College of Agriculture and Natural Resources
MICHIGAN STATE UNIVERSITY

WorldTAP

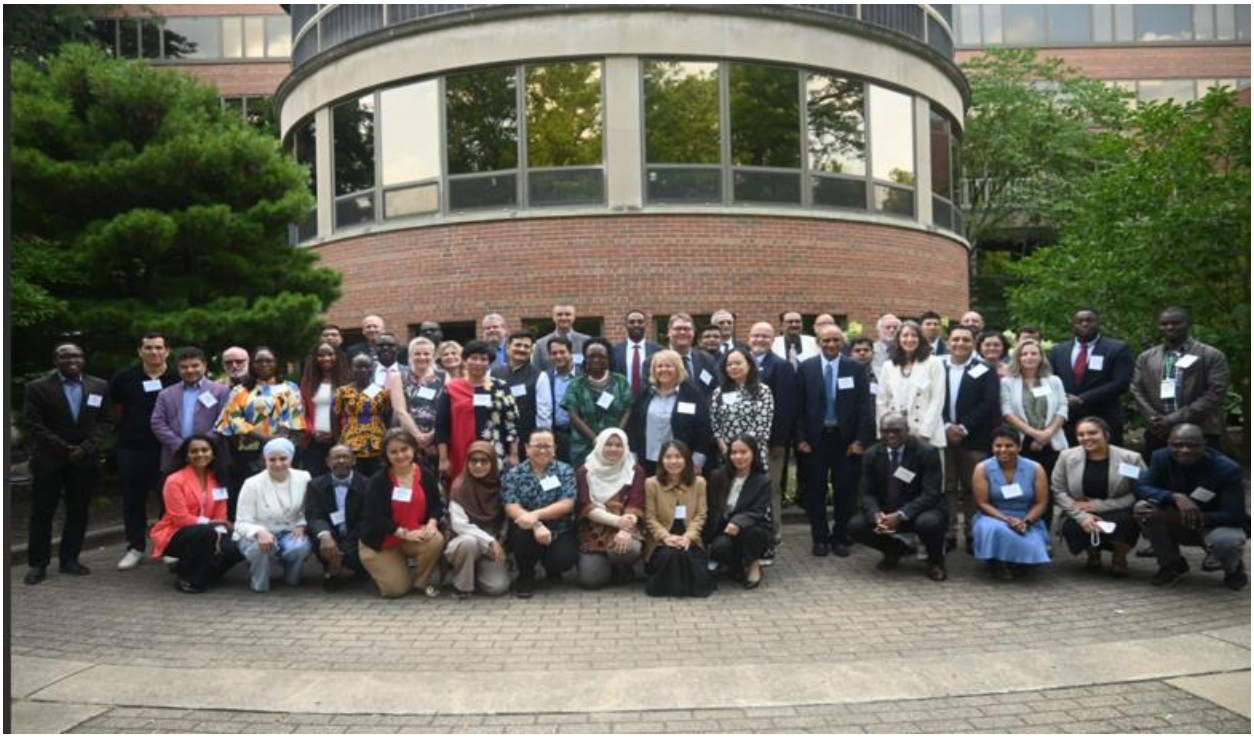
MICHIGAN STATE UNIVERSITY

Proceedings of the Global Food Safety Symposium

July 21 – 24, 2024

Organized by:

World Technology Access Program (WorldTAP)
College of Agriculture and Natural Resources
Michigan State University
East Lansing, Michigan, USA



Proceedings Prepared by:

Dr. Karim Maredia, Dr. Ramjee Ghimire, Dr. Allan Liavoga,
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Foreword

International cooperation and collaboration are the hallmark of Michigan State University (MSU). As a premier land grant university in the U.S., MSU is actively involved in providing training and capacity building in agri-food systems and international agriculture. Food safety is one of the core areas of the training and capacity-building programs offered by the College of Agriculture and Natural Resources (CANR) at MSU.

Food safety is a global issue. Strong nations are built on safe, abundant, healthy, and hygienic food supply. There can be no food security without food safety. Recognizing the critical role food safety plays in agri-food systems, public health, and trade, the World Technology Access Program in CANR at MSU initiated the International Food Safety Short Course in 1999 to share U.S, experiences and best practices in food safety with the global community.

Over the past 25 years, more than 700 food safety professionals from over 75 countries have been trained through the international food safety short course. This program has been offered annually in collaboration with faculty members from several departments and units at MSU and other collaborators from U.S. state and federal agencies, industry, and non-governmental and international organizations.

In celebration of the 25th anniversary of this program, we were delighted to host the Global Food Safety Symposium at MSU from July 21 – 24, 2024, which brought together a diverse group of more than 71 participants from over 25 countries. The goal of this symposium was to reflect on the past and discuss future opportunities in strengthening food safety capacity worldwide. MSU is grateful to CropLife America, Neogen Corporation, Reckitt, and Michigan Dairy for their generous support for the symposium. This report summarizes the deliberations, keynote addresses, interactive panel discussions, and breakout sessions held at the symposium.

Moving forward: Building on the strong network developed over the past 25 years, MSU will work with its partners and launch a global food safety knowledge hub to serve as a platform for sharing food safety-related information, educational and training programs, and networking opportunities worldwide. The WorldTAP program is looking forward to continuing collaborations with the global partners in offering food safety-related services.

With best wishes,

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Acknowledgements

Michigan State University's College of Agriculture and Natural Resources extends its sincere gratitude to all participants for their active participation and contributions to the global symposium on food safety. We especially value the insights provided by our international attendees, whose unique perspectives enriched the discussion. Our thanks also go to the guest speakers and food safety practitioners from both within and outside the State of Michigan who generously shared their knowledge and experiences. This symposium was made possible through the generous support of our partners including Reckitt, Neogen Corporation, Michigan Dairy, and CropLife America. Finally, we appreciate the hard work of the WorldTAP Team members - Dr. Karim Maredia, Dr. Allan Liavoga, Dr. Ramjee Ghimire, Dr. Callista Rakhmatov, and Dr. Saroopa Taylor, along with Ms. Emma Jernstadt and Mr. Samir Sherali.

Acronyms

AI	Artificial Intelligence
BIS	Bureau of Indian Standards
CANR	College of Agriculture and Natural Resources
CSR	Corporate Social Responsibility
FAO	United Nations Food and Agriculture Organization
FBOs	Food Business Operators
FDA	Food and Drug Administration
FSIL	Feed the Future Innovation Lab for Food Safety
FSIS	USDA Food Safety Inspection Service
GFoLNet	Global Food Laboratory Network
GFSI	Global Food Safety Initiatives
GFSKH	Global Food Safety Knowledge Hub
GFSS	Global Food Safety Symposium
GMO	Genetically Modified Organism
HACCP	Hygiene Critical Control Point
IFIC	International Food Information Council
IFPTI	International Food Protection Training Institute
INFOSAN	International Food Safety Authorities Network
IoT	Internet of Things
LAMP	Loop Medicated Isothermal Application
LMICs	Low- and Middle-Income Countries
MSU	Michigan State University
PPP	Public Private Partnership
SMEs	Small and Medium Enterprises
SPS	Sanitary and Phytosanitary Measures
ToT	Training of Trainers
USAID	United States Agency for International Development
USDA	United State Department of Agriculture
WHO	World Health Organization
WorldTAP	World Technology Access Program

Executive Summary

Food safety is fundamental to food and health security. The risks associated with unsafe food products have broader implications for nutritional status and overall food security. Foodborne diseases not only endanger the lives of consumers but also have economic implications associated with healthcare costs and productivity losses.

To commemorate the 25th anniversary of the International Food Safety Training Course conducted by the College of Agriculture and Natural Resources (CANR), Michigan State University (MSU) organized a Global Food Safety Symposium from July 21–24, 2024, in East Lansing, Michigan. The overarching objective of the symposium was to provide a forum to discuss and recommend ways to strengthen global food safety systems, aiming to protect public health and facilitate international trade. The discussions focused on current and emerging issues, regulatory gaps, research, education and outreach, new tools and technologies, and education and training models, while charting a path forward.

More than 70 food safety professionals from public and private sectors, representing 25 countries, attended the symposium at MSU. The event featured keynote presentations, panel discussions and breakout sessions that covered six broad themes: food safety policy and regulations; research and innovations; diagnostic tools and technologies; product safety and quality; education, training and communication; and international trade. Participants shared their diverse perspectives and experiences, identified gaps and issues and discussed strategies for future collaboration and opportunities to strengthen global food safety systems.

Key conclusions from the symposium included the critical role of effective food safety systems in ensuring global food security and the collective responsibility of all stakeholders to build resilient food systems. Global collaboration among governments, industry, NGOs, academia, civil society and development agencies is essential for strengthening food safety capacities, especially in low- and middle-income countries. Recognizing the multidimensional and multisectoral nature of food safety, a holistic approach addressing food safety from "farm to fork" was recommended. The symposium highlighted the public-private partnerships (PPPs) as vital for advancing food safety programs globally.

The symposium emphasized the need for collaboration among national regulatory agencies and various organizations to avoid overlap and duplication as well as ensuring that local food safety standards are aligned with international standards. Participants stressed the importance of continuing education and training for stakeholders and raising awareness through extension and outreach programs. Participants also stressed the importance of leveraging new tools and technologies for the diagnosis, detection and traceability of food hazards. Harmonizing food safety policies with international standards was identified as a key priority. As a way forward, symposium participants recommended the establishment of a **Global Food Safety Knowledge Hub (GFSKH)** to serve as a clearinghouse and a global resource for food safety information, education, training and networking opportunities.

Background

The Imperative of Food Safety

Food safety is a fundamental public health concern. The risks associated with unsafe food extend beyond individual health issues; they have broader implications for nutritional status, overall food security and international trade. Unsafe foods not only endanger lives but also create substantial economic burdens due to healthcare costs and productivity losses.

Complex Food Supply Chains

Globalization has complicated food supply chains. Longer supply chains mean more points where contamination can occur, increasing the potential for food safety risks. This complexity is further exacerbated by the effects of climate change which influences food production, processing, storage and distribution. Adapting to these challenges requires a multifaceted approach that includes both preventive and responsive strategies and best practices.

Holistic Approach to Food Safety

Adopting food safety practices effectively involves examining it through a holistic, systems-based lens. This means considering the entire food supply chain, from farm to fork. Everyone in the food system—producers, processors, distributors and consumers—have a role to play. Implementing preventive measures, improving hygiene practices and leveraging technologies for better monitoring along the food supply chain are crucial steps in minimizing risks.

National and International Coordination

To ensure that food safety standards are both effective and efficient, coordination at multiple levels is essential. National governments must develop and enforce rigorous food safety standards and regulations. Regionally and internationally, there must be efforts to harmonize food safety standards and regulations to facilitate trade while protecting public health. This involves balancing stringent safety measures with the need to avoid creating unnecessary trade barriers.

Technological Innovations and Capacity Building

Innovation plays a key role in advancing food safety. Tools and technologies such as blockchain for traceability, advanced sensors for detecting contaminants and data analytics for predicting potential outbreaks can enhance food safety systems. Additionally, strengthening the capacity of food safety systems through training resources, communication, networking and infrastructure is vital for adapting to new risks and maintaining consumer confidence.

Introduction

Since 1999 when the International Food Safety Short Course at Michigan State University (MSU) started, it has achieved remarkable success by training over 800 professionals mostly from low- and middle-income countries (LIMCs). This training program has focused on critical areas such as food safety policy, food laws and regulations, risk analysis, risk management, risk communication and food safety program implementation.

To commemorate this milestone, the World Technology Access Program (WorldTAP) in the College of Agriculture and Natural Resources at MSU organized a Global Food Safety Symposium from July 21 to 24, 2024. This event brought together 71 participants

from 25 countries, highlighting the program's outcomes and global impacts. The countries represented spanned diverse regions including Africa, Asia, the Americas and Europe, showcasing the broad reach and influence of MSU's efforts on global food safety training and capacity building.

The symposium served not only as a celebration of past achievements, but also as an important platform for shaping the future of food safety in a global context. It underscored the vital importance of continuous collaboration in tackling global food safety challenges. By fostering dialogue and experience sharing, the symposium highlighted the urgent need for collective action to ensure safer, nutritious and healthier food for all.

Objectives

The goal of the symposium was to provide a forum to deliberate and recommend ways of strengthening current global food safety systems to protect public health and facilitate international trade by examining:

- *Current and emerging issues*: identified and discussed both existing and new challenges in food safety to stay ahead of potential threats and trends globally.
- *Gaps in regulations and policies*: assessed and pinpointed deficiencies in current food safety regulations and policies with an emphasis on addressing how these gaps affect responses to emerging issues.
- *Research and outreach*: examined the inadequacies in food safety research and the effectiveness of communication and outreach programs, and ways to improve.
- *New tools and technologies*: the potential of innovative food safety diagnostic and analytical tools and technologies was explored to enhance the effectiveness of food safety programs with a focus on leveraging digital advancements.
- *Education and training models*: new approaches and models for education and training were brainstormed to better tackle current and emerging food safety challenges aiming to improve the workforce's readiness.

Symposium Overview

Participants and Scope

- *Geographic diversity*: The inclusion of participants from Africa, the Americas, Asia and Europe highlights the global perspective of the symposium. This diversity was crucial for understanding regional challenges and solutions in food safety.
- *Stakeholders*: The mix of stakeholders, including regulators, academicians, scientists, industry and NGO representatives, ensured that discussions were grounded in practical experience and informed by regulatory, research and outreach perspectives.

Format

- *Interactive sessions*: Interactive panel discussions and breakout sessions provided opportunities for in-depth discussions and dialogue. These sessions were meant to allow for targeted brainstorming on specific issues with diverse ideas and perspectives from different countries and stakeholders.
- *Keynote Addresses*: Presentations from eminent professionals in food safety set the stage for discussions and provided high-level insights into current issues, trends and challenges in food safety systems in a global context.

Focus Areas

- *Policy and regulations*: This topic addressed the frameworks governing food safety and how they can be adapted or improved in response to emerging global issues.
- *Research and innovations*: Focused on new developments in food safety science, including novel technologies and methodologies.
- *Diagnostic tools and solutions*: Discussed advancements in food safety testing methods and the development of new diagnostic tools.
- *Education and Training*: Examined current food safety educational and training methods and their effectiveness.
- *Communication and Outreach*: Looked at strategies for raising awareness on food safety issues and ensuring effective communication with the public and other stakeholders.
- *Food Product Safety and Quality*: Assessed how current food safety systems respond to current and emerging threats to food supply chains.
- *International Trade*: Discussed how food safety policies and practices affect global trade and how international cooperation can be improved to address cross-border food safety challenges.

Symposium Highlights

The Global Food Safety Symposium program started on Sunday, July 21 with an inaugural session. Dr. Karim Maredia, director of International Programs in the College of Agriculture and Natural Resources (CANR) at Michigan State University (MSU) provided context, background and overview of the symposium. Dr. Maredia highlighted the achievements and impacts of MSU's International food safety short course, which has been offered over the past 25 years.

Dr. George Smith, director of AgBioResearch and senior associate dean of College of Agriculture and Natural Resources at MSU welcomed the symposium participants. He stressed the importance of food safety in building resilient food security programs globally. Dr. Smith congratulated the MSU WorldTAP team for achieving this milestone of 25 years of food safety education and training for professionals from all over the world. He challenged the participants to be bold, innovative, strategic, transformative and to think outside the box towards building effective food safety programs in the future.

In the keynote speech at the opening session, Dr. Robert Donofrio, the chief scientific officer from the Neogen Corporation based in Lansing, Michigan, highlighted the pivotal role of new technologies in enhancing global food safety and security. He called for greater collaboration between industry and academia, presenting a three-pronged approach: improving food safety, enhancing animal welfare, and increasing output through genomics tools.

Dr. Kelly Cormier, food safety division chief, Center for Nutrition, Bureau for Resilience, Environment and Food Security at USAID in Washington, D.C., highlighted that the goal of food safety for all can seem elusive, and progress is slow. She added that to push this agenda forward the USAID advocates for five action points: sustain political will to modernize legislative and governance frameworks for food safety system; enhancement of the performance of food control systems through evidence-based decision making; ensure international representation and advocacy for food safety; elevation of consumer and industry awareness of food safety to generate demand for both legislative and governance reform as well as private sector investment; harmonize

standards and improve border systems to facilitate trade in safe food. The network of champions and change agents is evolving in complexity to match the scope of the challenges.

Ms. Margaret Burns-Rath, acting international coordination executive, USDA Food Safety Inspection Services (FSIS), stressed that food safety cannot be viewed as an island, and it poses a challenge due to the interconnectedness between humans, animals and environmental health; hence the importance of integration of the one health approach in food safety governance. Countries need to actively be involved in Codex standard-setting processes for harmonized approach to risk assessment and risk management. Harnessing science, artificial intelligence (AI) and other tools and technologies will be key to effectively managing food safety in the future. Regulatory agencies across the globe need to embrace transparency and data sharing and frequently engage relevant stakeholders for an inclusive process.

Mr. Ray DeVirgiliis, global regulatory policy manager at Reckitt/Mead Johnson Nutrition Corporation, emphasized the need for harmonizing global regulatory frameworks, particularly in relation to infant milk formulas. He illustrated this with the varying Vitamin D requirements in infant milk across Europe and other regions of the world. Mr. DeVirgiliis also underscored the necessity of streamlining product approval timelines by recognizing third-party risk assessments and accelerating the approval process.

Delivering his keynote address on "Emerging Issues and Technological Advancements in Food Safety," Mr. Tony Flood, senior director of food and ingredient safety at the International Food Information Council (IFIC) shared the results of a study which shows that healthcare professionals and registered dietitians are the most trusted sources for what foods to eat and what foods to avoid. Emerging food safety issues such as microplastic are sporadic in nature, are not connected to policy or regulation, are negative to the environment and/or public health and are disruptive to consensus science. To handle these issues, we need constant monitoring, consistent data and results across multiple researchers, "Expert" input and perspective, and data, conclusions and recommendations matter.

In his closing remarks, Dr. Mattthew Daum, interim dean of MSU College of Agriculture and Natural Resources highlighted MSU's land-grant mission of advancing knowledge and transforming lives. He extended CANR commitment to supporting food safety capacity strengthening programs globally. Dr. Daum thanked the WorldTAP team at MSU for organizing the global symposium and the achievements of past 25 years. He emphasized the need for all the participants of symposium working together to address pressing challenges of global food security.

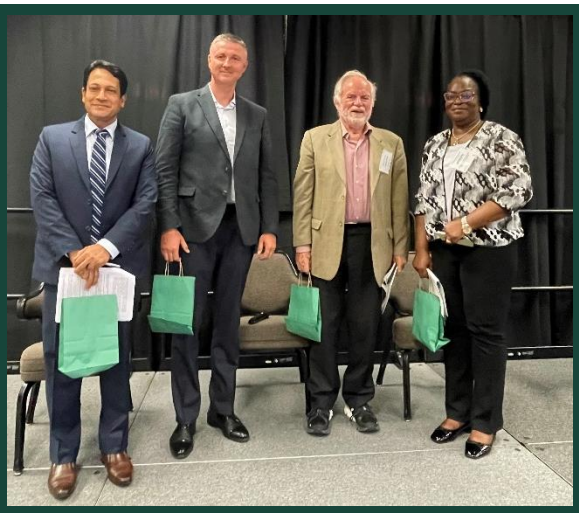
Panel Discussions:

During the global food safety symposium, six interactive panel discussions were held. The summary of the panel sessions and key strategies and recommendations are highlighted below:

Panel I. Food Safety Policy and Regulations

Introduction

Food safety is considered a public good, and it is responsibility of everyone to protect the food supply chain. Unacceptable rates of foodborne illness remain, while new food safety risks are emerging, and new hazards continue to enter the food supply. Food safety policies and regulations are necessary to prevent, protect against, mitigate, respond



Panel I Moderator: Ms. Modupe Adeyemo, program officer – Food Safety, African Union Development Agency (AUDA-NEPAD), South Africa

Panel I Members:

- Mr. Ray DeVirgiliis, global regulatory policy manager, Regulatory Policy in Nutrition, Reckitt, USA (participated virtually via Zoom)
- Dr. Mehedi Hasan, project management specialist, USAID Mission, Bangladesh
- Dr. Dzemil Hajric, director general, National Food Authority, Bosnia and Herzegovina
- Dr. P. Vincent Hegarty, adjunct professor, Global Food Law Program, College of Law, MSU, USA

to and recover from threats and hazards that pose the greatest risks in the food supply.

Science-based policies and regulations and their implementation and enforcement are critical for ensuring a safer food supply chain for the global community. Policy and regulatory interventions that improve food safety processes and practices at the domestic level have a spillover effect that allows a country to meet international standards and engage in international trade. The reverse is also true, striving to meet food safety standards and requirements of the importing countries can also impact domestic food safety processes and practices for the exporting countries.

As the world around us evolves rapidly with the adoption of new technologies that range from digital tools to new sources of food ingredients as well as new business models for supplying and distributing foods, so does the emergence of new issues to consider when regulating food safety. The role of intergovernmental and multistakeholders' engagement at the national, regional, and international levels as well as public and private sector collaboration should be factored in at all stages of food safety policy and regulatory development and implementation. Below are identified issues that countries can address by adopting the suggested strategies for stronger and more resilient food safety ecosystems.

Current Challenges and Deficiencies

- *Shift from hazards to risk:* developing countries often tend to focus more on hazards than risks, leading to misplaced priorities and investments in food safety governance.
- *Governance and jurisdictional overlap:* lack of coordinated efforts and overlapping roles among agencies leads to ineffective regulatory enforcement, duplication of efforts and waste of resources.
- *Slow bureaucratic processes:* Bureaucratic delays in updating regulatory standards and guidelines result in lost opportunities and slow adaptation to new challenges.
- *Transparency and trust:* Regulatory processes at national level often lack transparency, leading to public distrust.
- *Standard harmonization:* Instances where local standards are not aligned with international standards (e.g., Codex), causing trade challenges and conflicts.
- *Resistance to new measures:* The food industry in some regions resists new regulations for example, labelling requirements.

- *Scientific evidence and technological adaptation:* Slow adoption of scientific evidence and new technologies hampers the effectiveness of food safety regulations and the ability to remain current.
- *Focus on export markets:* In low- and middle-income countries (LMICs) particularly, more emphasis is placed on food safety for export markets with less attention on locally consumed foods especially in informal markets.
- *Decentralization:* The potential benefits of decentralizing regulations for better enforcement have not been fully exploited.

Recommendations and Strategies

a) Policy and regulatory framework
  - *Governance clarity* - Clearly define roles and responsibilities of governing agencies to avoid overlaps, duplications and improve efficiency.
  - *Stakeholder consultation* - Engage all stakeholders including businesses, policy makers and consumers in policy and regulatory development whilst ensuring transparency in the process.
  - *Scientific basis and data* - Formulate policies based on scientific evidence and data. This should be supplemented with regular audits and impact assessments to inform policy and regulatory adjustments for the improvement of food safety systems.
  - *Artificial Intelligence (AI) in regulation* - integrate AI to enhance regulatory processes.

b) Strengthening Regulatory Processes
  - *Crisis preparedness* - Develop and maintain a comprehensive food safety emergency response plan addressing preparedness, management and response.
  - *Proactive approach* - Implement surveillance systems to generate data, use AI for threat identification, involve academia in research and ensure that traceability systems are in place.
  - *Capacity building* - Invest in training, establishment of accredited laboratories and testing methods to support food safety policy implementation.

c) Harmonizing Policies
  - *Alignment with international standards* - Ensure alignment with Codex Alimentarius and ISO standards. Set milestone targets for developing countries to elevate food safety standards.
  - *Overcoming barriers* - Address bureaucratic processes and improve communication and coordination among relevant government departments.
  - *Codex meetings* - Encourage and support national participation in codex meetings and harmonize standards with a focus on public safety as well as trade.

d) Embracing the One Health Approach
  - *Integrated approach* - Foster collaboration between relevant government departments to implement one health approach. Share information and data across sectors and agencies.
  - *Umbrella organization* - Establish a national One Health Commission to guide governments and oversee information sharing.
  - *Joint action plan* - Develop and implement joint action plans with clear guidelines, prioritizing food safety within the One Health framework.
  - *Public-private partnerships* - Encourage collaboration between the public and private sectors for effective integration and implementation of food safety policies.

Panel II. Research and Innovation in Food Safety

Introduction

Food systems are increasingly becoming globalized, and it's expected that they will experience more changes in the next decade than we have seen in recent years. These transformations will present new challenges for food safety, underscoring the urgent need for research and innovation. It is crucial to develop advanced methods for predicting, detecting, testing, preventing and responding to emerging risks in food systems.

Given the rapid pace of scientific advancement, new food technologies and shifting trade dynamics, more research and innovation across all areas of food safety are essential. Regulatory science must also stay current with these technological advancements and emerging issues to support robust regulatory frameworks and decision-making processes. The swift evolution of global food systems, along with pressing concerns like climate change, antimicrobial resistance and new pathogens, makes it clear that innovative research and strong partnerships are crucial for effective food safety management systems. The following issues and strategies were proposed during the panel discussion to help improve research and innovation in food safety. By addressing these constraints, stakeholders can work to advance food safety research and innovation ecosystems and help enhance resiliency in our food systems.

Current Challenges and Deficiencies

- *Private sector involvement:* The private sector should be engaged early in public-private research collaborations to ensure successful commercialization and scaling of research outputs.
- *Funding gaps:* Food safety research frequently suffers from a lack of long-term funding and is often given low priority by funding agencies and governments. Additionally, there is insufficient investment in critical infrastructure for food safety research, such as diagnostics laboratory facilities.
- *Regulatory sluggishness:* Regulatory processes are slow to integrate new scientific findings and advancements leading to a lag in adapting to emerging issues.

Panel II Moderator: Dr. Cathy Weir, principal regulatory affairs scientist, Kalsec, Kalamazoo, Michigan, USA

Panel II Members:

- Dr. Felicia Wu, distinguished professor, Michigan State University, USA
- Dr. Alejandro Ortega-Beltran, research scientist, International Institute of Tropical Agriculture, Ibadan, Nigeria
- Dr. Manojit Basu, vice president of science policy, CropLife America, Washington, DC, USA
- Dr. Kelley Cormier, Food Safety Division chief, Center for Nutrition, USAID Bureau for Resilience, Environment and Food Security, Washington, DC, USA

- *Focus on export market:* There is a tendency for food safety research to prioritize and focus more on food trade or export-oriented food products over locally consumed products.
- *Antimicrobial resistance:* Overuse and misuse of antibiotics is leading to resistance of microbes to even very strong antibiotics, which needs to be addressed through targeted research, outreach and program implementation.
- *Surveillance:* Research into affordable and accessible tools and technologies for rapid and efficient disease detection and surveillance is crucial especially for LMICs.
- *Climate change:* More research should be directed towards anticipating and addressing food safety issues arising from climate change.
- *One-Health approach:* Food safety is intrinsically linked to human health, environmental health and animal health. Therefore, countries need to integrate a One-Health approach into their food safety research, outreach and program implementation agenda.

Recommendations and Strategies

a) Areas for research and innovation

- *Responding to emerging risks* - With climate change altering patterns of disease and pest prevalence, research into adaptive food safety practices is crucial. This includes developing more resilient food crops and sustainable practices to mitigate the effects of climate change on food safety.
- *Addressing antimicrobial resistance* - Research into alternative treatments and preventative measures, such as vaccines for livestock and more stringent antibiotic stewardship, is essential.
- *Regulatory science* - As new technologies and threats emerge, regulatory frameworks must adapt. This requires ongoing research to inform policy and ensure that regulations are based on the latest scientific evidence. Collaboration between scientists, policymakers, regulators and industry stakeholders can help develop robust, flexible policies.
- *Innovative partnerships:* Addressing these challenges will require collaboration across various sectors, including academia, industry, government, NGOs and international organizations. Building partnerships can facilitate the sharing of knowledge and resources, leading to more effective solutions.
- Other potential research areas:
    - *Detection and surveillance* - research to develop easy methods for tracking hazards and surveillance.
    - *Consumer behavior* - research on consumer demand and consumer behavior in rural and urban areas and how it impacts food safety and food systems.
    - *AI* - Research on the application of AI to enhance traceability of food hazards and risks.
    - *Pollutant adjuvants* - research on the effects of pollutant adjuvants in pesticides on food products and their breakdown products.
    - *Microbial indicators* - develop new packaging technologies with microbial indicators, such as color-changing stickers, to signal contamination**.**
    - *Food preservation* - Innovate in food preservation technologies to improve shelf-life,

particularly especially in LMICs where there are populations with limited refrigeration and cold storage capabilities.

b) Innovative research partnerships

- *Public-private collaboration* - Encourage partnerships that involve both the public and private sectors, with clearly defined roles and goals for effectiveness.
- *Indigenous knowledge* - Integrate indigenous knowledge into research and ensure equitable benefit-sharing through strategic partnerships.
- *Cross-disciplinary engagement* - create platforms and facilitate collaborations across disciplines including social and natural sciences to tackle complex food safety challenges.
- *Science communication* - include science communicators in partnerships to effectively translate and communicate complex research findings to broader audiences.
- *Global frameworks* - Develop specific global frameworks (i.e., similar to a "Nagoya Protocol" for food safety) to highlight research and industry needs in food safety.

c) Research funding and public engagement

- Governments to diversify funding pool to reduce reliance on external donors whose objectives may not necessarily align with national priorities.
- Advocate for increased investment by governments in food safety diagnostic infrastructure.
- Consider informal markets in food safety policies and program implementation.
- Increase awareness and education about the benefits and safety of indigenous crops.

Panel III. Diagnostics Tools and Solutions

Panel III Moderator: Dr Manojit Basu, vice president of science policy, CropLife America, Washington, DC, USA

Panel III Members:

Dr. Hemant Koshia, commissioner of Gujarat state, Food & Drugs Control Administration, Gujrat, India

- Ms. Dzigbordi Ama Bakar, head, Food Safety and Consumer Education, Food and Drugs Authority, Accra, Ghana
- Dr. Khin Nyein Aye, food safety consultant, Sci Spec Testing Services, Yangon, Myanmar

Introduction

Difficulties in detecting and testing food contaminants will increase with new and emerging threats and contaminants. Due to time and resource constraints, traditional regulatory practices and existing detection methods for food contaminants will not be adequate to test for all potential contaminants in food. Necessitating the advancement of diagnostic and testing solutions for food safety to keep pace with the new threats to food safety.

New digital technologies offer the potential to help predict and prevent food safety issues as well as improve detection and response when

problems occur. Digital technologies linked to big data have a very high potential for further development in the agri-sector by reshaping food supply chains. They also have the potential to contribute toward more efficient, resilient and transparent food systems and specific supply chains.

As food safety challenges evolve, traditional detection methods face limitations. Emerging contaminants and increasing complexity demand more advanced, efficient and adaptable but also affordable diagnostic tools. Below is an overview of key issues, recent techniques and recommendations for improving food safety diagnostics.

Current Challenges and Deficiencies

- *Complex contaminants*: Each contaminant requires specific testing methods, complicating detection.
- *Need for rapid and affordable diagnostic tools*: Especially crucial for microbial contaminants and adulteration.
- *Counterfeit and adulteration detection*: Challenges include identifying and verifying authenticity.
- *Regulation enforcement*: Many LMICs struggle with inadequate tools to effectively enforce food laws and regulations.
- *Sensitivity and portability*: Developing countries often lack affordable and portable devices for detection of sporadic and trace contaminants.
- *Matrix effects*: Food matrix can mask contaminants or skew detection accuracy.
- *Time-consuming methods*: Traditional methods delay responses in outbreaks as they tend to be tedious and time consuming.
- *Resource-intensive adaptation*: Updating methods for new pathogens or novel foods is costly and slow.
- *Infrastructure needs*: Advanced testing requires substantial investment, often lacking in LMICs.
- *Specific regional issues*: In Africa, rapid detection for aflatoxins and adulterants like Sudan dye is crucial.
- *Need for surveillance data*: LMICs lag in gathering data on foodborne diseases hampering effective policy prioritization and regulatory responsiveness.
- *Globalization and supply chain complexity*: Increased difficulty in monitoring and tracing.
- *Emerging pathogens and novel foods*: New threats require ongoing adaptation.

Modern Techniques in Diagnostics

Some of the recent techniques that could be or are applied in food safety diagnostics include:

- *Nanotechnology* - enhances sensitivity and specificity of tests.
- *Rapid detection techniques* - includes methods like loop-mediated isothermal amplification (LAMP) and microarray for quick results.
- *Next-generation sequencing* - provides detailed microbial profiles and traceability.
- *PCR-based techniques* - enables precise pathogen detection.
- *Proteomics* - identifies proteins associated with contaminants.
- *Blockchain and internet of things (IoT)* - improves traceability and data integrity across the supply chain.
- *Biosensors and immunosensors* - offers real-time detection with high sensitivity.
- *CRISPR-based diagnostics* - provides specific and rapid detection capabilities.
- *Microfluidics* - facilitates miniaturized and efficient testing.

- *AI and machine learning* - enhances data analysis, pattern recognition, and prediction.
- *AI in whole genome sequencing* - helps in identifying microbial strains and traceability.
- *Automated visual inspection* - identifies defects and contaminants in food products.
- *Sensor technology and IoT:* For continuous monitoring and real-time data transmission.
- *Cloud computing* - enhances data storage, accessibility and remote analysis.

Recommendations and Strategies

1. *Predicting and detecting risks* - Emerging technologies like AI and machine learning can help anticipate and identify potential food safety risks before they become widespread issues. Advanced sensors and data analytics can monitor food products throughout the supply chain to detect contaminants early.
2. *Testing and preventing contaminants* - New methodologies in molecular biology, such as CRISPR and next-generation sequencing, could revolutionize how we test for and understand foodborne pathogens. Enhanced biosensors and rapid testing kits will improve our ability to respond quickly to contamination.
3. *Simplify diagnostic tools* - Make tools more user-friendly and applicable across different contexts.
4. *Establish regional laboratories* - Create centers of excellence for diagnostics, addressing bureaucratic delays is necessary.
5. *Strengthen national frameworks* - Improve capabilities of national food regulatory agencies.
6. *Donor and development agencies* - Support the acquisition of diagnostic tools and infrastructure in LMICs.
7. *Centers of excellence for training* - Develop training programs and network with global laboratories to streamline standards.
8. *Improve data repositories and analysis* - Enhance global food safety data systems like the Global Food Laboratory Network (GFoLNet) for better analysis, decision-making and data sharing.

Panel IV. Food Product Safety and Quality

Panel Moderator: Dr. Kirk Dolan, professor, Food Science and Human Nutrition Department, MSU, USA

Panel Members:

- Mr. Derek DeLand, NSF International, Ann Arbor, Michigan, USA
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Introduction

Consumers are increasingly prioritizing food safety and demanding higher-quality and safer

food products. In response, the food industry is evolving with reformulated products, innovative new foods, and a greater reliance on digital technologies. Advances in food manufacturing and processing are leading to products with distinct safety profiles, driven by shifts in consumer preferences due to demographic and lifestyle changes. Recently, new food safety challenges have emerged, both from newly identified pathogens and from fundamental shifts in the susceptibility of populations to foodborne illnesses.

Additionally, globalization has introduced new complexities to food systems and their safety concerns. Ensuring safe and high-quality food requires a collaborative effort among key stakeholders– governments, the food industry and consumers. Some notable constraints and practical recommendations for countries to enhance the provision of safe and quality food products are discussed below.

Key Challenges and Deficiencies

- *Lack of food safety knowledge:* Insufficient awareness and training on food safety practices e.g. basic hygiene practices in the public sphere and informal food sector (e.g. street foods). This deficiency in knowledge and practices varies across different regions.
- *Cultural beliefs and practices:* Resistance to new food safety practices due to cultural norms, and the different practices and beliefs affect food handling and safety.
- *Access to clean water:* Access to clean water is critical for food safety; there is variability in water quality and availability, particularly in LMICs.
- *Chemical contamination:* Residual chemicals in food from agriculture and processing are a major concern, and the levels of contamination and regulation enforcement vary from region to region.
- *Microbial contamination:* Presence of different pathogens and their prevalence is influenced on local food systems.
- *Food fraud and mislabeling:* Adulteration and deception in labeling for economic gain undermines consumer trust. This problem varies from country to country *depending on* enforcement and ability to detect food fraud.
- *Informal markets:* Hygienic conditions and basic knowledge on food handling are often poor in informal markets, that are predominant in the LMICs.
- *Antimicrobial resistance:* Widespread overuse and misuse of antibiotics in food production contributes to resistance of microbes to these antibiotics, but none or limited regulatory controls and practices and educational and awareness programs exist.

Recommendations and Strategies

a) Enhance Education and Awareness
    - *Government and Academia* - Develop and execute educational programs for food handlers, farmers and consumers. Leverage local leaders and social media for effective outreach.
    - *NGOs* - Provide financial backing for community food safety campaigns and create guidelines tailored to local practices.
    - *Industry* - Foster food safety education through corporate social responsibility (CSR) initiatives.

b) Improve infrastructure and resources
    - Government - Invest in clean water access, sanitary facilities and infrastructure upgrades in informal markets to promote the adoption of food safety best practices.

c) Strengthen regulatory frameworks

- *Government* - develop and enforce risk-based and science-based food safety regulations, enhance regulatory capacity and improve coordination between agencies.
- *Academia* - conduct research to inform policy and offer training programs for regulators.
- *Industry* - support the adherence to food safety regulations.

d) Leverage technology and innovation

- Government and Academia - promote the development and use of innovative technologies for food safety monitoring and surveillance. Utilize digital platforms for disseminating information and tracking compliance.
- Industry - Invest in traceability systems and modern diagnostic tools.
- NGOs - Support the adoption of technology in local communities.

e) Small and medium-sized enterprises (SMEs)

- *Government* - offer financial and technical assistance to help SMEs meet food safety standards. Provide regulatory flexibility, particularly for micro and informal businesses, with a set of minimum food safety standards to be implemented.
- *Industry and NGOs* - encourage public-private partnerships to share resources and develop expertise.
- *Academia:* Offer hands-on training programs in food safety for food handlers in SMEs.

f) Promote sustainable practices

- Government and Academia - encourage sustainable agriculture and waste management practices through appropriate policy formulation and implementation.
- Industry - embrace eco-friendly practices and support sustainability CSR initiatives.
- NGOs - execute community-based projects to manage plastic waste and promote sustainability.

Panel V. Food Safety Education, Training, Communication, and Outreach

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Introduction

Education and training initiatives in food safety are vital for strengthening food safety capacities. These efforts are also crucial for increasing consumer awareness and understanding of food hazards. Providing policymakers and regulators with the necessary tools and knowledge is essential for crafting and effectively implementing science-based policies and regulations at the national, regional and international levels. Furthermore, robust training programs are needed to develop a skilled workforce capable of addressing new and emerging food safety challenges.

Educating and raising awareness among the public or target groups about food safety presents several challenges. It is critical to identify these obstacles and address them effectively within food safety education, training, communication, and outreach programs. To properly inform and educate the public about food safety risks, effective risk communication strategies must be implemented. Successful communication and outreach activities are key to achieving this objective. The multifaceted nature of food safety education, training, and communication underlines the need for a comprehensive approach to enhance global food safety systems.

Key Challenges and Deficiencies

Lack of awareness and knowledge: A large proportion of the population is not familiar with the basic food safety practices and the risks associated with improper handling of food products.

- *Insufficient competence:* Policy makers and regulators are lacking in knowledge of current science and best practices in food safety
- *Behavioral change*: Changing entrenched habits and behaviors related to food handling and preparation can be challenging.
- *Diverse audiences*: Tailoring messages to different audiences including consumers, food handlers, policy makers and regulators requires a range of communication strategies.
- *Resource Constraints*: Limited budgets and resources hinder the development and implementation of comprehensive training and outreach programs.
- *Keeping Up with Evolving Risks*: Food safety threats and technologies evolve, necessitating continuous updates to training materials and methods.

Recommendations and Strategies

a) Key stakeholders to engage

- *Consumers* - Develop targeted educational campaigns to raise awareness about food safety practices and risks.
- *Regulators and policy makers* - Offer basic and advanced training on risk assessment, regulatory frameworks, and the latest scientific developments in food safety
- *Small businesses* - Provide cost-effective, practical skills and training solutions tailored to the needs of small food business operators.
- *Educators and consumer advocates* - Integrate food safety education into school curriculums and advocate for consumer rights.
- *Community support groups and extension* - Use these groups to reach underserved populations and provide localized food safety education.
- *Donor community* - Engage in collaborative projects and funding opportunities to support food safety initiatives.
- *Media* - Utilize media platforms for widespread dissemination of food safety information and to counter misinformation.

b) Bridging the capacity gaps

- *Qualified regulators retiring* - Address this by developing succession planning and knowledge transfer programs. Establish partnerships with universities to create specialized training programs targeting upcoming and early career professionals. The knowledge and skills of retired regulators should be utilized through mentoring programs for early career regulators.
- *Emerging issues* - Foster continuous professional development through modular, up-to-date training that can quickly adapt to new challenges.
- *Collaboration with academia* - Create formal partnerships with academic institutions to integrate food safety into their curricula and research initiatives.
- *Specialized areas of food safety* - Map out the journey for specialization within food safety, identifying and promoting areas where specialized courses and/or advanced training is needed.
- *Engagement with university extension staff* - Collaborate with extension staff to disseminate knowledge and training in a community-based, accessible manner.
- *Training of laboratory technicians* - The technicians working in the food safety laboratories need to acquire skills to operate and maintain laboratory equipment.

c) Creating a global food safety knowledge hub

- Vision of the knowledge hub is to build a global resource network which can serve as a repository and clearinghouse of food safety information and deliver comprehensive, food safety farm-to-plate knowledge and promote public-private partnerships. This effort will align with global stakeholder strategies to ensure resilient and well-regulated agrifood systems, ultimately securing safer food supply for everyone.
- Additional benefits of the hub include:
    - Expert pool and training - utilizing high-throughput labs and novel test methods.
    - Global internship framework - building capacity through international internships.
    - Joint research programs - collaborating on global research to generate and share data for public benefit.
    - Access to current research findings - collate and provide access to food safety educational materials and publications.
    - Fit-for-purpose systems - developing systems to integrate small-scale producers and processors.
- Key outcome is the training and education of food safety inspectors, practitioners, managers, negotiators, lawyers, diagnostic and surveillance laboratory managers, consumer awareness program managers.

d) Additional capacity strengthening

- *Food Safety Training* - Train more food safety specialists knowledgeable in the entire farm-to-fork continuum.
- *Legal expertise in food safety* - Develop training for attorneys and legal personnel to handle food safety laws and regulations.
- *Strong food safety culture* - Invest in programs that build a robust food safety culture within organizations and communities.
- *Critical and systems thinking* - Incorporate these skills into training to enhance problem-solving capabilities.
- *Enhance job competitiveness* - Improve job conditions and benefits to attract and retain food safety professionals.

- *Degree and certificate programs* - Explore creating under-graduate and post-graduate degree programs, short course as well as certificate programs focused on various aspects of food safety using both conventional and virtual approaches using ICT/digital technologies for online programs.
- *Mentoring programs* - Develop programs to pair experienced professionals with new entrants to the field.
- *Consumer education* - Tailor programs to educate the public, children and underserved populations about food safety.
- *Social and soft skills* - Inject social sciences and soft skill aspects in the food safety training programs.

e) Implement effective risk communication strategies

- *Develop clear messaging* - Create concise, actionable messages tailored to different audiences highlighting key risk factors and preventive measures
- *Use multiple channels* - Disseminate information through various channels such as social media, local news, educational programs and public service announcements.
- *Engage in two-way Communication* - Encourage feedback from the public and stakeholders to address concerns and misconceptions. Utilize surveys, focus groups and interactive platforms.
- *Evaluate and adapt:*
    - Assess effectiveness - regularly evaluate the impact of training programs and communication efforts through surveys, assessments and feedback mechanisms.
    - Adapt strategies - adjust training content and communication strategies based on feedback and evolving food safety challenges. Stay flexible and responsive to new scientific insights and emerging risks.
    - Foster collaboration - collaboration among local, national, regional and international organizations, academic institutions and industry experts to stay informed about global trends and best practices.

f) Promote awareness and advocacy

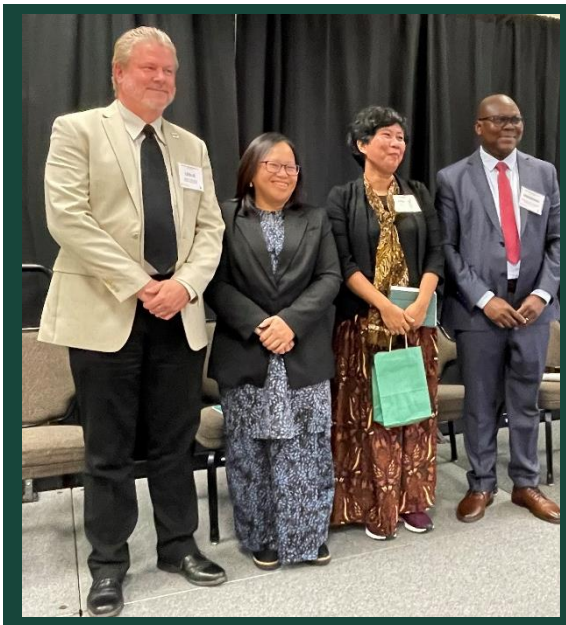
- *Public campaigns* - Launch awareness campaigns to emphasize the importance of food safety. Use stories and testimonials to make the message relatable.
- *Support policy development* - Advocate for policies that support food safety education and provide funding for sustained training and outreach initiatives.

Panel VI. Food Safety and International Trade

Introduction

While trade can contribute to the provision of sufficient, nutritious and variety of food to consumers as well as economic growth, it can also contribute to the increased possibilities of unsafe food. Food safety is an issue that transcends international borders.
Globalization of the food market has increased importation and exportation of food products among countries posing new food safety risks from emerging pests, pathogens and diseases, possible reintroduction of risks that had previously been under control or promoting the spread of contaminated food more widely.

This therefore requires countries to take further steps to improve food safety at the national, regional and international levels and ensure proper application and harmonization of food standards. However, there should be a balance so that food safety measures and



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controls protect public health while avoiding unnecessary costs and trade barriers.

Food safety in the context of international trade is a complex issue involving multiple stakeholders, regulations and standards. Herein is a summary and some challenges and recommendations for improving food safety standards, practices and regulatory harmonization globally:

Key Challenges and Deficiencies

- *Regulatory Challenges*
    - Facilitating vs. Hindering: Current food safety regulations can both facilitate and hinder international trade. Differences between regulations, such as those between the EU and USA, create barriers to trade and increase compliance costs for exporters.
    - Restrictive Regulations: While stringent regulations can impede trade, they also push exporting countries to improve their food safety standards.
- *Export Certification*
    - Governments issue export certificates to assure that food products meet international standards, but these certificates can be inconsistent and vary in their requirements.

- *Harmonization Issues*
    - Difficulty in Implementation: Harmonization of food safety regulations is challenging due to varying data, approaches and standards adopted by different countries and regions.

Recommendations and Strategies

a) Enhance harmonization

- *WTO ePing portal* - Encourage countries to notify their trading partners of any regulatory changes via the WTO ePing portal.
- *Equivalence principles* - Promote the use of equivalence principles to recognize that different standards can achieve the same level of safety.

b) Participation in international standard setting

- *Codex Alimentarius* - Encourage countries to actively participate in the Codex international standard-setting processes and support expert participation.

- *WTO SPS Committee* - Support countries' involvement in WTO Sanitary and Phytosanitary (SPS) Committee meetings for better trade negotiations.

c) Strengthen compliance and inspection
- *Capacity building* - Invest in strengthening the capacity of competent authorities and inspectorate systems to enforce compliance with international standards.

d) Improve standards implementation
- *Stakeholder capacity* - Enhance the capacity of stakeholders to effectively domesticate and operationalize food safety standards and regulations.
- *Private sector initiatives* – Leverage initiatives like the Global Food Safety Initiative (GFSI) that set food safety benchmarks for food industry.

e) Support scientific data and research
- *Data generation* - Support the generation of scientific data at national and regional level to inform standard setting.
- *Research capacity* - Strengthen food safety research and risk assessment capacity.

f) Address resource constraints
- *Training* - Support training programs and overcome resource constraints through public-private partnerships.
- *Government support* - Advocate for government support and commitment to food safety initiatives.

g) Improve coordination
- *Cooperation* - Encourage collaboration and support the establishment of functional food safety regulatory convergence forums at the national and regional levels.

h) Regulatory transparency
- Foster transparency in food safety regulatory processes to build trust and facilitate international trade.

i) Recognition of certification systems
- Promote mutual recognition of food safety certification systems to reduce duplication and streamline processes.

j) Global data Platform
- Strengthen and widen the scope of the International Food Safety Authorities Network (INFOSAN) a global network managed jointly by the WHO and FAO which facilitates the rapid exchange of information about food safety across borders and between members and makes food safety data readily available and accessible to all countries. Strengthen the capacity of the LMICs to effectively utilize this platform.

Symposium Synthesis

The symposium participants recognized that food safety is a shared responsibility essential for ensuring a secure food supply chain amidst evolving risks and new challenges. To manage these risks and protect public health while facilitating international trade, effective policies and regulations and their implementation are necessary. Both domestic and international standards influence food safety practices and trade, highlighting the need for alignment.

From a policy and regulatory standpoint, participants highlighted several elements. A predominant focus on hazards rather than risk can lead to inefficient resource allocation. Furthermore, overlapping roles among various departments and agencies often result in ineffective enforcement and bureaucratic delays in updating food safety standards, impeding timely responses to new issues. Additionally, limited transparency in

regulatory processes can erode public trust. Conflicts between local and international standards also impact trade and safety.

To address these challenges, clear governance, stakeholder engagement and alignment with international standards are crucial. It is essential for governments to prioritize food safety as a developmental goal and allocate the necessary resources to enhance regulatory frameworks and food safety governance and implementation. As global food systems evolve rapidly, tackling food safety challenges becomes increasingly important. Research and innovation will play a key role in addressing both current and emerging issues, such as climate change, antimicrobial resistance and new pathogens and contaminants. Effective solutions will require advanced methods and strategic actions.

Participants highlighted that progress in food safety program implementation is hindered by factors such as funding shortfalls, slow adoption of new scientific findings, limited public-private sector collaboration and inadequate investments in data concerning human, environmental and animal health, particularly in low- and middle-income countries (LMICs), where large amounts of food products are sold in informal markets (i.e., street food). Addressing these challenges necessitates a coordinated and multipronged approach involving research, partnerships, coordination and increased investments.

The detection and testing of food contaminants are becoming more complex due to emerging threats and intricate global supply chains. Traditional methods and regulatory practices are often insufficient due to time and resource constraints, underscoring the need for advancements in diagnostic technologies and the technical skills to utilize them. Specialized testing and rapid, affordable diagnostic tools are essential for identifying microbial contaminants and adulteration practices. The challenge of detecting counterfeit and adulterated products persists, especially in LMICs, where inadequate tools and infrastructure further complicate regulation.

There is now an opportunity to embrace new scientific techniques and technologies, such as nanotechnology, rapid detection methods, next-generation sequencing, PCR-based techniques, biosensors, AI, machine learning, blockchain and IoT. These emerging technologies offer potential for early risk detection, rapid testing and enhanced monitoring.

Consumer demand for higher food safety and quality is driving the food industry to adopt advanced technologies for safer food supply. However, challenges remain, including inadequate food safety knowledge, cultural resistance and poor water quality and sanitation, particularly in LMICs. Addressing these issues requires improved access to clean water and sanitary facilities, as well as financial and technical support for small and medium-sized food businesses. Promoting eco-friendly practices and sustainable agriculture is also crucial. Collaborative efforts among governments, industry, academia and consumers are vital for advancing food safety and quality.

Strengthening capacity through education and training is fundamental for enhancing food safety practices, increasing consumer awareness and supporting policymakers and regulators. Effective training programs are necessary to build a skilled workforce capable of addressing emerging food safety challenges. Educating the public about food safety involves overcoming challenges such as effective risk communication and adopting a comprehensive approach to improve global food safety systems.

Inclusively engaging relevant stakeholders along the whole farm-to-folk continuum, identifying and bridging capacity gaps, promoting awareness and improving communication about food safety risks are essential steps in strengthening global food safety capacity and in turn global food security.

As a way forward, to address these challenges and strengthen food safety capacities in LMICs, the symposium participants recognized the need for global collaboration. It was recommended to establish a "global food safety knowledge hub" to serve as a repository and a clearinghouse for food safety related information, training tools and resources, networking opportunities, funding opportunities, roster of food safety professionals. An international steering committee will be formed to take this global platform forward.

The key recommendation from the 2024 Global Food Safety Symposium held at Michigan State University was to continue strengthening food safety capacity-building programs worldwide through global collaboration and cooperation. With this goal in mind, symposium participants strongly recommended the establishment of a "Global Food Safety Knowledge Hub" to serve as a repository and a clearinghouse for the sharing and exchange of food safety related information, training tools and resources, networking opportunities, funding opportunities, and a roster of food safety professionals. An international steering committee will be formed to take this global platform forward towards building global knowledge partnerships in food safety for a food secure world.

Recognition

The College of Agriculture and Natural Resources at Michigan State University appreciates the contributions of the following organizations over the past 25 years. Without their generous support, this program would not have been possible.

1. Michigan State University
2. Reckitt
3. Neogen Corporation
4. United States Agency for International Development (USAID)
5. U.S. Food and Drug Administration (FDA)
6. U.S. Department of Agriculture Food Safety and Inspection Service (USDA FSIS)
7. U.S. Department of Agriculture Foreign Agricultural Service (USDA-FAS)
8. Bill and Melinda Gates Foundation
9. African Union Development Agency – New Partnership for Africa's Development (AUDA-NEPAD)
10. Michigan Dairy
11. Country Fresh
12. Michigan Department of Agriculture and Rural Development (MDARD)
13. National Sanitation Foundation International (NSF International)
14. CropLife America
15. International Food Protection Training Institute (IFPTI)
16. International Food Information Council (IFIC)

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