The Fleming Fund
Fellowship Scheme

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The Fleming Fellowship Scheme:
Transforming leadership in AMR

November 2024

Cover: QWArS training in Eswatini, led by African Society for Laboratory Medicine.

Executive Summary

The Fleming Fund is a UK aid programme that aims to improve antimicrobial resistance (AMR) surveillance in Africa and Asia. AMR is a major global health threat that is estimated to directly cause more than one million deaths annually because of drug-resistant bacterial infections.

The Fleming Fund recognises that strengthening the One Health workforce is integral to establishing and sustaining AMR national surveillance systems. In 2018, the programme launched a Fellowship Scheme for individuals working within key institutes of the human, animal, and environmental health sectors. The purpose was to build the expertise needed to generate, share, and use data on antimicrobial resistance and use. The Fellowship Scheme is an integral and essential part of the Fleming Fund's strategy, with investments made through Regional and Country Grants.

A Legacy Review was conducted in 2024 to understand how the Fellowship Scheme contributes to individual and health systems-level shifts. The aim was to examine the Scheme's impact from 2018 to 2023, following up on the experiences and career impact of the 181 fellows that completed the Scheme in phase 1 of the Fleming Fund. The assessment used a combination of online and key informant interviews.

The report highlights three key levels of change, based on responses from 119 fellows from 41 institutions in 19 countries:

1. Individual shifts in the professional lives of Fellows

As a result of participation in the Fellowship Scheme, laboratory scientists, epidemiologists, pharmacists, physicians, and veterinarians reported acquiring relevant AMR-related skills and the knowledge has enhanced their ability to produce, analyse, share, and use AMR data. These skills have furthered their position as leading professionals for AMR in their sector (and countries) and contributed to shifts in their career trajectory, earning new job titles or additional roles and responsibilities relevant to AMR surveillance and response.

2. Institutional shifts in quality standards and partnerships

Fleming Fund partners such as government departments, ministries of health, and agriculture, veterinary and human health services, food safety, and pharmaceutical departments, alongside public health laboratories, hospitals, and tertiary institutions confirmed that the Fellowship Scheme was relevant and effective in strengthening their institutions. For example, fellows have applied their new skills and knowledge to improve quality standards for laboratory diagnosis of organisms and antibiotic susceptibility. Skills transfer has occurred with fellows training others within their institutions, enhancing and sustaining the impact of the Fellowship Scheme. Also, institutional collaborations across the various One Health sectors to deliver fellowship collaborative projects have improved public awareness of AMR and strengthened AMR governance structures.

3. National systems shift to strengthen AMR response

Fellows have helped develop and revise National Action Plans to tackle AMR. By leveraging their fellowship experience, they have advocated and provided technical inputs to inform national regulations on antimicrobial use and laboratory standards. As national AMR focal points, and in some cases, members of AMR governance committees, fellows are sustainably influencing the direction of their country's response to AMR. Collaborative projects initiated during the fellowship provide evidence for shifts in policies and decisions on antimicrobial use. From a sustainability perspective, professional retention seemed high and workforce application of skills and training of other colleagues resulted from the programme.

Policy Fellow Sabrina Yesmin presenting at 'Current AMR Patterns and AMU Trends in Bangladesh' dissemination programme of CAPTURA, led by International Vaccine Institute.

This review provides follow up on the contribution and impact of a full-scale mentorship and professional development intervention across many diverse low- and middle-income settings. Overall, the legacy review provides strong evidence of the contribution of the Fellowship Scheme to support improved AMR surveillance and an impact on policy and practice. By providing opportunities to fellows, the improved technical capacity and leadership within the AMR One Health workforce has contributed to quality standards in laboratories, national awareness and understanding of AMR, and strong country AMR governance structures. The unique approach of the Fleming Fellowship Scheme has proven to be effective at providing a localised learning experience tailored to the specific capacity needs of the One Health workforce.

Use of findings

This legacy review provides insights into the perceptions of Alumni Fellows and the Beneficiary Institutions on the relevance and influence of the phase 1 Fellowship scheme. Information in this report, should therefore not be used as the sole source for estimating the general technical achievements of the phase 1 Fellowship Scheme. This report is primarily to inform programme learning and adaptations.

About the Fleming Fund

The UK Department of Health and Social Care's (DHSC) Fleming Fund is a UK aid programme supporting up to 25 countries across Africa and Asia to tackle antimicrobial resistance (AMR), a leading contributor to deaths from infectious diseases worldwide. The Fleming Fund invests in strengthening surveillance systems through a portfolio of country grants, regional grants, and fellowships, as well as global projects.

Acknowledgment and disclaimer

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Acronyms

WHO	World Health Organization
MM	Mott MacDonald
AMR	Antimicrobial Resistance
AMC	Antimicrobial Consumption
AMU	Antimicrobial Use
ASLM	African Society for Laboratory Medicine
AST	Aspartate Aminotransferase
BI	Beneficiary Institution
CPD	Continuing Professional Development
DHSC	Department of Health and Social Care
GLASS	Global Antimicrobial Resistance Surveillance System
HH	Human Health
Lao PDR	Lao People's Democratic Republic
LMICs	Low and middle-income countries
LSHTM	London School of Hygiene and Tropical Medicine
NAP	National Action Plan
QWArS	Qualifying the Workforce for AMR Surveillance in Africa and Asia
SOP	Standard Operating Protocols
STEM	Science, technology, engineering, and mathematics
UK	United Kingdom
WHONET	Free software for management and analysis of microbiology laboratory (whonet.org)

1. Background

Antibiotic resistance (AMR) is a global challenge, requiring a global response. Without action, the world risks returning to the pre-antibiotic era with associated impact on human development. in 2019, an estimated 4.95 million deaths were associated with bacterial AMR, including 1.27 million deaths attributable to bacterial AMR[1], a figure which is set to worsen if action is not taken. LMICs are particularly at risk, where populations face the highest burden of resistant infections and the least ability to track and respond to the crisis.

The UK Government has led the global response to AMR, a centrepiece of which is the investment in the Fleming Fund programme. Since 2017, Fleming Fund investments have been made across 23 LMICs to improve the capacity of national AMR surveillance systems to generate, share, and use data to guide the response to AMR. Mott MacDonald is the Management Agent for the Fleming Fund and oversees the Country, Regional Grants and Fellowship Scheme through five main investment areas:

- Laboratory infrastructure enhancement.
- Human resource strengthening and workforce reforms.
- Surveillance systems strengthening.
- Building foundations for AMR surveillance data use.
- Rational use of antimicrobial medicines.

One key challenge that the Fleming Fund seeks to address is the human resource capacity gap. To address this, the Fleming Fellowship Scheme was specifically designed to support the professional development of key AMR practitioners and policymakers in selected countries. Key objectives of the Fleming Fellowship Scheme are to:

- Enhance investments made by the Country and Regional Grants for improved surveillance AMR and Antimicrobial Use (AMU).
- Promote peer-to-peer learning and joint problem-solving through participation in One Health projects and communities of practice.
- Contribute to the global dialogue on evidence-based approaches to combatting AMR.
- Support a cadre of national and international leaders with technical competence and equipped for confident advocacy.

Following five years of implementation of the Fellowship Scheme, a legacy review was conducted to assess if and how the Fleming Fellowship Scheme has made an impact; not just on individuals, but also on key institutions and systems in different country settings. Insights from the legacy review will also support the Fleming Fund's strategic learning agenda and inform reflections on the pathways to sustainable results outlined in the Fleming Fund Theory of Change.

[1] Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis - The Lancet

1.1 Approach

This legacy review targeted fellows who had graduated from the Fellowship Scheme in the first phase (from 2018-2023), along with their employers, which we refer to as 'Beneficiary Institutions[2]' (BIs). These fellows are now part of an Alumni Scheme. Semi-structured questionnaires were developed to guide interviews with fellows and senior staff from their Beneficiary Institutions. Data collection for the legacy reviews was undertaken by each fellow's 'Host Institution' – the academic institution contracted by the Fleming Fund to deliver the fellowship. Host Institutions used proforma online templates to record responses to semi-structured interviews with Fellows and Beneficiary Institutions, and summaries of key findings and observations. All data collected was uploaded to Mott MacDonald's secure data systems, from where it was collated and analysed to address the following learning questions:

1. What is the scope and coverage of the Fleming Fund Fellowship programme?
2. How has the Fellowship programme influenced the professional lives of fellows and the local institutions they work for?
3. How have the Fellows contributed to their country's response to AMR?

1.2 Legacy Review respondents

Data collection for the legacy review was targeted at the 181 Alumni Fellows who successfully completed the Fellowship Scheme by the end of 2023. Their respective employers (BIs) who include government public health department, hospitals, laboratories, and tertiary institutions were also interviewed to corroborate the findings of interviews with alumni. Host Institutions were encouraged to interview as many traceable alumni as possible, aiming for an 80% response rate. A total of 119 (66%) alumni were interviewed across 19 countries, equating to 88% Professional fellows and 12% Policy fellows. Of those interviewed, 55% of respondents were from the animal health sector and 45% were from the human health sector. Gender representation was slightly skewed to males as three out of five respondents were male.

Training on microbiology laboratory techniques and laboratory quality management systems at National Institute of Health, Islamabad, Pakistan in 2021.

[2] Beneficiary Institutions include Government health department, ministries, agencies, and public health and animal health laboratories, tertiary institutions, and hospitals.

Training on bacteria identification and antibiotic susceptibility test, disk diffusion method by National Veterinary Laboratory at National Centre for Animal Health to surveillance laboratory officials in Thimphu, Bhutan.

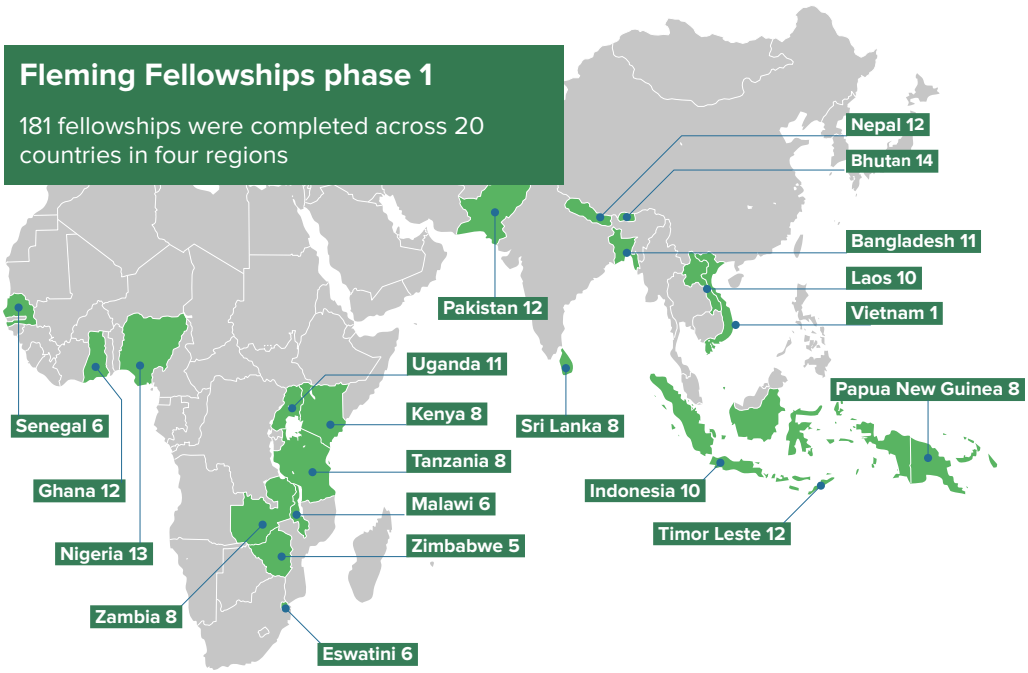
Figure 1: Legacy review respondents by country

Host Institutions	Country	BI Interviews	Total # of Alumni Interviewed
University of Liverpool[4]	Nigeria		12
American Society for Laboratory Medicine	Tanzania	7	7
Doherty Institute	Pakistan	1	5
	Timor-Leste	1	9
	Papua New Guinea		1
	Nepal	1	5
	Bhutan	1	3
Erasmus Medical Center	Indonesia	2	10
	Vietnam		0
Fondation Mérieux	Laos (Lao PDR)	3	7
	Senegal		6
Chinese University of Hong Kong	Bangladesh	5	8
	Sri Lanka	1	8
London School of Hygiene and Tropical Medicine	Ghana	3	11
	Zimbabwe	2	5
St George's	Eswatini	2	5
University of Edinburgh	Uganda	4	6
	Kenya	3	4
	Malawi	2	3
	Zambia	3	4
	Total:	**41**	**119**

[4] University of Liverpool was not the Host Institution responsible for Nigeria in phase 1. The Technical University of Denmark (DTU) coordinated the phase 1 fellowship programme in Nigeria.

2. Scope and coverage of the Fellowship Scheme

Figure 2: Geographical representation of phase 1 Fellowship Alumni



The Fleming Fellowship Scheme aims to contribute directly to human resource strengthening and workforce development by supporting the professional development of practitioners and influencers within the AMR workforce. The scheme encourages peer-to-peer learning, strong One Health communities of practice, and communication within the highest levels of government to influence AMR policies. Fellows are selected via a competitive process from within public government institutions to directly build national capacity in response to AMR. Funding is allocated to Host Institutions to work with a cohort of fellows (up to 14 fellows) in each country.[5]

Host Institutions

In phase 1, the Fleming Fellowship Scheme engaged 14 Host Institutions to deliver workplace-based fellowships to 191 health professionals in 20 countries across four regions. Of these, 181 fellows successfully completed the scheme. Host Institutions are academic and research institutions with strong expertise and institutional capacity to deliver AMR fellowships across One Health sectors. All were recruited against standard terms of reference that required them to demonstrate capabilities for delivering fellowships in laboratory science, surveillance and/or AMR policy covering human and animal health sectors while observing the Fleming Fund's principles.[7]

[5] Fellowships | Fleming Fund

[7] Phase 1 Fleming Fund principles: One Health; country ownership; alignment; sustainability; value for money.

[8] AMR bodies refers to National constituted committees or groups such as infection prevention and control (IPC) committee, AMR committees, AMR working groups etc.

Human Health Fellow Temas Ikanofi, based in Papua New Guinea.

Placement of Fellowships

The placement process was coordinated at regional level with a focus on country ownership. In-country AMR bodies[8] identified Beneficiary Institutions and distributed the fellowship terms of reference. Competitive calls were advertised internally within the BIs, and qualified interested candidates were encouraged to apply. The terms of reference for fellowships included explicit reference to the areas of expertise covered across the One Health sectors and values of gender and equity. All applications had to be endorsed by the relevant BIs before they could be submitted.

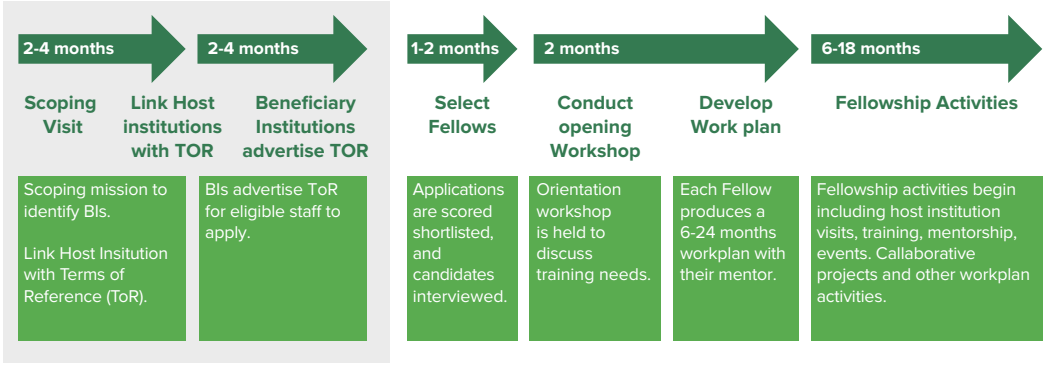
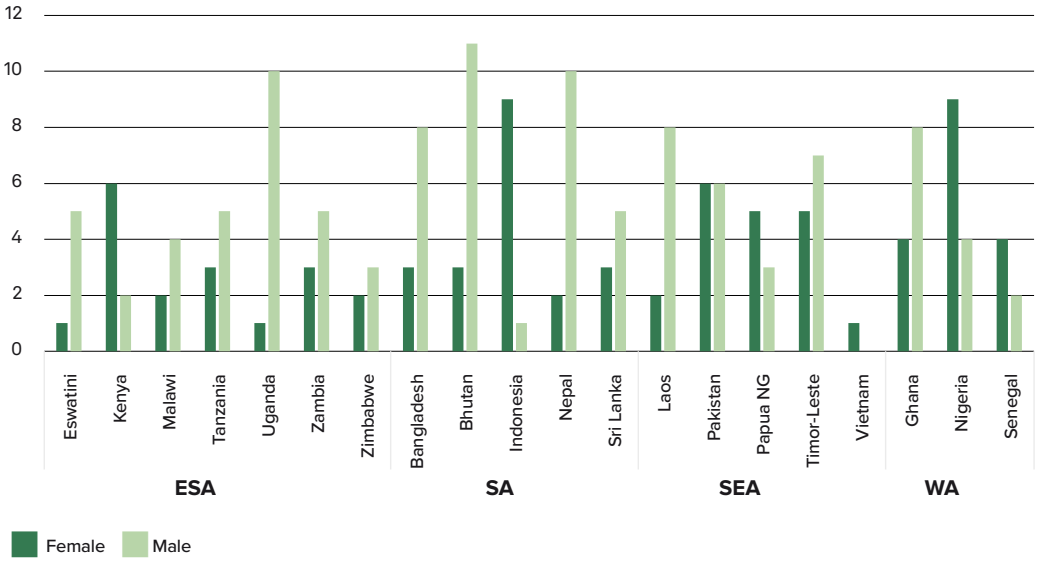


Figure 3: Process for selecting and awarding Fleming Fellowships

Overall, in phase 1, 68% of applicants to the Fellowship Scheme were male and 32% were female. Among appointed fellows, 67% were male and 33% were female; however, there were some regional differences, with female representation among appointed fellows in the Southeast Asia and Africa averaging slightly higher. There was also some variation across funding rounds – for example, 48% of appointed fellows from the first funding round (Cohort 1) were female. It was notable, however, that data on the gender balance in Beneficiary (employing) Institutions indicated that, on average, the proportion of female employees was just 38% (range, 36-44%). These gender imbalances in the institutional environment at country level proved a key constraint in achieving more equal gender representation across phase 1 fellowships. However, once fellows had been recruited, significant efforts were made to ensure equitable participation of female fellows in fellowship activities and events, e.g., conference and symposium attendance and webinar presentations and to the extent possible made allowances for life-events (e.g. maternity leave). By the end of 2023, the Fleming Fund had graduated 181 fellows, of whom 41% were female.

Figure 4: Regional and gender distribution of fellowship graduates (Alumni Fellows)



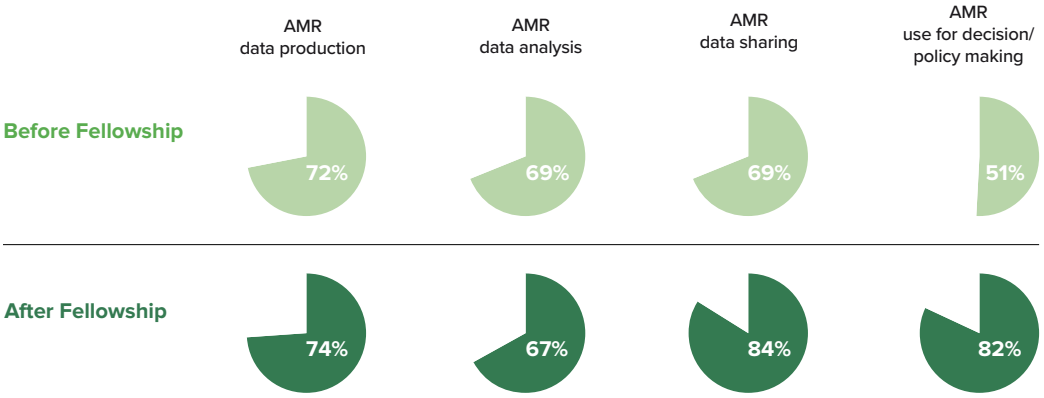
3. Impact of Fellowships

3.1 Influence on professional lives of Fellows.

Enhanced AMR related skills and knowledge

> *"I have gained a wealth of new skills and knowledge regarding Antimicrobial Resistance (AMR), an area that was not previously a major concern for me. I now have a deeper understanding of how drugs are used and the implications for AMR."*
>
> **Professional Fellow, Animal Health, Uganda**

Figure 5: Duties related to AMR performed by Alumni Fellows



Alumni interviewed = 119

Performing MIC using the Vitek 2 Compact at National Veterinary Laboratory, National Centre for Animal Health in Thimphu, Bhutan.

The Fleming Fund Fellowship Scheme is characterised by customised professional development for each fellow that centres on applied thematic learning within the workplace environment. Figure 5 shows that overall, both policy and professional Alumni Fellows are more actively involved in AMR data production, analysis, sharing and use following participation in the programme. The most obvious shifts were seen with AMR data sharing and use for decision/policy making. This could be attributed to the tailored training and mentorship designed to provide skills and learning relevant to the Fellows' on-job roles on AMR. During the fellowship, professional development opportunities covered areas such as advanced techniques in bacteriology, biosecurity, bioinformatics, whole genome sequencing, AMR/AMU surveillance, diagnostics, as well as data use, and health economics for policy development. The purpose was to improve the depth of knowledge of the fellows in their given area of specialism (whether it be microbiology, pharmacy or epidemiology, surveillance and advocacy).

Alumni Fellows interviewed for the legacy review identified some topics as new information that has improved their knowledge on AMR and One Health. Some also confirmed that they have gained new bench-skills and technical skills (e.g., in data analytics and study design) that have improved their capacity to carry out AMR surveillance and research activities.

Aquaculture Fellows in Sri Lanka performing E.coli isolation for AMR analysis.

" I have grown through the training, gaining more knowledge and confidence practical skills. I've enjoyed receiving CPD [continuing professional development] certificates for the training I have completed which I can use going forward. I am more confident on a day-to-day basis on the results that I release, it's quality data that is being produced and shared with GLASS."

Professional Fellow, Eswatini.

As part of the Fellowship Scheme, fellows were required to work closely with their cohort to develop a collaborative project that gave practical training and supported peer-to-peer learning and One Health collaboration. Alumni Fellows interviewed for this legacy review reflected on their experience completing their collaborative projects, and the links to networks of professionals they have gained from the experience. Many suggested they had also acquired enhanced critical thinking and leadership skills through the experience. Some also mentioned that the fellowship built their confidence to engage in AMR-related issues.

"It (Fellowship) was an enriching experience which, through interacting with the mentors, improved my conceptual and critical thinking. I also gained some leadership skills which are useful in my current position as Deputy Director Epidemiology and Informatics (previously Veterinary Research Officer)."

Professional Fellow, Animal Health Zimbabwe

66%

Alumni have new roles

Expanded career pathways

Responses captured in this legacy review provide considerable evidence that the fellowship experience equips fellows with relevant skills and knowledge to enhance their expertise, enabling them to contribute more proactively to the response to AMR. Approximately three out of every five Alumni Fellows interviewed for the review indicated that their role has changed since they started the fellowship. In some cases, this included a change in job title or an expansion in their scope of work to include AMR related duties. For example:

- A Veterinary Officer at the start of the fellowship is currently a Senior Veterinary Officer.
- A Deputy Director of Prevention Control Division has taken on the additional responsibility of being the National AMR focal point.

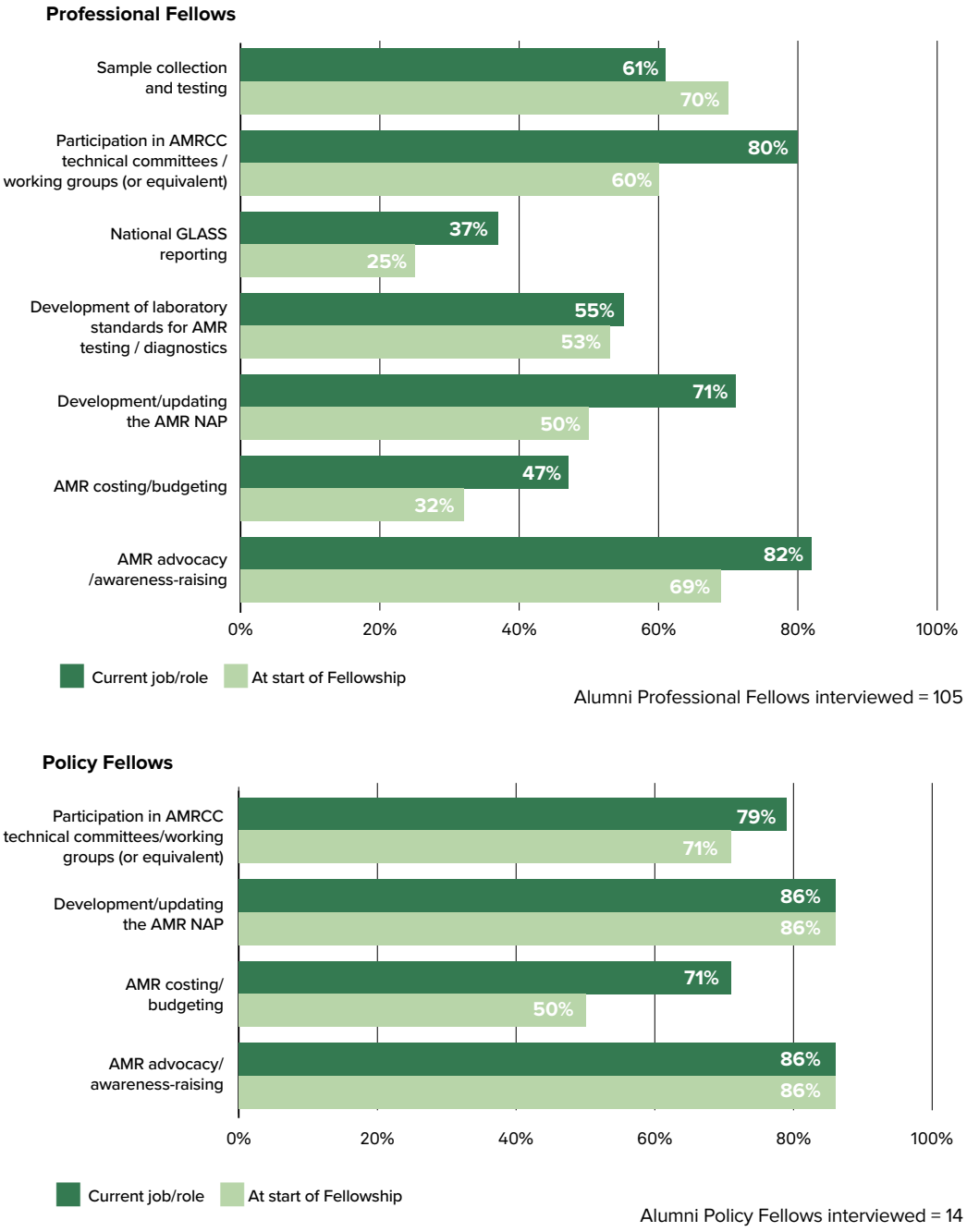
The Fellowship Scheme is needs-driven, county-focused, and part-time with long-term mentorship to support the professional development of practitioners. As such, Fellows are defined by two distinct categories with core learning objectives tailored to their individual specific workplan. Below are brief descriptions of each category of fellows:

- Professional Fellows – are expected to develop core skills required to generate, disseminate, and use country-level data on antimicrobial use and AMR.
- Policy Fellows – are expected to provide leadership in AMR workforce development and sustainable institutional / systems strengthening through training of peers and colleagues, and active participation in professional networks, conferences, and communities of practice.

Analysis of the expected specific AMR-related duties of these different categories revealed that at the start of the fellowship only 50% of the Policy fellows interviewed were actively engaged in AMR costing/budgeting. This changed after participating in the Fellowship Scheme, as up to 71% of the Policy fellows interviewed mentioned that, following the fellowship, their current jobs always/often/sometimes involved AMR costing/budgeting.

Overall, both Professional and Policy Alumni Fellows interviewed for this review indicated that their daily job requirements increased positively to include more relevant AMR-specific duties to contribute to AMR data sharing analysis and use. Comparatively there was a decline in the number of fellows who indicated that they are currently engaged in sample collection and testing. This may be attributed to changes in their job scope and titles which require less active involvement in AMR data production and more supervision and data analysis.

Figure 6: Specific related duties to AMR of Professional and Policy Fellows



Training on bacteria identification and antibiotic susceptibility test, disk diffusion method by National Veterinary Laboratory at National Centre for Animal Health, to surveillance laboratory officials in Thimphu, Bhutan.

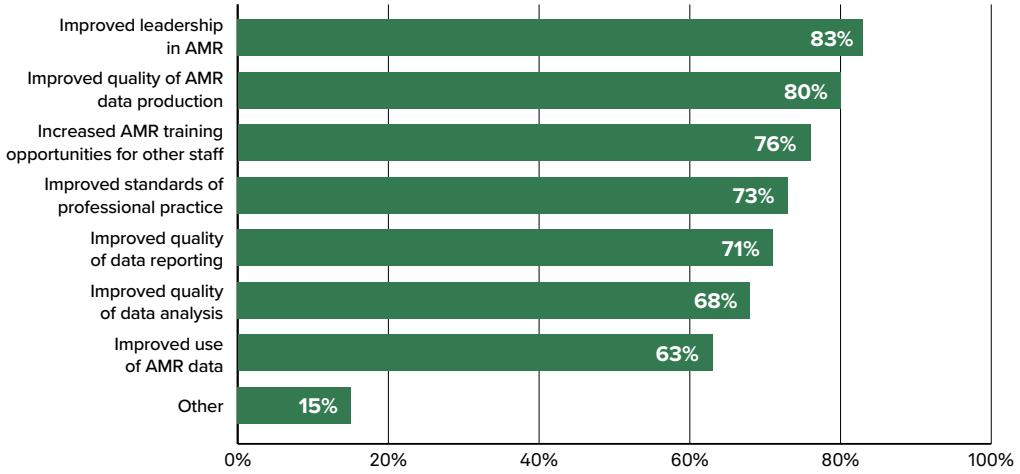
"During the fellowship, I immersed myself in antimicrobial resistance (AMR) research and gain specialized knowledge. This expertise continues to inform my work, even beyond AMR-specific contexts. Collaborating with other fellow researchers, clinicians and policymakers and improve my communication skill."

Professional Fellow, Human Health, Lao PDR

Ceca sample collection during surveillance at Regional Livestock Development Centre, Tsimasham, Bhutan.

3.2 Influence on Beneficiary Institutions

Figure 7: How has the Fleming Fellowship Scheme benefited your institution?



BIs interviewed = 41

Health professionals from 137 different institutions (BIs) in the human and animal health sectors participated in the Fleming Fellowship Scheme between 2018 and 2023. These institutions included national health departments and agencies, tertiary educational institutes, public health, and veterinary laboratories. For this legacy review, 41 Beneficiary Institutions from 16 countries were interviewed to corroborate the responses from the Alumni Fellows. Notably, all but two of the BIs interviewed, confirmed that the Fleming Fund Fellowship Scheme has benefited their institution. Top 3 benefits included:

- Improved leadership in AMR.
- Improved quality of AMR data production.
- Increased AMR training opportunities for other staff.

Directors and heads of units of the various BIs interviewed mentioned that the Alumni Fellows hold prominent leadership roles in driving AMR-related initiatives within their institution; this includes fostering the creation of AMR stewardship groups across different locations and enhancing internal coordination with clinicians. This has generally also influenced the quality of AMR data production.

> *"A gap analysis of my home laboratory processes using a checklist sent by my Mentor helped to see what needed to be done to improve the quality of our lab output (Microbial ID and AST). This greatly improved the interaction between the clinicians and the lab, yielding better patient outcome. I also shared the wealth of knowledge gained through the Fellowship with my colleagues and other stakeholders at my institution through webinars and formal Stepdown trainings.."*
>
> **Professional Fellow, Human Health, Nigeria**

Increased AMR training opportunities for other staff

> *"I have trained other laboratory personnel at the reference and at 5 provincial labs (Masvingo, Bulawayo, Mutare, Gweru and Gwanda) on bacterial identification, AST and Method Validation."*
>
> **Professional Fellow, Animal Health, Zimbabwe**

Of the BIs interviewed, 76% indicated that other staff within their institution have been trained and/or mentored by the Alumni Fellows. Responses from the Alumni Fellows suggest that some of the trainings they conducted were specific to new equipment provided by the Fleming Fund to improve laboratory diagnosis. Other trainings were related to the different topics covered during the Fellowship Scheme. The Fellowship Scheme adopts a multidisciplinary approach spanning bench-sciences (microbiology and molecular testing), management (including supply and procurement, biosafety and biosecurity), One Health (human and animal health, agriculture, horticulture, and aquaculture), epidemiology, statistics and surveillance.

Overall, there was a general perception that the knowledge and skills the Alumni Fellows shared with their colleagues have improved the overall capacity of their BI to collect, analyse, report and use quality AMR data.

Improved standards of professional practice

One out of two Alumni Fellows interviewed indicated that they had supported the development of laboratory standards for AMR testing, such as the review and update of standard operating protocols (SOPs) and guidelines. Responses from their respective BIs indicated that their institution had benefited from improved quality standards. In Zambia, for example, a Professional fellow from the Animal Health sector worked with her BI to improve their quality management system, fostering a culture of meticulously maintaining documents for quality control purposes. This subsequently facilitated the institution's accreditation for Salmonella and Enterobacterales Surveillance.

Improvements with AMR data use for clinical practice

Responses from Alumni Fellows and their Beneficiary Institutions suggests that there has been significant improvement in the generation of AMR data and management of this data to improve patient care and overall clinical practice. Of the Professional Alumni Fellows, 73% interviewed are currently involved in AMR sample collection and testing while up to 84% of both Professional and Policy Alumni Fellows interviewed are actively involved in AMR data sharing. In Eswatini, the BI interviewed mentioned that clinical practice in Mbabane Hospital has been positively influenced by the AMR results shared with clinicians. Results have influenced patient diagnostics and care.

> *"The AMS teams have been empowered to share their results with clinicians and this is changing practice on the ground."*
>
> **Senior Representative, Mbabane Hospital, Eswatini**

Animal Health Fellow Mabel Aworh, based in Nigeria.

3.3 Contributions to country AMR response

> *"I have used the knowledge gained through the fellowship to improve the data management activities at the ministry of health. I have also participated in the technical work groups as a resource person and contribute to the WHONET training programs, development of National Strategic Plan, budgeting, and costing, World Antimicrobial Awareness Week activities, and data analysis."*
>
> **Professional Fellow, Sri Lanka**

As a consequence of training and mentorship, Fellows identified their contributions to their respective countries' AMR response across several spheres of influence.

Technical contributions to the development of National Action Plans to tackle AMR

At the end of 2023, 11 out of 23 countries where the Fleming Fund has invested had a costed AMR surveillance strategy or National Action Plan (NAP). This policy document outlines priorities and systems required to tackle AMR. Alumni Fellows from 19 countries indicated that they had contributed to the development of their country's National Action Plan through participation in technical forums, including AMR technical working groups and AMR committees. Topics such as Economics and AMR Policy, Compassionate Leadership, Social Science and AMR and Communication in Science taught during the fellowship enhanced the capacity and confidence of fellows to engage in AMR policy dialogue. In Laos and Bangladesh, fellows believe their participation in the review of the National AMR policy contributed to the strengthening of regulations on AMU.

Deworming cattle for AMR analysis, in Uganda. Credit: Animal Health Fellow Joseph Kungu.

> *"I actively contributed to the development and refinement of Laos' national AMR policies. Our policies now emphasize prudent antibiotic use, infection prevention, and surveillance."*
>
> **Professional Fellow, Human Health, Laos**

Fostering AMR stewardship through AMR Technical Working Groups and AMR committees

Implementation of a National Action Plan or AMR strategy requires clear priorities on antimicrobial stewardship[9]. As part of the Fellowship Scheme fellows are taught about the use and stewardship of antimicrobials. This has had its impact on the contribution of fellows to country-level AMR stewardship. Most fellows indicated that they have been nominated as AMR focal points and/or are members of one of their country's AMR technical working groups or AMR committee. As members they provide technical inputs to the review of laboratory protocols and standards. For example, a Professional Fellow in Tanzania was appointed by the Ministry of Health as team lead for development of the national hospital formulary template and this will be adopted by health facilities across the country.

[9] Antimicrobial stewardship within the Fleming Fund Fellowship Scheme refers to measures or approaches used to optimise antimicrobial use within a system. It's exponents promote appropriate prescribing of antimicrobials, based on local evidence of antimicrobial effectiveness and resistance data, thereby contributing to the continued effectiveness of antibiotics in a population.

"The implementation of the National Antimicrobial stewardship program in eight facilities in Malawi.... has greatly benefited from the input and leadership of Fellows in the Fleming Fund Fellowship Programme."

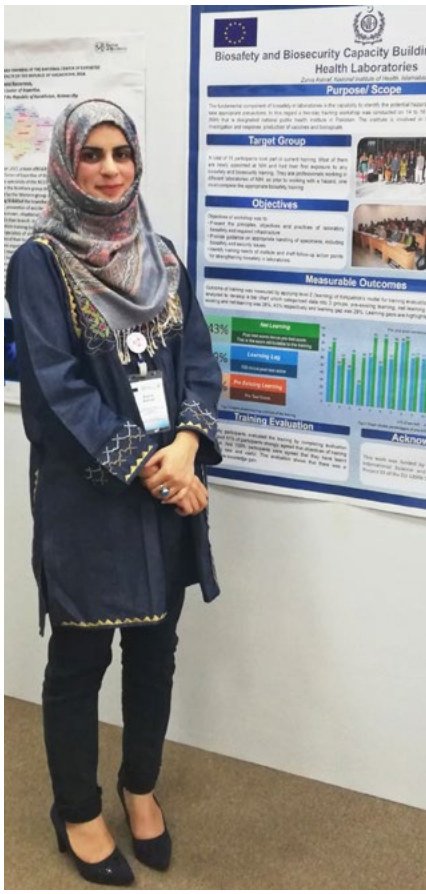
Senior Representative, Public Health Institute, Malawi

Multisectoral and international collaboration through Fellowship networks

By leveraging professional networks from the fellowship experience, Alumni Fellows have initiated collaborations across public and private sector actors, across human health, animal health and the environment to tackle AMR. In their opinion, the One Health approach taught during the fellowship built their capacity to engage with multisectoral stakeholders to break the silos and address the risks of inappropriate AMU and its related effects on AMR. In Zambia, the Public Health Unit Department of Veterinary Services is reportedly now (for the first time) working closely with the Ministry of Health and Environment to address AMR. Alumni Fellows have also taken steps to engage with private laboratories to build their capacity to collect, analyse and report AMR data by sharing skills learnt from the fellowship experience. Overall, this has improved the availability of good quality AMR data at country level.

"As a member of the National Technical Working Group on Residues of Veterinary Drugs in Foods and the AMR Community of Practice, I have collaborated with stakeholders across sectors to develop and implement comprehensive strategies for combating AMR in Nigeria. This involvement has allowed me to contribute to policy formulation, regulatory frameworks, and capacity-building efforts aimed at promoting antimicrobial stewardship, strengthening regulations, and improving supply chain management practices."

Professional Fellow, Human Health, Nigeria



Human Health Fellow Zurva Ashraf.

Fellows contribute to raising awareness of AMR

Policy Fellows Romona Ndanyi and Evelyn Wesangula.

Regional AMR Champion Media House Award for 'Silent Pandemic' documentary. Credit: Distory Communications.

In Kenya, two Alumni Fellows produced "The Silent Pandemic" documentary, which aims to shine a light on AMR, and raise awareness among policymakers and the public in Kenya. Both Professional (82%) and Policy (86%) Alumni Fellows interviewed have been engaged in AMR advocacy or awareness raising. Enthusiasm for these campaigns were largely inspired by their fellowship experience. Fellows reported that they participated in media and community outreach during World AMR Awareness Week.

In Indonesia, Alumni Fellows embarked on community outreach programmes to educate the public and professionals about the danger to themselves and others of buying antibiotics over the counter without prescription. In Nigeria and Pakistan, farmers were encouraged to adopt best practices such as hygienic animal husbandry to reduce the use of antimicrobials and protect against AMR. In Bangladesh, Alumni Fellows and their Beneficiary institutions reported that the increased awareness of AMR because of advocacy led to the initiation of AMR surveillance in fish and fish products.

"After this fellowship we achieved the skill to start AMR surveillance in aquaculture in Bangladesh."

Senior Representative, Animal Health, Quality Control Laboratory, Dept. of Fisheries, Bangladesh.

Fellowship collaborative projects inform guidelines on AMU

The design of the Fellowship Scheme includes the execution of collaborative projects to meet a specific and identified AMR-related need, emerging theme or threat within a country or region. Fellows work closely within their cohort and are supported by their mentors to design, cost and plan the project. These projects provide fellows with the opportunity to apply the practical skills they have acquired during the fellowship and embed them within their institution. The projects themselves can also be used as a tool to engage with policy makers and enhance the country's response to AMR.

Fellows interviewed during this review reflected on the professional networks they established while implementing their projects. Some have completed and published the results from their projects while others have started to engage with relevant stakeholders to ensure that results from the projects inform national guidelines on the use of antimicrobials. For example, in Nigeria a group of fellows and their mentors published a paper on Rare serovars of non-typhoidal Salmonella enterica isolated from humans, beef cattle and abattoir environments in Nigeria - PubMed (nih.gov). This study was centred on abattoirs in Nigeria. A total of 448 samples were collected from humans, slaughtered cattle, and abattoirs between May and December 2020. Results from the study revealed that beef cattle are potentially a risk to public health as rare resistant strains of Salmonella serovars were identified in bacterial cultures. In Eswatini, one of the fellows interviewed was very optimistic that the collaborative project that he is working on will inform guidelines for dairy farms in the country while another in Indonesia mentioned that:

"The genomic surveillance developed during the fellowship led to policy recommendations on genomic surveillance by the end of 2023."

Policy Fellow, Human Health, Indonesia

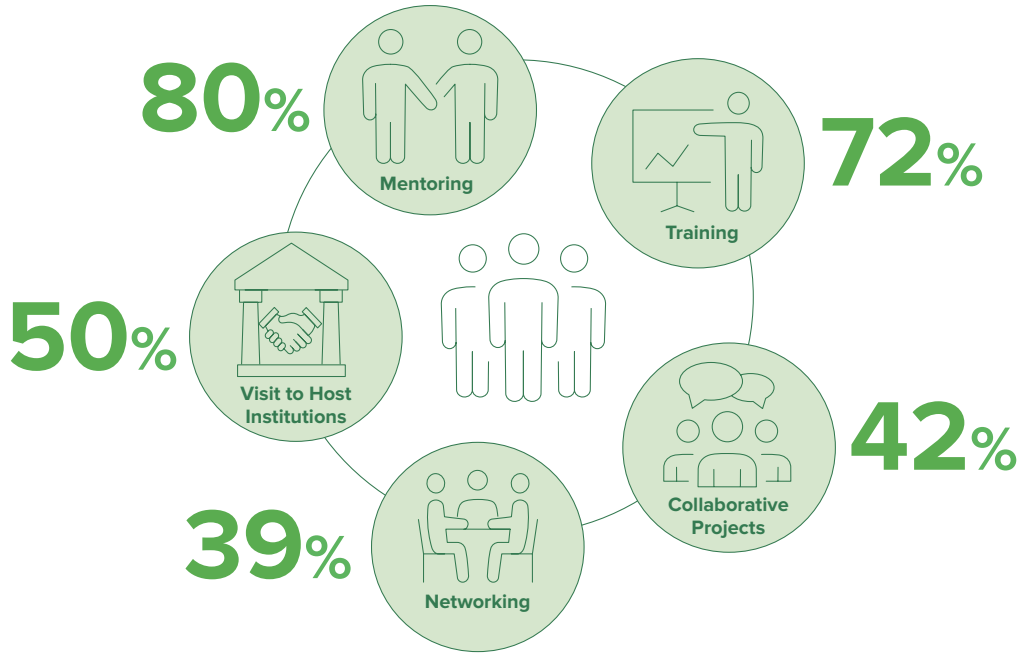
Invited by International Livestock Research Institute, Policy Fellows debate: 'How policymakers use evidence to design AMR strategies' at Københavns Uni, Denmark.

4. Moving forward

"My institution benefited from the ideas that I brought back from the institutions that I visited in Malawi and the United Kingdom. I contributed to the development of quality management systems in the bacteriology lab and in the evaluation of new equipment in the lab. With the exposure that I gained, it was easier to use the new equipment and adapt to the new automated systems that were introduced through the fund and I imparted the knowledge to colleagues working in the lab."

Professional Fellow, Zimbabwe

Figure 8: Alumni Fellow's perception of the most useful aspects of the Fellowship



Alumni Fellows interviewed = 119

Mentorship is a key element of the Fellowship Scheme. Through collaboration with Host Institutions, leading academics and practitioners are selected to mentor a specific Fellow or Fellows. Once Mentors and Fellows have been matched, they develop a joint workplan with deliverables for human resource development and career path tracking. It is therefore not surprising that up to 80% of alumni interview during this review identified mentorship as the most useful aspect of their fellowship experience. Initial training is also provided to Fellows on GLASS and WHO-NET, as well as foundation sciences, such as epidemiology (if needed). This is followed up by mentors through ongoing communication including in-person meetings both in-country and at the Host Institution. Fellows are supported, over time, to cascade the training, becoming mentors themselves for others working in surveillance in the country.

Results from this legacy review have also revealed that networking opportunities provided by the Fellowship Scheme has been beneficial in fostering national and international collaborations to tackle AMR. The scheme uses online, and in-person approaches to connect with fellows and support relationship building with their peers, mentors, and industry professionals. Other useful aspects of the fellowship identified by the alumni include the opportunities to attend conferences and the support to publish is academic journals.

Training on Ceca sample collection from poultry farm by National Veterinary Laboratory, National Centre for Animal Health at Paro, Bhutan.

4.1 Suggestions to improve impact

The Fleming Fund programme is currently in its second phase of implementation. It was therefore imperative to gather the perception of Alumni and Beneficiary institutions on what more the programme can do to improve impact. Below are highlights of suggestions captured during this review:

More time: The most common suggestion from fellows was the need for more time. Fellows suggested the duration of the Fellowship be increased to allow more engagement with Host Institutions and hands-on training. Fellows also raised challenges arising from not being relieved of any or enough work duties to fully participate in their fellowship activities. To maximise the time available for the fellowship, the programme is tailored to the individual needs of the fellow using a competency assessment tool and a detailed workplan which allows fellows to embed what they have learnt in their daily work.

Improve communication and collaborations with Beneficiary Institutions: Responses from BIs suggest a need for more active engagement with the employers (department heads/ directors/managers/supervisors) of fellows during the selection of fellows, selection of research topics/scope of fellowship as well as monitoring of fellows. BIs, would also like more regular feedback on progress including updates from the Mentor on Fellow's workplan deliverables as well as general lessons learnt and the overall impact of the cohort. BIs also believed that Fellows could benefit from having both local and international mentorship. This appeal from the BIs has already been incorporated into the design of the fellowship. It is, however, imperative to include BIs in the orientation workshops as well as regular communique sent out about fellowship updates and activities. Staff turnover within public institutions is inevitable, hence the need to ensure that key personnel or contacts within the BIs are reviewed periodically to ensure continuous communication and engagement in relation to fellowship(s) within their respective organisations.

Scale up: Both fellows and BIs requested for an expansion of the training, to include more staff within their institution, as well as from other facilities across the country. They also believed that there is a need for a national level adoption of the fellowship programme. This might imply a need for the government to support the sustainability and scale up of the fellowship. One of the first activities of the Fleming Fund at country level was a mapping of existing capabilities, capacity, activities and the identification of the most pressing needs and gaps in AMR surveillance. This informed the implementation plan of the programme to include capacity building activities by country grantees as well as the Fellowship scheme.

The capacity building component of the country grantees has a broader scope as the fellowship scheme is specifically tailored to key individuals in strategic institutions within the country. As part of the scheme Fellows are tasked with training colleagues within their institutions, however, for those within government institutions they are frequently required to train staff in other sites.

4.2 Suggestions to support Alumni Fellows

Post fellowship, Alumni Fellows leverage their networks to maintain contact with peers, mentors, and other sector professionals. These networks are the backbone for sustaining the impact of the fellowship programme. For this review we asked alumni how else we can support them to continue contributing to combatting AMR within their country or region.

Below are highlights of suggestions received.

Continuous access: Alumni Fellows would like to continue having access to relevant resources, learning and networking opportunities such as conferences, workshops, symposiums, trainings, and funding for research activities. As fellows they had access to many resources that facilitated their professional lives and capacity to improve AMR-related functions within their institutions and country. They believe that this should continue (to some extent) even after the end of the fellowship. This might include access to funds to support participation in relevant AMR activities.

Participation in phase 2: Most Alumni Fellows interviewed expressed interest in supporting the next phase of the Fleming Fund programme. Specifically, they felt they could contribute to the Fellowship scheme as:

- Mentors or co-mentors.
- Collaborators with new fellows on research projects and awareness campaigns.
- Champions or participants in country/regional grant AMR relevant activities.

Stay in touch: Generally, Alumni Fellows would like to be kept informed of happenings within the Fleming Fund programme and Fellowship Scheme. Some mentioned that they would appreciate having periodic updates on success stories and best practices for combatting AMR. They recognise that tackling AMR requires a long-term strategy and would like to continue contributing to this by staying abreast of new trends.

Policy Fellow Mabel Aworh, based in Nigeria with the British High Commissioner for Nigeria.

Aquaculture Fellow Israel Mugezi at the Fisheries Institute in Uganda.

5. Conclusion

The WHO Global strategy on human resources for health acknowledges that health systems can only function with trained and capable health workers. It also recognises that countries at various economic levels, struggle with addressing challenges associated with workforce capacity development. The unique approach of the Fleming Fund Fellowship Scheme has proven to be effective at providing a localised learning experience tailored to the specific capacity needs of health workers. Its design empowers a self-directed learning experience through a customised workplan. This learning autonomy is enhanced with mentorship and peer learning as well as national and international collaborations to develop projects that address AMR related health issues within their context.

Overall, the legacy review provides evidence of individual, institutional, and national level shifts attributed to the Fellow's participation in the fellowship scheme. Despite the fluidity of the labour markets and prevailing 'brain drain' emigration in LMICs, Fellows have remained committed to advancing AMR initiatives within their country and have taken on new roles (66%) or additional responsibilities in their current jobs. The ripple effect of the cascade of step-down training and mentorships led by Fellows provides a ripe foundation for the next round of fellowships. Over time this is expected to build up a critical mass of health professionals equipped to drive and shape technical and policy changes within their countries. Evidence from this legacy review has also revealed that:

Mainstreaming gender in health workforce capacity development requires a systems-level approach to address the gender disparities in each context. While the selection of fellows was and continues to be based on merit, results in this review revealed some disparities in the gender ratio of candidates who applied for the scheme. This may have been influenced by the pattern of STEM[10] education and employment for women in different countries. It is therefore apparent that clearer statements of equal opportunities should be emphasised throughout the application process. However, it is worthy to note that, at national level HRH gender equity disparities is subject to several determining factors beyond the scope of the Fleming Fund. According to WHO achieving global targets on universal health coverage (UHC), requires the implementation of policies that tackle the root causes of gender inequities.

Learner-centred approaches to health workforce capacity development builds ownership, capacity, and motivation for improved performance. Tailoring the learning content and experience to the professional development needs of fellows has enabled them to apply their learning immediately resulting in improved systems for AMR data production, sharing and use. This has also influenced their career pathways and professional astuteness.

Inter-professional and institutional collaborations drive continuous professional development and system strengthening. The design of the fellowship was structured to provide an enabling environment for long lasting relationships amongst academics, health professionals and institutions at national, regional, and international levels. This review has shown that fellows and Beneficiary Institutions have benefited from multiple levels of collaborations across sectors and institutions. Many Host Institutions have also expressed their intention to continue relationships with Alumni and Beneficiary Institutions in different capacities including as research partners. These continuous engagements could potentially influence the longer-term strengthening of national health systems and response to AMR and should outlast the funding period and develop into other forms of collaboration over the longer term.

[10] STEM is an umbrella term used to group together the distinct but related technical disciplines of science, technology, engineering, and mathematics.

5.1 Key recommendations for the Fellowship Scheme

As the programme progresses into its second phase, recommendations from Alumni and Beneficiary Institutions highlighted in this review have been incorporated into the implementation of the Fellowship Scheme where possible. Key areas of consideration include:

Improved timelines and workload management: For phase 2, the Fellowship Scheme has been designed to reduce the overall time per fellow (from 30% to 20% FTE) but lengthen the amount of learning. The intention was to reduce the overall work/fellowship balance to more manageable levels. However, the reality is that the overall timelines of the Fellowship for phase 2 with be like those of phase 1.

Scale up and national adoption: During phase 2, the programme intends to host one cohort per country in 20 countries resulting in a total of 200 fellowships. Eligible candidates' applications will be sourced from additional Beneficiary Institutions to build on the work from phase 1. Suggestions on working with alumni as mentors/co-mentors have been put forward to enhance local networks and provide continuous learning opportunities for both the alumni and new fellows. The Fleming Fund programme has a high-level sustainability strategy that includes engagements with key stakeholders to promote national ownership of the programme's initiatives. For example, the Fleming regional grantee QWArS has managed to get national adoption of the programme in Malawi and Nigeria, and a handful of other African countries are interested in doing so. The key for QWArS national adoption/endorsement has been the development of a qualification framework delivered by the ASLM Academy and CPD accreditation by Wits University. The qualification framework allows registered experts to be tracked and re-qualified. Since QWArS is a professional training (not an academic course), the credential recognition is at the level of professional bodies/councils and the Ministry of Health/ Agriculture.

Continuous engagement with Alumni and Beneficiary Institutions: Alumni engagement is seen as part of the drive for sustainability as well as providing continued development and support of phase 2 Fellows. The expansion of their networks increases the opportunity for mutual learning and dissemination in-country as well as internationally. The Alumni Network is a key part of the phase 2 Fellowship programme but requires sufficient (though not large amounts) of funding to develop them. The programme will therefore explore sustainable approaches to Alumni engagement. More effective communication will be explored to enhance engagements with Beneficiary Instuitions throughout the implementation of the programme. This would include participation in orientation workshops for fellows as well as other relevant seminars and workshops, and ensuring Fellows are aware of their responsibilities in communicating progress with their managers and organisation leads. Host Institutions will continue to be encouraged to identify focal points in Beneficiary Institutions who can support the learning journey of their fellows.

Training on bacteria identification and antibiotic susceptibility test, disk diffusion method by National Veterinary Laboratory at National Centre for Animal Health, to surveillance laboratory officials in Thimphu, Bhutan.

Conclusions from this review demonstrate that building the technical capacity of the AMR health workforce contributes to improved AMR/AMU understanding and laboratory quality standards, which consequently strengthens country AMR systems.

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