordable?
HMW leverage and inform research on human TB?
HMW interest researchers and funders/advocates in mTB for bTB
HMW leverage successful strategies from other advocacy strategies?
HMW develop an urgency/compelling story re: TB?
HMW control TB in wildlife?
HMW define routes of transmission of TB for wildlife, livestock, humans?
HMW carry out test and slaughter?
HMW develop vaccines for wildlife?
HMW implement active and passive surveillance?
HMW limit the interface between wildlife and domestic animals and man?
HMW determine the rates of m. bovis infection in many different wildlife species in different countries?

HMW determine TB control on wildlife as a contributor to control in livestock?
HMW study risk factors exposing domestic animal and human populations to wild reservoirs?
HMW estimate the prevalence of bovine TB in wildlife?
HMW develop whole genome sequencing and sampling of multiple species to identify directions of transmission?
HMW vaccinate wildlife?
HMW identify vaccine delivery systems?
HMW find other diseases within wildlife which could inform us?
HMW identify the transmission of TB in wildlife habitats when our understanding of wildlife is so minimal?
HMW determine levels of vaccine efficacy to control the spread of TB?
HMW identify the wildlife reservoirs/maintenance hosts in Africa and Asia?
HMW understand the ROI for bTB control in livestock?
HMW find the necessary experts?
HMW access the appropriate technology?
HMW identify funding?
HMW do this in live animals?
HMW develop new tools to perform these studies in wildlife?
HMW establish a priority for control on bTB in humans-livestock-wildlife?
HMW find an advocate who can sell our whole interface?
HMW understand the existing priority of bTB control in public, animal, and while life health organizations/governments?
HMW quantify the burden of bTB in human-wildlife-livestock?
HMW raise the profile of bTB on a ONE Health model/case?
HMW develop economic estimates of health and conservation?
HMW produce advocacy tools that include economic and social evidence?
HMW make compensation policy efficient for positive cattle?
HMW interest funders to address bTB?
HMW provide data on the magnitude of the problem for each setting?
HMW convince decision makers of the pertinence of bTB control?

HMW address the lack of data on which to base discussions with funders and stakeholders?
HMW interest farmers to control bTB?
HMW demonstrate the economic losses by smallholders due to bTB?
HMW communicate the burden of bTB on livestock and wildlife and impact to local and regional communities?
HMW incentivize all players to participate in surveillance and control programs as they develop?
HMW establish a community based surveillance and control approach in developing countries?
HMW understand the commonalities and particularities of different approaches in different contexts?
HMW capture and learn about different approaches used in different contexts?
HMW conduct pilot studies in different contexts?
HMW sort out communities and particularities?
HMW avoid politicization of control?
HMW drive home these inter-connections?
HMW establish relevant models for different settings (smallholders, semi-intensive)?
HMW adopt control solutions for specific contexts and populations?
HMW learn from human TB for bTB and vice versa?
HMW network researchers from different regions?
HMW incentivize the various small/medium/large holders to converge with international programs?
HMW make bTB control and global and public good?
HMW establish multidisciplinary international networks?
HMW ensure representation of smallholders in these networks?
HMW define how farmers will benefit from TB control in different settings?
HMW leverage these networks by tackling more diseases than bTB?
HMW take advantage of the situation's potential?

Attendees of the bTB Workshop

Rabat, Morccco • December 2015

