THE UNIVERSITY
of EDINBURGH

Analysis of the progress of antimicrobial resistance management in the Pacific Island Countries and Territories through the development and implementation of National Action Plans.

Abstract

The magnitude of the antimicrobial resistance (AMR) crisis is globally acknowledged. Approximately 700,000 deaths per year are attributed to resistant infections. By 2050, it is estimated to reach 10 million deaths. The most impacted by AMR are the lower-middle income countries (LMICs), largely because of insufficient resources and inadequate infrastructure. The south Pacific Islands Countries and Territories (PICTs) are comprised of mostly LMICs. The region is highly susceptible to disease outbreaks and natural disasters. It is anticipated that these threats will rise owing to the worsening effects of climate change. With a population of approximately 2.3 million, the PICTs comprise of hundreds of islands scattered over an area equivalent to 15% of the earth's surface. With the increase in holiday and medical tourism to and from this area, the developing PICTs are at a heightened risk of increased spread of multi-drug resistant organisms.

To minimise the effects of AMR on countries, the World Health Organization (WHO) developed a Global Action Plan (GAP). They encouraged each member country to implement their own National Action Plan (NAP) developed from objectives aligned with the GAP. There is a paucity of data on AMR governance framework for this region. This paper assesses the AMR National Action Plans of the PICTs and evaluates their alignment to the Global Action Plan. With the aim of monitoring the progress of AMR in PICTs, this study compiles and analyses the responses of PICTs to the Tripartite AMR Country Self-Assessment Survey (TrACSS) from 2016 to 2020. Review of recent Antimicrobial Stewardship (AMS) studies from the Pacific region provides an additional understanding of the significant drivers of AMR impacting on this region and the actions needed to limit the spread of AMR.

There were significant areas for future development identified by this study. These include NAP development and implementation from most of the PICTs,

strengthening AMR surveillance, introducing mechanisms to prevent stock-outs of medications and essential medical products, dedicated AMS education for antimicrobial prescribers, improved infection prevention and control practices, and ongoing AMR awareness campaigns for the public and healthcare professionals. Developing, implementing, and monitoring NAPs that are aligned to the objectives of the Global Action Plan will determine and support best practises for controlling the spread of AMR in PICTs.

Table of Contents

List of Figures

List of Legends

List of tables

Abbreviations and Acronyms

AMR	Antimicrobial Resistance
AMS	Antimicrobial Stewardship
ATG	Antibiotic Treatment Guidelines
AWaRe	WHO classification for antibiotics - Access, Watch, and Reserve
CoVID-19	Disease state of the Coronavirus SARS-CoV-2
CSA	Country Situational Analysis
ESBL	Extended Spectrum Beta-Lactamase
FAO	Food and Agriculture Organization of the United Nations
GAP	AMR Global Action Plan
GLASS	Global Antimicrobial Resistance and Use Surveillance System
HIB	*Haemophilus influenzae type b*
HIC	High Income Country
HIV	Human Immunodeficiency Virus
HPV	Human Papilloma Virus
ICU	Intensive Care Unit
IDC	Indwelling Catheter
IPC	Infection Prevention and Control
KPN	*Klebsiella pneumoniae*
LMIC	Low-Middle Income Country
MHMS	Ministry of Health and Medical Services
MPB	Medical Products Board
MDRO	Multi-Drug Resistant Organism
NAMRC	National AMR Committee
NAP	AMR National Action Plan
NDR	No Data Received
NMPP	National Medicines Product Policy
OECD	Organisation for Economic Co-operation and Development
OIE	World Organisation for Animal Health
PHSN	Pacific Public Health Surveillance Network
PICT	Developing South Pacific Island Countries and Territories
QNA	Question Not Asked
SARS	Disease state of Coronavirus SARS-CoV-1
S.M.A.R.T.	Specific, Measurable, Achievable, Realistic, Timely
SOP	Strategic Operational Plan
SSI	Skin and Soft Tissue Infection
STG	Standard Therapeutic Guidelines
STI	Sexually Transmitted Infections
TB	Tuberculosis
TOR	Terms of Reference
TrACSS	Tripartite AMR Country Self-Assessment Survey
TWG	Technical Working Group
WaSH	Water supply, Sanitation, and Hygiene program
WHO	World Health Organization

1. Introduction

Antimicrobial resistance (AMR) has emerged as one of the key public health challenges of the 21st century. Effective prevention and treatment of a growing range of infections caused by bacteria, viruses, fungi and other microorganisms is under grave threat. Antibiotic resistance in bacteria is especially serious. To varying degrees, bacteria have been developing resistance to both older and novel antibiotics over several decades.[1] The extent of the global AMR problem is formidable. Previously it was estimated that by 2050, 10 million lives will be lost each year to AMR.[2,3,4] Prior to a study performed in 2019 by Murray *et al* [5], it was reported that approximately 700,000 deaths per year were a result of antimicrobial resistant infections.[4] Findings from the study by Murray *et al* showed the estimates of deaths attributable to AMR annually have been clearly underestimated. This study is the most comprehensive analysis of the global burden of AMR to date. It globally estimated that in 2019, of the 4.95 million deaths that were associated with AMR, 1.27 million were directly attributable to drug resistant infections.[5] If we continue at this pace, it is expected that we risk an economic output of USD 100 trillion by 2050 due to the rise and spread of drug resistant infections.[4] AMR is not an arbitrary concept that only affects the sick and the poor – it is indiscriminate in whom it impacts. The inequity of resources influences the gravity of this impact. Antimicrobials, particularly antibiotics, strengthen and support modern medicine. If they lose their effectiveness, key medical procedures and treatments could become too dangerous to perform.[4] Confronted with the 'silent pandemic', the need for action to avoid a developing global crisis is imperative.[1]

In May 2015 the World Health Assembly recognised the threat of AMR to both human and animal health.[6,7] In response, the World Health Organisation (WHO) developed the Global Action Plan (GAP) in collaboration with the Food and Agriculture Organisation (FAO) and World Organisation for Animal Health (OIE). It was endorsed by all Member countries.[8] This Plan delivered a broad framework based on five major strategic objectives:

- to improve awareness and understanding of AMR
- to strengthen knowledge through surveillance and research
- to reduce the incidence of infection

- to optimise the use of antimicrobials
- to develop the economic case for sustainable investment taking into account the needs of all countries and to increase investment in new medicines, diagnostic tools, vaccines and other interventions.[7,9]

The GAP defines the roles of national governments and the Tripartite organisations (FAO, OIE, and WHO) in fostering a One Health Approach. The GAP incorporated an appeal for all member countries to develop and implement collaborative, multisectoral National Action Plans (NAP) by 2017.[10] NAPs would serve to address AMR in their individual country whilst aligning with the objectives of the GAP.[11] By March 2018, one hundred countries globally had prepared their NAP and a further sixty-seven countries were in preparation.[10] This was an encouraging response, however, the greatest challenge for a country is not the preparation but the implementation and sustainability of their NAP.[10]

Since 2016, country progress for implementation of a NAP has been monitored by the annual Tripartite AMR Country Self-Assessment Survey (TrACSS). This survey is jointly administered by the Food and Agriculture Organization of the United Nations (FAO), World Organisation for Animal Health (OIE) and WHO.[12] It is designed to be completed at country level by relevant authorities from different national government sectors.

Pacific Island Countries and Territories

The south Pacific developing region comprises island countries and territories. Those included in this study are the fourteen PICTs involved in WHO Country Cooperation Strategy for the Pacific Island Countries (Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, Fiji, French Polynesia, Kiribati, the Marshall Islands, Nauru, New Caledonia, Palau, Solomon Islands, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna) as well as Cook Islands, Niue, Pitcairn Islands, Samoa, and Tokelau. A map of this area is provided in *Figure 1*. These PICTs are particularly vulnerable to AMR. The region has a population of about 2.3 million people living on hundreds of islands scattered over an area equivalent to 15% of the earth's surface.[13] There is a great diversity across this region. Fiji is the most populated PICT with approximately 900,000 inhabitants in comparison to the least populated PICTs of Nauru and Tuvalu with

estimated populations of approximately 11,000.[13] Kiribati is one of the most remote countries globally. It is geographically dispersed with 33 atolls spread across an ocean larger than the area of India.[13] PICT land areas are relatively small with limited natural resources.[14] The region is prone to disease outbreaks and natural disasters. These threats are increasing due to the worsening effects of global environmental and climate change.[14]

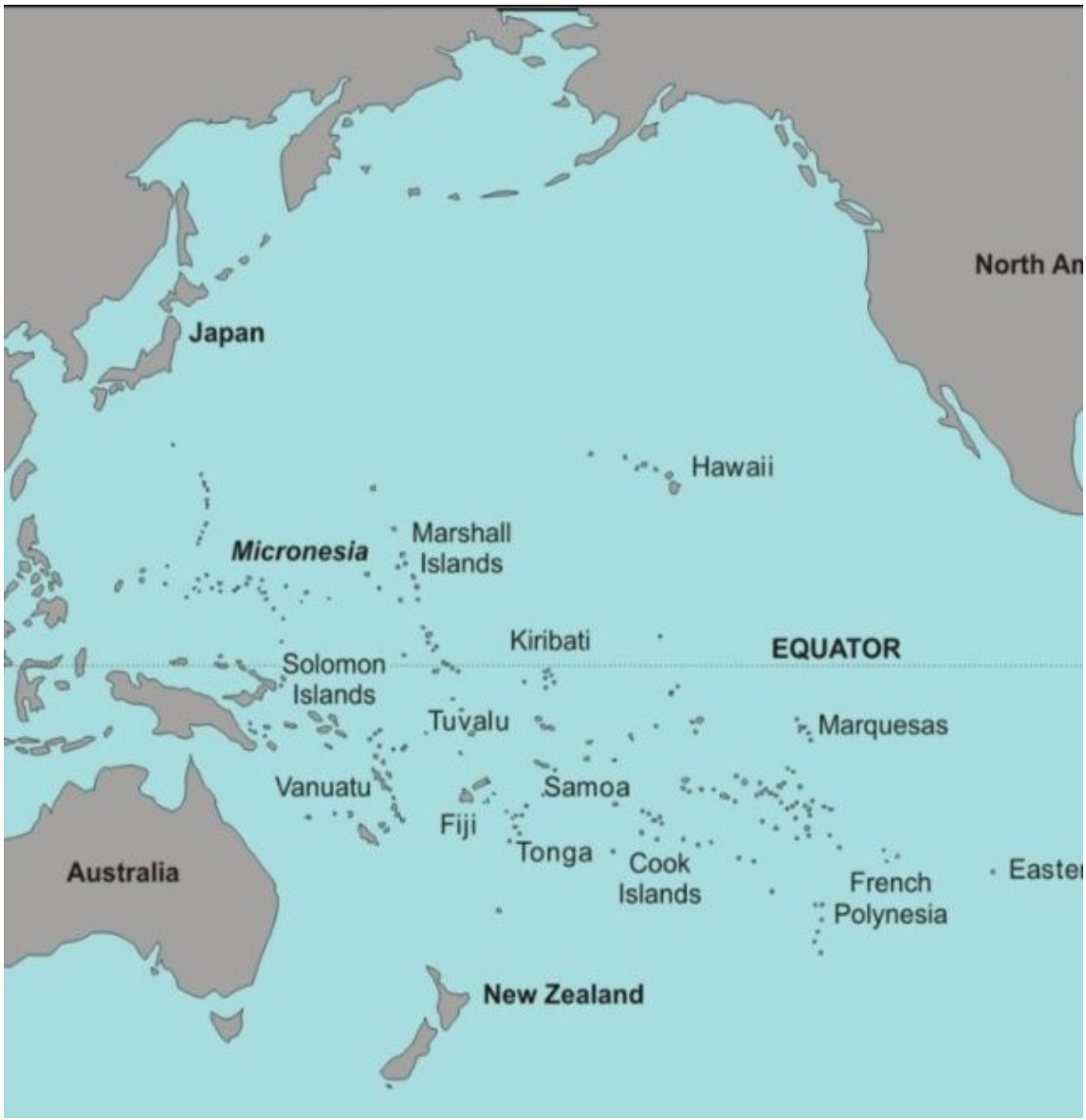

Figure 1: Map of South Pacific Islands and Territories.[15]

Most of the PICTs are ranked as LMIC by the World Bank.[16] PICTs rely significantly on tourism to support their economies. Geographical dispersion of the islands coupled with high costs of fuel have previously seen low volumes of

tourists, however the emergence of new low cost airlines[17] has seen approximately two million tourist arrivals to PICTs in 2018 (prior to CoVID-19) [18]. These arrivals are increasingly from countries such as China and Russia.[17] With greater economic opportunities and increased travel, a heightened risk of AMR movement is likely to ensue.

An increase in medical tourism has also created concern for AMR introduction to the PICTs. Particular medical procedures such as renal transplants, are not available in PICTs so patients either self-fund or receive government support to obtain treatment overseas. India is a common destination for medical procedures. With India's high prevalence of AMR, returning patients increase their possibility for colonisation and further spread of multi-drug resistant organisms.[17]

LMICs are particularly vulnerable to the direct and indirect impacts of AMR.[19] With limited data available from this region, it is important to evaluate the progress of the PICTs in adopting the GAP's objectives through the development and implementation of a NAP. AMR awareness and support for strong AMS practices is vital in minimising the impact of AMR. The goal of the AMR GAP is "*to ensure, for as long as possible, continuity of successful treatment and prevention of infectious diseases with effective and safe medicines that are quality-assured, used in a responsible way, and accessible to all who need them*".[20]

Up to this point, actions to combat AMR have been episodic and uneven resulting in inequities.[21] Highlighting the disparities that exist will confidently inform decision making and drive appropriate actions to manage AMR in the region. AMR is a complex issue and necessitates a comprehensive framework to assess the governance of a NAP.[22]

2. Method

2.1. NAP Framework Analysis

The WHO's library of NAPs was accessed to retrieve NAPs from the developing South Pacific region. A content analysis of the NAPs was performed, guided by the AMR governance framework proposed by Anderson et al. [23] The three governance areas of policy design, implementation tools, and monitoring and evaluation, were assessed. This framework incorporates the five strategic objectives promoted in the GAP.[24] For criteria applied to this analysis see *Table 1, Table 2,* and *Table 3*.

Table 1: AMR Governance Framework criteria analysis - Policy Design.[23]

Domain	Analysis criteria
Strategic Vision	Has a situational analysis been conducted to establish the prevalence of AMR in the country? Has a NAP been developed and implemented? If not, is there a timeframe for the development and implementation? Are the NAP objectives specific, time-bound, and measurable? Does the NAP outline quantitative targets for antimicrobial use and AMR?
Coordination	Does the NAP address coordination between sectors of the One Health approach, and across different levels of each sector? Is there an intersectoral committee and/or ministry that is responsible for coordination and implementation of the NAP?
Participation	Throughout the development of the NAP, was a high level of stakeholder participation facilitated? Are the activities in the NAP inclusive across the One Health sectors? Was there a technical advisory group or subject matter experts that provided support during the development of the NAP?
Accountability	Is there a ministry and/or an intersectoral committee accountable to the government, for the coordination and implementation of the NAP? Is there a nominated person responsible from each One Health sector? If objectives are not met, are there agreements as to the subsequent action?
Transparency	Is there public access to the complete NAP? Is there public access to all NAP progress reports? Is there public access to information about funding of the NAP activities? Is there public access to all AMR and antimicrobial use surveillance data?
Sustainability	Is the implementation of the NAP supported by all relevant stakeholders through either a written mandate or voluntary agreement? Are there dedicated budgets assigned for the different activities specified in the NAP? Are there future budget considerations for ongoing implementation activities listed in the NAP? For the implementation, monitoring and evaluation of the NAP, is there provisions for ongoing support by a technical advisory group of subject matter experts?
Equity	Does the NAP encourage responsible use of existing essential antimicrobials? Does the NAP facilitate equitable access to the existing essential antimicrobials?

Table 2: AMR Governance Framework criteria analysis - Implementation Tools.[23]

Domain	Analysis Criteria
Surveillance	Is there a national surveillance system monitoring resistance in microorganisms across the three One Health sectors? Is there a national surveillance system monitoring antimicrobial use in the One Health sectors? Does externally assessed, adequate laboratory capacity and capability exist to support surveillance of resistant microorganisms?
Antimicrobial Stewardship	Are there antimicrobial stewardship programs established across the human and animal health sectors? Are there widely available rapid diagnostic tools available? Are they in regular use? Are there national guidelines outlining indications for use and interpretation of results? Are there current national guidelines on antimicrobial use across a range of settings in human and animal health? Are there current national guidelines on the use of rapid diagnostic tools across human and animal health? Are financial and/or non-financial incentives or penalties used in the One Health sectors to reduce inappropriate antimicrobial use?
Infection, Prevention and Control	Are there current IPC guidelines and policies supporting all levels of the One Health sectors? As an approach to infection prevention, are immunisation programs used across all One Health sectors? Are financial and/or non-financial incentives or penalties used to encourage observance of IPC policies across One Health sectors?
Education	Is basic education of AMR and the strategies involved in tackling its spread, supported by programs and certifications for all involved groups of professionals? For all the involved groups of professionals, are there continuing education programs to ensure the developing knowledge necessary for sustained efforts in the challenge of AMR? A sustainable workforce is required to deliver AMS and IPC policies, does the NAP deliver a workforce strategy?
Public Awareness	Are there any AMR focused public awareness campaigns employed across various information mediums? Are there any educational programs (including school children) used to focus on AMR? Do the public awareness campaigns account for an ongoing campaign? Are aspects of psychology, behavioural and social sciences considered in the conception of the public awareness campaign?
Medicines Regulation	Is the appropriate use of antimicrobials in human and animal health safeguarded by regulations? Is there an authority that assumes responsibility for the monitoring and enforcement of the legislation? Does the authority have a dedicated budget for this provision?
Fostering Research & Development; Facilitating Market Access to Novel Products	Does the NAP prioritise the fostering of research and development, as well as facilitate market access to novel antimicrobials, vaccines, diagnostics, and alternative treatments for One Health sectors, particularly human and animal health? Does the NAP address country contribution, at both national and international levels, to research and development of novel agents? Does the NAP address a national budget dedicated to the research and development of novel antimicrobials, vaccines, diagnostics, and alternative treatments?

Table 3: AMR Governance Framework criteria analysis - Monitoring and Evaluation.[23]

Domain	Analysis criteria
Reporting	Are NAP progress reports published annually? Are surveillance reports, containing data on national antimicrobial usage and incidence of AMR, published annually? Is there national collaboration with, and AMR incidence data sharing with international surveillance systems?
Feedback Mechanisms	Do feedback mechanisms exist at both regional and organisational level in relaying surveillance data? Are regular deadlines defined for progress review of specific actions in the NAP, as well as feedback arrangements for both regional and organisation levels?
Effectiveness	Has the effectiveness of policies and/or interventions implemented undergone an evaluation process? Has there been an attempt to evaluate the cost-effectiveness of the implemented policies or interventions?
AMR Research	Does the NAP prioritise research into understanding the drivers and effect of AMR, as well as research into potential interventions and policies? Is AMR research afforded a dedicated national budget?

2.2. Monitoring progress of AMR in PICTs using the Tripartite AMR Country Self-Assessment Survey responses

The Global Database for the Tripartite Antimicrobial Resistance Country Self-Assessment Survey (TrACSS) responses were used to monitor the progress of AMR management in the PICTs. There were four survey years of responses applied to this analysis commencing with 2016-2017 and concluding with 2019-2020.[25] The TrACSS required relevant authorities to identify their country's progress under the GAP objectives across One Health sectors by answering a number of questions.[26]

Self-assessment survey responses were accessed and recorded from each survey period according to the relevant PICTs. Where countries had responded in multiple survey periods, the most current response was compiled. The responses were tabled and colour-coded denoting the progress of the response. Refer to *Legend 1* and *Legend 2.*

2.3 Review of studies analysing AMR awareness and AMS practices in the PICTs

A systematic assessment was conducted of recent peer-reviewed and grey literature for antimicrobial use and AMS in PICTs between 2014 and 2021 was conducted. Four main search terms were used: *antimicrobial (antimicrobial, antibiotic), AMR, AMS, and PICTs.* There was a paucity of studies within this time interval. Five studies that presented findings conducive to assessing the progress of AMR management in PICTs were identified.

3 Results

3.1 PICTs AMR National Action Plans

The Fiji National Antimicrobial Resistance Action Plan was the only published NAP in the WHO library from this region.

3.1.1 Policy design of Fiji National Antimicrobial Resistance Action Plan

Effective NAP implementation relies on fundamental policy design. Policy design involves general and procedural issues of a NAP such as participation and co-ordination across multiple sectors and levels in delivering the service, transparency, equity, and sustainability.[23] A summary of results for the analysis of policy design of the Fiji NAP are provided in *Table 4.* Fiji's NAP was presented as a somewhat strategic plan to be followed by an operational plan of activities for NAP implementation.[27] Defining these implementation activities within the NAP would have given greater clarity to the NAP's objectives, and improve overall achievability. The Strategic Operational Plan (SOP) could not be found online and hence its existence could not be authenticated. Unavailability of significant information that was anticipated to be included in the SOP, has impacted considerably on the assessment findings.

Country Situational Analysis of Fiji

A country situational analysis (CSA) for Fiji was conducted in 2015 and a summary is included in the NAP. The CSA was compiled using comprehensive literature reviews of published and unpublished data as well as interviews with key informants across all relevant sectors.[28] The CSA should ideally guide the policy design of the NAP, however, Fiji 's CSA was completed after the NAP was designed.[27] This would require modification of identified targets in the NAP in accordance with the findings from the CSA. The findings identified AMR as a priority with four major gaps emphasised:

- a lack of AMR awareness in all areas
- a deficit of comprehensive national AMR policies
- an absence of monitoring systems for the national surveillance of AMR and antimicrobial use

- poor implementation and regulation of a national response to AMR through Fiji's nationwide health system.

Development of Fiji's NAP

Following on from the recognition of the four major gaps in the CSA, a NAP was launched in November 2015.[29] The launch involved Fiji Government officials, WHO representatives, and staff from the Ministry of Health and Medical Services. Please refer to launch in *Figure 2.* The NAP addressed the four major gaps but there were no clear responsibilities, S.M.A.R.T targets or monitoring and evaluation processes cited in the NAP. This was expected to be managed through the development of a two-year Strategic Operational Plan (SOP) by the National AMR committee (NAMRC) once the NAP had been adopted. The SOP could not be found online, however there were references to areas and targets of the Fiji NAP in other online documents such as Fiji's National Strategic Plan of 2016-2020[30] and the WHO Country Cooperation Strategy 2018-2022.[31] In the National Strategic Plan 2016-2020, Priority Area 3 highlights the need for "*restructuring of the overall communicable disease program to strengthen and integrate key functions*" such as laboratory services, surveillance, and communications to support health emergency preparedness, response, and resilience. The WHO Country Cooperation Strategy 2018-2022 national strategic priority 5 considers the need to " *improve access to essential medicines and health technologies, including traditional and complementary medicines, and to contain antimicrobial resistance."* [31] Section 4 of this priority involves the implementation of the NAP and mobilising resources for full implementation. This strategy considers targets for achieving this.[31]

The NAMRC was responsible for the implementation of the NAP. This committee was formed by the Medicinal Products Board and is subject to, and acts in accordance with, any directions given by the Board. Stakeholder consultations were held in 2014 to guide the terms of reference for the NAMRC.[28] As outlined in the NAP, the multi-sectoral committee consists of members[28] from:

- Ministries of Health and Medical Services
- Agriculture, Fisheries and Forestry, and Education
- Department of Environment

- Fiji Tertiary Institutions
- Private Sector (Pharmaceutical and General practitioners)
- Consumer Council
- Fiji Revenue and Customs Authority
- Biosecurity Authority of Fiji.

The committee receives technical advice from the Grant Management Unit and WHO representative (reporting to tripartite agreement), and other relevant representatives.[28] Prior to the development of the NAP, the Ministry of Health and Medical Services (MHMS) along with the support of WHO held two national workshops.[28]

The first workshop, held from 20 to 21 August 2015, identified AMR as a threat to the sustainability of Fiji's public health response to communicable diseases. It was recognised that an inter-sectoral AMR working group was needed. Discussions established that Fiji's national response framework to AMR would need to involve a multi-stakeholder approach and should include international agencies. The development of the framework for Fiji's NAP was guided by the WHO Global Action Plan, the Australian National Plan on Antimicrobial Resistance, and the Regional Action Agenda.[28]

The second workshop, held from 1-2 October 2015, was intended to finalise Fiji's NAP and seek guidance for the development of the SOP which would contain clear actions, responsibilities, budget, and processes of monitoring and evaluation of the NAP.[28]

One Health Approach to the Fiji AMR National Action Plan

The Fiji NAP adopts a One Health approach and activities are inclusive across human, animal and ecosystem health. An example of this can be seen in strategic objective 2.2 "*Build laboratory capacity and infrastructure to test for antimicrobial resistant microorganisms in the environment, animal and human health".*[28] However, with the NAP lacking accountability and S.M.A.R.T. targets, it is difficult to determine whether the activities are achievable or sustainable. The NAP encourages responsible use of antimicrobials across One Health sectors but it does fail to address the inextricably linked concept of responsible use of, and equitable access to, antimicrobials. [23]

Figure 2: The permanent secretary of Health and Medical services, Director of Pacific Technical Support and WHO representative to the South Pacific, with staff from the Ministry of Health and Medical Services at the launch of Fiji's National AMR Action Plan.[32]

Table 4: Results of analysis of Fiji's AMR NAP policy design.

Policy Design	
Strategic Vision	Country situational analysis (CSA) conducted in 2015. CSA summary contained in NAP. CSA identified AMR as a priority. Four major gaps were highlighted in the areas of AMR awareness, national AMR policies, monitoring of AMR and antimicrobial use, and national health system response to AMR. NAP launched in November 2015 addressing the gaps recognised in the CSA. No S.M.A.R.T. targets applied. No evidence of the development of a two-year Strategic Operational Plan that was to be adopted following the implementation of the NAP.
Coordination	Implementation of the NAP is the responsibility of the National AMR Committee (NAMRC). NAMRC to be formed by the Medical Products Board (MPB) of Fiji. NAMRC is a multi-sectoral committee with recommended members from various government ministries, tertiary institutions, private sector, consumer councils, customs authorities, and biosecurity authorities. Technical advisors to the NAMRC includes WHO representative.
Participation	Two national workshops were held prior to the development of the NAP with support from the Ministry of Health and Medical Services (MHMS) and WHO. Findings Workshop 1: AMR threatens the sustainability of Fiji's public health response to communicable diseases, and an inter-sectoral AMR working group along with a One Health approach was needed for Fiji's national AMR response framework.[28] Findings Workshop 2: Finalising Fiji's NAP and seeking guidance for the development of the Strategic Operational Plan.[28]
Accountability	NAMRC is responsible for co-ordination and implementation of the NAP. NAMRC developed their Terms of Reference (TOR) which are endorsed by the MPB.[28] NAMRC will report to, and make recommendations to, the MPB. NAP does not allocate responsibilities to a particular individual or department. There are no consequences raised if responsibilities fail to be executed.
Transparency	Fiji AMR NAP publicly available on WHO NAP database. Progress reports and funding information is not publicly available online. Data used in the development of the NAP was not publicly available online.
Sustainability	No written mandates or voluntary agreements to implement the NAP from any relevant sectors were unavailable online. No publicly released budgets (past, present or future) related to the NAP were available online. No Strategic Operational Plan was available online.
Equity	NAP encourages responsible use of antimicrobials and the importance of AMS but does not clearly address equitable access to antimicrobials.

3.1.2 Tools used to implement Fiji's AMR National Action Plan.

This second governance area involves vital interventions that are contained within the GAP and focuses on whether surveillance, AMS, and IPC are implemented across the One Health sectors. It also examines whether fundamental AMR tools are being utilised.[23] A summary of results for the analysis of implementation tools for the Fiji NAP are provided in *Table 5*.

Establishing and strengthening surveillance in Fiji's AMR NAP

The NAP addresses the establishment and strengthening of a nationally coordinated surveillance system in Objective 2. An online search up to and including 2020 has failed to find any information related to a nationally coordinated surveillance system being established or the laboratory capacity and capability being addressed. Fiji has not contributed data to international surveillance agencies such as GLASS. However, this is likely due to a lack of infrastructure.

Antimicrobial Stewardship used in Fiji's AMR NAP implementation process

Although the NAP addresses the establishment of a National Stewardship Program for both private and public hospitals, there is no focus on AMS programs in private medical practice. Objective 4 (p15 of NAP) addresses the optimisation of "*the use of antimicrobial medicines in human and animal health.*"

The importance of regulations in Fiji's AMR NAP implementation process

The NAP implementation process emphasises the need for the development of regulations to cover the governance of antimicrobials across all sectors (including environmental). These regulations are aligned with existing legislations thereby strengthening the role of pre-existing regulatory bodies. It affords these regulatory bodies a greater scope in the private sector, and the ability to establish and implement stewardship programs at national and local levels.

Tools for controlling the inappropriate use of antimicrobials

Incentivising prescribers to reduce inappropriate use of antimicrobials in any of the One Health sectors was not addressed in the NAP. The NAP refers to a regular review and strengthening of current antimicrobial treatment guidelines, review and strengthening of current regulations and policies for the procurement, prescribing and dispensing of antimicrobials, and regular evaluation of antimicrobial use.[23] The process to facilitate these objectives and implement systems for monitoring compliance to the antimicrobial treatment guidelines was not addressed in the NAP. This process would require individual physician and patient-level data, farm-level antimicrobial usage data, and an efficient method to

collect and utilise this data to drive change. It would also necessitate equitable and timely access to appropriate antimicrobials.[23]

Infection prevention and disease control

The NAP addresses IPC across all One Health sectors in objective 4 (p14) '*Reduce the incidence of antimicrobial resistance events in human, animal and environmental health through improved infection, prevention and control practices.'* National IPC guidelines for Fiji could not be found online but they have been referred to in the IPC Guidelines for Pacific[33] and in a paper from 2009 by Tuisawana.[34] In 2010 the Pacific Infection Control Network presented guidelines for adaptation for any PICT.[33]

Strengthening of vaccination programs for both human and animal sectors is addressed in Objective 4.2.2 (p14 of the NAP). An online search for a national animal vaccination program was unproductive. Again, there was no incentivisation or penalties to address conformity to IPC policies in all One Health sectors.

AMR Education and Awareness

The education program strategy set out in the NAP showed some encouraging components. Educational materials for raising awareness of AMR would be produced in the three major spoken languages of Fiji (English, Hindi, and Fijian). Undertaking awareness programs in schools and introducing AMR as part of continuous professional development for all sectors was also proposed in the NAP. An invitation to well-known celebrities and sporting identities to participate in the awareness campaigns to generate involvement of a greater audience was also recommended in the NAP, as was the use of social media and other information platforms to broaden public awareness.

Research and development

The NAP aims to develop a multi-sectoral research agenda (Objective 2.4) but does not focus on fostering research and development, or facilitating market access to novel antimicrobials, diagnostics, vaccines or alternative treatments for both humans and animals. This is most likely due to the scarcity of resources available. The NAP proposes alternatives for antimicrobial use, such as

probiotics, and seeks to develop guidelines to facilitate the use of these alternatives.

Table 5: Results of analysis of Fiji's AMR NAP implementation.

Implementation Tools	
Surveillance	NAP addresses establishment and strengthening of nationally co-ordinated surveillance systems. NAP addresses the need to build laboratory capacity and capability across the One Health sectors.
Antimicrobial Stewardship	NAP addresses the establishment of a National Stewardship Program for both public and private hospitals. NAP addresses the need for stewardship programs for the animal sector. NAP does not address the need for community stewardship programs in private practice. NAP addresses the need for regular review and strengthening of the existing Essential Medicine List which includes veterinary medicines, and antibiotic treatment guidelines (ATG). NAP addresses the need for environmental regulations to legislate for the appropriate disposal of antimicrobials across One Health sectors. NAP fails to address incentives or penalties to reduce inappropriate antimicrobial use. Monitoring adherence to the current ATG was not addressed in the NAP.
Infection, Prevention and Control	NAP addresses the establishment of IPC programs across healthcare settings, agriculture, and fisheries. NAP addresses establishment of effective waste management. NAP addresses the establishment of a Risk Management Unit to develop risk assessment systems related to AMR in all One Health sectors. There are no Fiji-specific IPC guidelines, but IPC Guidelines for the Pacific enables adaptation for any PICT.[32] NAP addresses the strengthening of vaccination programs for both human and animal health sectors. NAP fails to address financial and non-financial incentives or penalties to encourage conformity to IPC policies across One Health sectors.
Education	NAP addresses the use of educational programs to raise awareness across all One Health sectors. These programs are employed in schools, tertiary education programs, as well as community education. Education materials are created in the three major languages spoken in Fiji: English, Hindi, and Fijian. NAP does not address any workforce strategies to provide a sustainable workforce to deliver both IPC or AMS policies in response to community needs.
Public Awareness	NAP outlines the various means by which AMR public awareness will be addressed. These include the use of social networking platforms, the implementation of awareness activities in schools and tertiary study institutions, and the engagement of well-known and influential people to be involved in AMR awareness campaigns.
Medicines Regulation	NAP addresses the development of appropriate regulations to cover the governance of antimicrobials in all One Health sectors aligned with the existing Medicinal Product Decree 2011. NAP does not identify an authority who will monitor and enforce legislation, or a budget to subsidise this.
Fostering Research & Development (R&D), and facilitating market access to novel products	NAP addresses the development of a multi-sectoral research agenda. It does not address Fiji's contribution to R&D of novel agents or facilitating market access to novel products. NAP addresses alternative treatments such as probiotics.

3.1.3 Monitoring and evaluation of Fiji's AMR National Action Plan.

Monitoring and evaluation are vital to the viability, effectiveness and sustainability of a NAP. A summary of results for the analysis of monitoring and evaluation of the Fiji NAP are provided in *Table 6*. The monitoring and evaluation processes were to be addressed in the SOP. As previously cited, the SOP could not be found online, and its existence could not be authenticated. There were no annual NAP progress reports, annual national resistant organism incidence reports, or annual national antimicrobial use reports available online between the years 2015 to 2021. There has been no collaboration with, or systemic data transmission to any global AMR surveillance systems such as GLASS.[35]

Feedback mechanisms, deadlines, and review processes monitoring and evaluating progress of objectives were not addressed in the NAP. It was stated in the Implementation Framework of Fiji's NAP[28] that a review process would be performed every three years or more frequently. An online search failed to locate a published review between 2015 and 2021.

Table 6: Results of analysis of Fiji's AMR NAP for monitoring and evaluation.

Monitoring and Evaluation	
Reporting	Annual NAP progress reports from 2015 to 2021 were unavailable. Annual national incidence reports from 2015 to 2021 regarding resistant organisms or antimicrobial use in Fiji were publicly unavailable online. There has been no participation in global surveillance systems such as GLASS from 2015 to 2021.[33]
Feedback Mechanisms	NAP does not document any feedback mechanisms, deadlines, and review processes for the progress of actions within the NAP. NAP indicated that a review process would be performed every three years or more frequently. An online search failed to find a published review between the years 2015 to 2021.
Effectiveness	NAP did not define processes for measuring the effectiveness of the implemented actions presented in the NAP. Measurement methods for cost effectiveness studies were not supported in the NAP.
AMR research	NAP addresses a multi-sectoral research agenda. It includes investment in resources for studies into such areas as water management sites and their effect on AMR spread. NAP addresses and supports the regular sharing of information from the annual One Health conference on AMR research together with the future development of a multi-sectoral research agenda.

3.2 Tripartite AMR Country Self-Assessment Survey Analysis

The global Tripartite AMR Country Self-Assessment Survey assesses a country's progress in managing AMR. The responses are publicly available from an online database. It was one of the first steps taken towards monitoring AMR NAPs globally.[23] Data collection through the TrACSS is wide-ranging and lacks detail. However, it provides baseline information on the status of a country's plan to address AMR across One Health sectors. A total of 10 PICTs took part in the self-assessment surveys over the four survey periods from 2016-2020. The most recent surveys' responses for each country were collated and analysed.

Diversity of survey participants from Pacific Island countries and territories.

The most populated of the PICTs was Fiji with a population of 904,184 (2021) and the least populated PICT was Tuvalu with 11,966 (2021).

World Bank rankings of the PICTs ranged from high income ranked (Palau) to an unclassified ranked Cook Islands. Four out of the 10 countries were classified as upper-middle income and four classified as lower income.

Fundamental to the development of an effective AMR NAP is recognising the interconnectedness of humans, animals, and the environment. Commitment to the One Health model and recognising that this interconnectedness contributes to AMR is central to the attainment of AMR management globally. Responses relating to One Health collaboration and co-ordination on AMR in the PICTs is presented in *Table 7.* Fiji, Micronesia, Vanuatu, and the Cook Islands have multi-sectoral groups working on a One Health approach to AMR. There was active involvement in human health, animal health, food production and safety, and the

environment through WaSH[36] program (Safe drinking water, sanitation, and hygiene). Half of the countries surveyed have not adopted this approach.

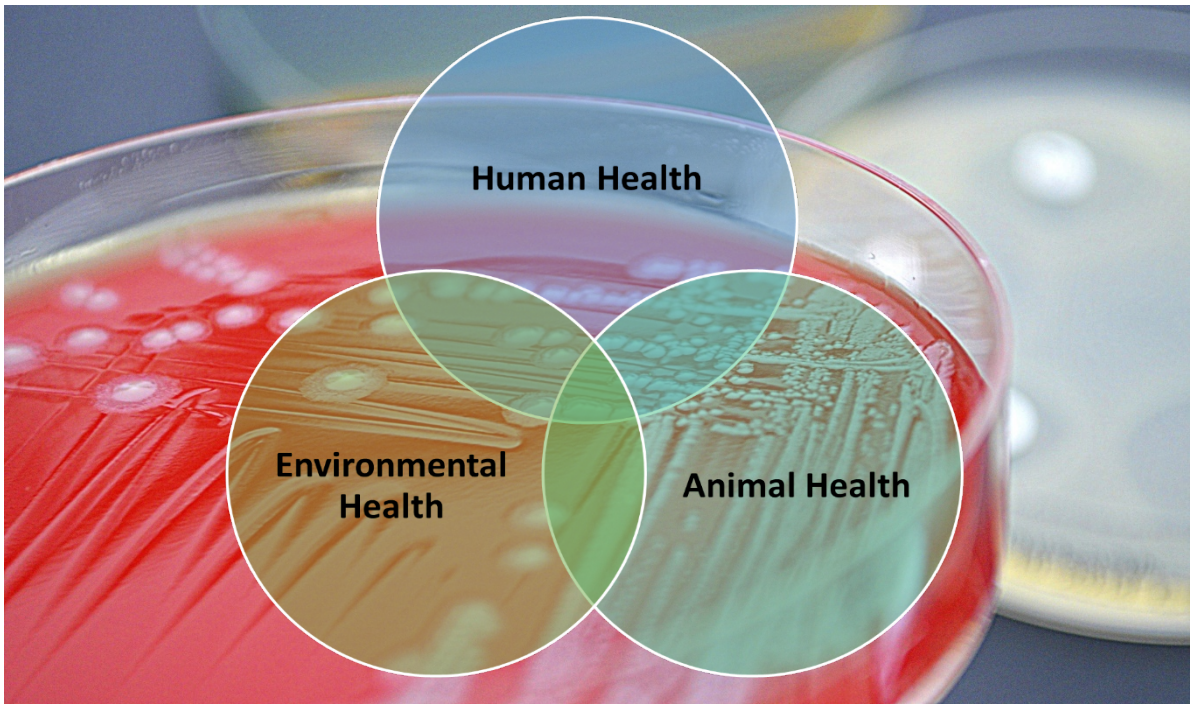

Figure 3: Interconnectedness of the One Health Approach. AMR can be managed more effectively by coordinating actions across human, animal and environmental health. Background image credit: Getty Images/iStockphoto.

Legend 1: Most recent survey participation year.

Survey year	
	2019-2020
	2018-2019
	2017-2018
	2016-2017

Legend 2: Progress in addressing the AMR objectives

Legend: Progress in addressing AMR objectives	
	Addressing the objective
	Partially addressing the objective
	Not addressing the objective
NDR	No data received

Table 7: PICTs progress in a multi-sectoral approach to AMR.[25]

Country	Year of most recent survey	Population at present and survey year	World Bank Rating (year of survey)	Multi-sector and One Health collaboration/coordination on AMR	Sectors actively involved in developing and implementing the AMR National Action Plan
Fiji	2019-2020	904,184 (2021)[37] 896,445 (2020)[37]	Upper Middle[38]	Joint working on issues including agreement on common objectives.	Human, animal, food production, food safety, environment (including WaSH)
Micronesia	2019-2020	555,383 (2021)[39] 548,914 (2020)[39]	Lower Middle[38]	Multi-sectoral working group(s)/coordination committee established with Government leadership.	Human, animal, food safety, environment (including WaSH)
Solomon Islands	2019-2020	706,888 (2021)[40] 686,884 (2020)[40]	Lower Middle[38]	No formal multi-sectoral governance or coordination mechanism on AMR exists.	Human, food safety, environment (including WaSH)
Palau	2018-2019	18,197 (2021)[41] 18,008 (2019)[41]	High[38]	No formal multi-sectoral governance or coordination mechanism on AMR exists.	Human ONLY
Tuvalu	2018-2019	11,966 (2021)[42] 11,646 (2019)[42]	Upper Middle[38]	No formal multi-sectoral governance or coordination mechanism on AMR exists.	Human, food safety, environment (including WASH)
Vanuatu	2018-2019	315,690 (2021)[42] 299,882 (2019)[42]	Lower Middle[38]	Multi-sectoral working group(s)/coordination committee established with Government leadership.	Human, animal, plant, food production, Food safety, environment (including WaSH)
Samoa	2017-2018	199,988 (2021)[42] 196,129 (2018)[42]	Upper Middle[38]	Integrated approaches used to implement the national AMR action plan.	YES (unexplained response)
Tonga	2017-2018	107,124 (2021)[43] 103,197 (2018)[43]	Upper Middle[38]	No formal multi-sectoral governance or coordination mechanism exists.	NO (unexplained response)
Cook Islands	2016-2017	17,583 (2021)[44] 17,507 (2017)[44]	Unclassified[38]	Multi-sectoral working group(s) or coordination committee on AMR established.	Human, animal, environment, and other sectors, with Government leadership.
Kiribati	2016-2017	121,634 (2021)[44] 114,158 (2017)[44]	Lower Middle[38]	No formal multi-sectoral governance or coordination mechanism exists.	NDR

Data relating to a country's progress in the development of a NAP is presented in *Table 8: PICT's individual country progress with development of an AMR NAP.*

Four of the ten countries surveyed have developed a NAP. However Fiji was the only PICT with a NAP in WHO's Library of AMR National Action Plans.[45] The remaining six PICTs had NAPs under development. The Solomon Islands had completed their CSA in 2017 informing the development of their NAP which was in draft form in 2019.[27] The delay in development and planning of NAPs in some of the PICTs was due to problems such as the inability to ensure stakeholders attend meetings.[27] Some of the PICTs linked their AMR NAP to existing action plans such as TB, HIV and Malaria. It was interesting to note that Tuvalu who previously stated that they had no NAP, answered that they linked their NAP to existing action plans.

Table 8: PICT's individual country progress with development of an AMR NAP.[25]

Country	Country progress with development of a national action plan on AMR	Country's national action plan on AMR linked to any other existing action plans (HIV, TB, Malaria, Neglected tropical diseases, STIs)	Country has laws or regulations on prescription and sale of antimicrobials for sector uses	Country has laws or regulations that prohibits the use of antibiotics for growth promotion in the absence of risk analysis.
Fiji	National AMR action plan approved by government that reflects Global Action Plan objectives, with a budgeted operational plan and monitoring arrangements.	HIV, TB, Malaria, Neglected tropical diseases, STIs	Human and animal	NO
Micronesia	National AMR action plan developed.	NO	NO	NO
Solomon Islands	National AMR action plan under development.	NO	Human and animal	YES
Palau	National AMR action plan under development.	NO	Human ONLY	NO
Tuvalu	No national AMR action plan.	HIV, TB, Malaria, Neglected tropical diseases	Human and animal	YES
Vanuatu	National AMR action plan under development.	TB, Malaria, Neglected tropical diseases	Human and animal	YES
Samoa	National AMR action plan developed.	NO	QNA	QNA
Tonga	National AMR action plan under development.	NDR	QNA	QNA
Cook Islands	National AMR action plan developed that addresses human health, animal health and other sectors.	QNA	QNA	QNA
Kiribati	National AMR action plan under development or plan involves only one sector or ministry.	QNA	QNA	QNA

Laws or regulations on prescription and sale of antimicrobials in PICTs was focussed on the human and animal sectors respectively. In PICT, animal farming is less substantial, with animals being kept as 'family animals'.[27] The survey does not take into consideration the regulating of these laws.

Improving awareness and understanding of AMR is fundamental for a collective action to managing AMR. *Table 9* presents data on the progress of AMR awareness and understanding through effective communication, education, and training. Fiji, Samoa, Tonga, Cook Islands, and Kiribati have government involvement in delivering AMR awareness campaigns focused on awareness and understanding of AMR risks and responses. Other PICTs have limited activities.

Table 9: PICT's progress in improving AMR awareness and understanding through effective communication, education and training.[25]

Country	Raising AMR awareness and understanding of risks and response	AMR training/professional education in the human health sector	AMR training/professional education in the veterinary sector	AMR training/professional education in farming, food production and safety, and environment	Progress with strengthening veterinary services
Fiji	National, govt-supported AMR awareness campaign targeting all/majority of priority stakeholder groups within sectors.	AMR is covered in some pre-service and in-service training or other continuing professional development for health workers.	AMR and prudent use of antimicrobials are covered in core curricula in some educational institutions.	Tailored ad hoc AMR training courses are available for all or the majority of key stakeholders.	Veterinary services assessed and plans developed to improve capacity, through a structured approach.
Micronesia	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders.	Ad hoc AMR training courses in some human health related disciplines.	No training of veterinary related professionals (veterinarians and veterinary paraprofessionals) related to AMR.	Tailored ad hoc AMR training courses available for at least two groups of key stakeholders.	No systematic approach at national level to strengthening Veterinary Services.
Solomon Islands	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders.	Ad hoc AMR training courses in some human health related disciplines.	Ad hoc AMR training courses available for veterinary related professionals.	Tailored ad hoc AMR training courses available for at least two groups of key stakeholders.	No systematic approach at national level to strengthening Veterinary Services.
Palau	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders.	AMR is covered in some pre-service and in-service training or other continuing professional development for health workers.	Ad hoc AMR training courses available for veterinary related professionals.	Tailored ad hoc AMR training courses available for at least two groups of key stakeholders.	No systematic approach at national level to strengthening Veterinary Services.
Tuvalu	Some activities in parts of the country to raise awareness about risks of AMR and actions that can be taken to address it.	Ad hoc AMR training courses in some human health related disciplines.	No training of veterinary related professionals (veterinarians and veterinary paraprofessionals) related to AMR.	No training provision on AMR for key stakeholders, e.g. farmers and farm workers, food and feed processors, environmental specialists.	No systematic approach at national level to strengthening Veterinary Services.
Vanuatu	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders.	Ad hoc AMR training courses in some human health related disciplines.	Ad hoc AMR training courses available for veterinary related professionals.	Tailored ad hoc AMR training courses available for at least two groups of key stakeholders.	Implementation of plan to strengthen capacity gaps in Veterinary Services underway.
Samoa	Nationwide, govt-supported AMR awareness campaign targeting all or the majority of relevant stakeholders within sector.	Nationwide, government-supported antibiotic awareness campaign targeting all or the majority of stakeholders.	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders within sector.	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders within sector.	Veterinary services assessed and plans developed to improve capacity, through a structured approach
Tonga	Nationwide, govt-supported AMR awareness campaign targeting all or most relevant stakeholders within sector.	Limited or small-scale AMR awareness campaign targeting some relevant stakeholders (e.g. Public, doctors, pharmacists).	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders within sector.	Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders within sector.	Veterinary services assessed and plans developed to improve capacity, through a structured approach.
Cook Islands	Nationwide antibiotic awareness campaign targeting the public, with govt involvement.	Ad hoc training courses in some health-related disciplines.	NDR	Some activities in parts of the country to raise awareness about AMR and actions to address it.	NDR
Kiribati	Nationwide antibiotic awareness campaign targeting the public, with govt involvement.	Ad hoc training courses in some health-related disciplines.	NDR	NDR	NDR

Training and professional education of AMR in the human health sector is more supported than in the veterinary and farming sectors, where education is delivered ad-hoc or not at all. As previously discussed in this paper, livestock farming in the PICT is not substantial.[27] However, veterinary services are being strengthened in PICTs. The first veterinary science program of the south Pacific was set up at Fiji National University in 2020.[46] Prior to this, students had to study at an Australian or New Zealand university. This has offered further opportunities to PICTs to strengthen their veterinary services.

Surveillance and research are used to strengthen the knowledge and evidence base for AMR. This is the foundation of objective 2 with response data presented in *Table 10* and *Table 11.*

Table 10: Progress in strengthening the knowledge and evidence base through surveillance and research in PICTs (part 1).[25]

Country	National monitoring system for consumption and rational use of antimicrobials in human health	National monitoring system for antimicrobials intended to be used in animals (sales/use)	National monitoring system for pesticide use in plant production including antimicrobial pesticides such as bactericides and fungicides
Fiji	System designed for surveillance of antimicrobial use, that includes monitoring national level sales or consumption of antibiotics in health services.	Data on antimicrobials used under veterinary supervision in animals are available at farm level, for individual animal species.	No national plan or system for monitoring use of pesticides including antimicrobial pesticides such as bactericides and fungicides used for the purpose of controlling bacteria or fungal diseases.
Micronesia	No national plan or system for monitoring use of antimicrobials.	No national plan or system for monitoring sales/use of antimicrobials in animals.	No national plan or system for monitoring use of pesticides including antimicrobial pesticides such as bactericides and fungicides used for the purpose of controlling bacteria or fungal diseases.
Solomon Islands	Every 1 to 2 years data is collected and reported on: a) Antimicrobial sales or consumption at human use; and antibiotic prescribing and appropriate/rational use, in a representative sample of health facilities, public and private.	No national plan or system for monitoring sales/use of antimicrobials in animals.	Plan agreed for monitoring quantities of pesticides including antimicrobial pesticides such as bactericides and fungicides used for the purpose of controlling bacteria or fungal diseases.
Palau	No national plan or system for monitoring use of antimicrobials	No national plan or system for monitoring sales/use of antimicrobials in animals.	No national plan or system for monitoring use of pesticides used for the purpose of controlling bacteria or fungal diseases.
Tuvalu	No national plan or system for monitoring use of antimicrobials	No national plan or system for monitoring sales/use of antimicrobials in animals.	No national plan or system for monitoring use of pesticides used for the purpose of controlling bacteria or fungal diseases.
Vanuatu	No national plan or system for monitoring use of antimicrobials.	Data collected and reported on total quantity of antimicrobials sold for/used in animals and their intended type of use (therapeutic or growth promotion).	No national plan or system for monitoring use of pesticides used for the purpose of controlling bacteria or fungal diseases.
Samoa	Every 1 to 2 years data is collected and reported on: Antimicrobial sales or consumption for human use; and antibiotic prescribing and appropriate/rational use, in a representative sample of health facilities, public and private.	No national plan or system for monitoring sales/use of antimicrobials in animals.	No national plan or system for monitoring use of antimicrobials in plants.
Tonga	System designed for surveillance of antimicrobial use, that includes monitoring national level sales or consumption of antibiotics in health services.	No national plan or system for monitoring sales/use of antimicrobials in animals.	NDR
Cook Islands	System designed for surveillance of antimicrobial use, that includes monitoring national level sales or consumption of antibiotics and rational use of antibiotics in health services.	No national plan or system for monitoring use of antimicrobials in animal or crop production	No national plan or system for monitoring use of antimicrobials in animal or crop production
Kiribati	No national plan or system for monitoring use of antimicrobials.	NDR	NDR

This objective examines national monitoring and surveillance systems across One Health sectors. This is assessed in two parts, and both involve the continuous collection of data. The first is related to a national monitoring system. The AMR monitoring system involves routine recording, analysis and distribution of information related to AMR.[47]

Table 11: Progress in strengthening the knowledge and evidence base through surveillance and research in PICTs (part 2).[25]

Country	National surveillance system for AMR in humans	National surveillance system for AMR in animals (terrestrial and aquatic)	Country using relevant AMR data to amend national strategy and/or inform decision making.					
			Human (WaSH)	Animal Health	Plant Health	Food Production	Food Safety	Environ-ment
Fiji	AMR data is collated locally for common bacteria, but data collection may not use a standardized approach and lacks national coordination and/or quality management.	No national plan for a system of surveillance of AMR	YES	YES	NDR	NDR	NDR	NDR
Micronesia	There is a functioning national AMR surveillance system covering common bacterial infections in hospitalized and community patients, with external quality assurance, and a national coordinating centre producing reports on AMR.	No national plan for a system of surveillance of AMR.	YES	NDR	NDR	NDR	YES	NDR
Solomon Islands	AMR data is collated locally for common bacteria, but data collection may not use a standardized approach and lacks national coordination and/or quality management.	No national plan for a system of surveillance of AMR.	YES	NO	NO	NO	NO	NO
Palau	No capacity for generating data (antibiotic susceptibility testing and accompanying clinical and epidemiological data) and reporting on antibiotic resistance.	No national plan for a system of surveillance of AMR.	NO	NO	NDR	NDR	NDR	NDR
Tuvalu	AMR data is collated locally for common bacteria, but data collection may not use a standardized approach and lacks national coordination and/or quality management.	No national plan for a system of surveillance of AMR.	NO	NO	NDR	NDR	NDR	NDR
Vanuatu	AMR data is collated locally for common bacteria, but data collection may not use a standardized approach and lacks national coordination and/or quality management.	No national plan for a system of surveillance of AMR.	NDR	NDR	NDR	NDR	NDR	NDR
Samoa	National AMR surveillance activities are in place for common bacterial pathogens that link patient information with susceptibility testing, with a national reference laboratory that participates in external quality assurance.	No national plan for a system of monitoring of AMR is available.	YES	NO	NO	NO	NO	NO
Tonga	AMR data is collated locally for common bacteria, but may not use a standardized approach and lacks national coordination and/or quality management.	National plan for monitoring AMR but capacity (including laboratory) for surveillance and reporting data on AMR is lacking.	NO	NO	NO	NO	NO	NO
Cook Islands	National AMR surveillance activities are in place for common bacterial pathogens that link patient information with susceptibility testing, with a national reference laboratory that participates in external quality assurance.	No national plan or system for monitoring AMR in animals, food and agricultural production.	YES	NO	QNA	QNA	NO	QNA
Kiribati	AMR data is collated locally for common bacteria but may not use a standardized approach and lacks national coordination and/or quality management.	NDR	NO	NDR	QNA	QNA	NDR	QNA

National surveillance systems are more comprehensive and active systems are made of at least three components: an AMR monitoring system; a predefined AMR intervention strategy; and a defined AMR frequency threshold.[47] Fiji and two other PICTs maintain they have a monitoring system for the sales and consumption of antimicrobials for human use. Fiji also maintains to have a national monitoring system for the sales and use of antimicrobials for animal use

at farm level. This did not concur with the information accessed in the assessment of the Fijian NAP. Most of the surveillance systems for AMR in humans operate at local level and for common pathogens. Findings from the NAP assessment previously in this paper show that laboratory infrastructure, capacity and capability are deficient, and this impacts greatly on surveillance potential. Surveillance systems are focused on human health in PICTs with Fiji using some data from animal health to inform national strategy.

Objective 3 examines the progress of countries to reduce the incidence of AMR through effective sanitation, hygiene and infection prevention strategies. Responses are presented in *Table 12.*

Table 12: Progress in reducing the incidence of infection through effective sanitation, hygiene, and IPC measures.[25]

Country	Infection Prevention and Control (IPC) in human health care	Good health, management and hygiene practices to reduce the use of antimicrobials and minimize development and transmission of AMR in animal production (terrestrial and aquatic)	Good management and hygiene practices to reduce the development and transmission of AMR in food processing
Fiji	A national IPC programme or operational plan is available. National IPC and water, sanitation and hygiene (WaSH) and environmental health standards exist but not fully implemented.	Some activities in place to develop and promote good production practices.	Some activities in place to develop and promote good management and hygiene practices.
Micronesia	A national IPC programme or operational plan is available. National IPC and water, sanitation and hygiene (WaSH) and environmental health standards exist but not fully implemented.	Some activities in place to develop and promote good production practices.	Some activities in place to develop and promote good management and hygiene practices.
Solomon Islands	National IPC programme available according to the WHO IPC and IPC plans and guidelines implemented nationwide. All health care facilities have a functional built environment (including water and sanitation), and necessary materials and equipment to perform IPC, per national standards.	No systematic efforts to improve good production practices.	Some activities in place to develop and promote good management and hygiene practices.
Palau	A national IPC programme or operational plan is available. National IPC and water, sanitation and hygiene (WaSH) and environmental health standards exist but not fully implemented.	Some activities in place to develop and promote good production practices.	Some activities in place to develop and promote good management and hygiene practices.
Tuvalu	A national IPC programme or operational plan is available. National IPC and water, sanitation and hygiene (WaSH) and environmental health standards exist but are not fully implemented.	Some activities in place to develop and promote good production practices.	No systematic efforts to improve good management and hygiene practices.
Vanuatu	A national IPC programme or operational plan is available. National IPC and water, sanitation and hygiene (WaSH) and environmental health standards exist but are not fully implemented.	National plan agreed to ensure good production practices in line with international standards. Nationally guidance for good production practices developed, adapted for implementation at local farm and food production level.	Some activities in place to develop and promote good management and hygiene practices.
Samoa	IPC programmes are in place and functioning at national and health facility levels according to the WHO IPC core components guidelines. Compliance and effectiveness are regularly evaluated and published. Plans and guidance are updated in response to monitoring.	National plan agreed to ensure good production practices in line with international standards. Nationally guidance for good production practices developed, adapted for implementation at local farm and food production level.	Some activities in place to develop and promote good production practices.
Tonga	A national IPC programme or operational plan is available. National IPC and water, sanitation and hygiene (WaSH) and environmental health standards exist but are not fully implemented.	National plan agreed to ensure good production practices in line with international standards. Nationally guidance for good production practices developed, adapted for implementation at local farm and food production level.	Some activities in place to develop and promote good production practices.
Cook Islands	A national IPC policy or operational plan is available, with standard operating procedures (SOPs), guidelines and protocols available to all hospitals.	No systematic efforts to improve infection prevention in the animal and food production sectors related to reducing use of antimicrobials.	QNA
Kiribati	A national IPC policy or operational plan is available, with standard operating procedures (SOPs), guidelines and protocols available to all hospitals.	NDR	QNA

The emphasis for IPC in the Pacific followed the SARS-CoV-1 epidemic in 2003 where approximately half of the cases were due to transmission in healthcare.[33] IPC gained greater focus following the first wave of the Influenza A (H1N1) pandemic in 2009. Most PICTs have a national IPC program available for human healthcare. Animal production and food processing have some local activities in place to minimise the development and transmission of AMR. Some PICTs maintain they have national plans to reduce the use of antimicrobials and minimise AMR spread for animal production. However, it is uncertain how detailed these would be considering the low level of animal production in the PICTs.

Optimising the use of antimicrobials across the One Health sectors is critical in minimising the spread of AMR. Objective 4 examines the efforts of PICTs in achieving this, with the relevant data presented in *Table 13.* Most of the PICTs maintain they have guidelines and practices in place to optimise antimicrobial use in human health. The TrACSS does not request any information on regulating these guidelines and practices. In recent surveys, countries have been asked if they have adopted 'AWaRe' classification for certain antibiotics. This classification was developed in 2017 by the WHO Expert Committee on Selection and Use of Essential Medicines. Antibiotics are classified into three distinct groups: Access, Watch, and Reserve, as a means of supporting AMS and to emphasise the importance of their appropriate use.[48] Fiji maintains that it optimises all aspects of the use of antimicrobials in animal health through national legislation. This did not agree with my findings. Most of the PICTs had little or no legislation covering the optimisation of antimicrobial use in animal health and plant production. The 2016-2017 survey introduced the area of legislation and/or regulations of antimicrobials to prevent contamination of the environment. Fiji, Cook Islands, and Kiribati contributed to this survey, and each had some legislation in place to prevent environmental contamination. The question was omitted from future survey years. However, I believe it should be reinstated due to the significance it holds in AMR spread and the spill-over of AMR from animals to humans.

Table 13: Progress in optimising the use of antimicrobials in human, animal, and plant health in PICT.[25]

Country	Optimizing antimicrobial use in human health	Adoption of "AWaRe"	Optimizing antimicrobial use in animal health	Optimizing antimicrobial pesticide use in plant production	Legislation and/or regulations to prevent contaminating environment with antimicrobials
Fiji	Practices to assure appropriate antimicrobial use being implemented in some healthcare facilities and guidelines for appropriate use of antimicrobials available.	Country has adopted the AWaRe classification of antibiotics in their National Essential Medicines List.	National legislation covers all aspects of national manufacture, import, marketing authorization, control of safety, quality and efficacy and distribution of antimicrobial products.	NDR	Regulations are in place that limit discharge of antimicrobial residues from municipal and pharm. industry waste and wastewater. A regulatory compliance system is functioning that includes compliance with regulations on antimicrobial residues (2016-2017 survey)
Micronesia	No/weak national policies for appropriate use.	Country has knowledge about the AWaRe classification of antibiotics and has intention to adopt it in the next few years.	No national policy or legislation regarding the quality, safety and efficacy of antimicrobial products, and their distribution, sale or use.	No national policy or legislation regarding the quality, safety and efficacy of pesticides including antimicrobial pesticides and their distribution, sale or use.	
Solomon Islands	Guidelines to enable appropriate use are implemented in most health facilities. Monitoring and surveillance are used to inform action and to update treatment guidelines and essential medicines lists.	Country has knowledge about the AWaRe classification of antibiotics and country has intention to adopt it in the next few years.	National legislation covers some aspects of national manufacture, import, marketing authorization, control of safety, quality and efficacy and distribution of antimicrobial products.	National legislation covers some aspects of manufacture, import, marketing authorization, control of safety, quality and efficacy and distribution of pesticides.	
Palau	National policies for antimicrobial governance developed for the community and health care settings.	QNA	No national policy or legislation regarding the quality, safety and efficacy of antimicrobial products, and their distribution, sale or use.	QNA	
Tuvalu	Guidelines to enable appropriate use are implemented in most health facilities. Monitoring and surveillance are used to inform action and update treatment guidelines and essential medicines lists.	QNA	National legislation covers some aspects of manufacture, import, marketing authorization, control of safety, quality and efficacy and distribution of antimicrobial products.	QNA	
Vanuatu	National policies for antimicrobial governance developed for the community and health care settings.	QNA	National legislation covers some aspects of manufacture, import, marketing authorization, control of safety, quality and efficacy and distribution of antimicrobial products.	QNA	
Samoa	Guidelines on optimizing antibiotic use are implemented for all major syndromes and data on use is systematically fed back to prescribers.	QNA	No national policy or legislation regarding the quality, safety and efficacy of antimicrobial products, and their distribution, sale or use.	No national policy or legislation regarding the quality, safety and efficacy of antimicrobial products, and their distribution, sale or use.	
Tonga	Practices to assure appropriate antimicrobial use being implemented in some healthcare facilities and guidelines for appropriate use of antimicrobials available.	QNA	No national policy or legislation regarding the quality, safety and efficacy of antimicrobial products, and their distribution, sale or use.	No national policy or legislation regarding the quality, safety and efficacy of antimicrobial products, and their distribution, sale or use.	
Cook Islands	Antimicrobial stewardship program implemented in most health care facilities and community. Regulations enforced on access to antibiotics and use in humans. Monitoring and surveillance inform action and update treatment guidelines and essential medicines lists.	QNA	No national policy or legislation regarding the quality and efficacy of antimicrobials and their use in animals, and crops.	No national policy or legislation regarding the quality and efficacy of antimicrobials and their use in animals, and crops.	There is a functioning regulatory compliance system for all types of waste/wastewater (sewage, health facilities, agriculture, manure and industrial effluent) to the environment.
Kiribati	No/weak national policy & regulations for antimicrobial stewardship.	QNA	NDR	NDR	Legislation and/or regulations are in place to control wastewater discharges from sewage to the environment.

3.3 AMR awareness and AMS practices in Fiji

Antimicrobial, and particularly antibiotic awareness, is at the core to managing AMR. There is an urgent need for ongoing community education of the role and use of antibiotics, as well as how they should be taken.[49] The antibiotic awareness study conducted by Mataika and Yim[50] at the Hibiscus Festival in Fiji discovered that public awareness of antibiotics and AMR remains a problem that needs immediate address. Findings of this study are presented in *Table 14.*

Table 14: Findings from a study by Mataika and Yim in assessing antibiotic awareness in Fiji.[50]

Study	Authors	Study design	Study findings
2015 Fijian Antibiotic Awareness Study[50]	Mataika J, Yim C.	Study of 5000 participants aimed to gather community perceptions and understanding of the role and use of antibiotics.	Education level of the participant highly correlated with knowledge of antibiotics. The terms amoxycillin or penicillin were more known and recognised than the term antibiotics. Large numbers of participants used antibiotics for viral infections such as 'colds or flu'. Antibiotics were used as treatment for headaches, dengue, asthma, pregnancy, and pain. Despite survey participants claiming to know what antibiotics are, 67.1% did not know about AMR. Antibiotics were frequently shared amongst family and friends. Antibiotics were occasionally obtained without prescriptions from retail pharmacies. Responses from participants to the question ' Where did you get your antibiotics from?' is presented in *Table 14.*

The researchers found that large numbers of Fijians are self-prescribing antibiotics to treat such ailments as headaches, pain, viral 'flu' infections, dengue, asthma, and pregnancy. They are more familiar with terms such as *penicillin* and *Amoxil* than they are with the term *antibiotic*. Antibiotics are frequently shared with family and friends and were occasionally procured without prescription from retail pharmacies. Antibiotic procurement practices of the participants are presented in *Table 15.*

Table 15: Source of antibiotic supply among survey participants.[50]

Response	Percentage of patients	Raw count
Doctor gave it to me	19.9%	992
Nurse gave it to me	3.1%	157
Retail pharmacy with prescription	11.8%	589
Retail pharmacy without prescription	1.7%	84
Government health clinic	52.5%	2,625
Government pharmacy	7.3%	366
Other	3.7%	184*
Total		**4,997**

**Of those that responded as 'other'*

- *15.2% had borrowed them from friends, neighbours or the antibiotics were residual from previous courses.*
- *1.7% had obtained antibiotics from pharmacies without prescription.*

The study expressed the genuine concerns of this practice by many pharmacists in Fiji. They also showed concerns for patients who only purchased a few days course of antibiotics due to the unaffordability of a full course.[51]

In a study by Pickmere and Booth,[51] pharmacists agreed their role was vital in managing the escalating issue of AMR through AMS. Not all pharmacists understood the concept of AMS in the study conducted to gauge their level of understanding, nevertheless most were able to explain some AMS objectives they were already fulfilling in their role as pharmacists. Findings from this study are presented in *Table 16.*

Table 16: Findings from a study by Pickmere and Booth [51] investigating the understanding of AMS by hospital and retail pharmacists.

Study	Authors	Study Design	Study Findings
2017 study to investigate the understanding of pharmacists in both retail and hospital settings of AMS concepts.[51]	Pickmere A, Booth K.	Study investigating the understanding of AMS concepts by two groups of pharmacists; those working in retail and hospital pharmacies. Prepared interviews and questionnaires were utilised to collect data and responses were collected from retail pharmacists in Suva and hospital pharmacy staff from three major Fijian hospitals.	Noticeable differences between retail and hospital pharmacists. Few hospital pharmacists understood concepts of AMS. All pharmacists agreed that their role was vital in AMS. Pharmacists understood their influence they on escalating AMR. Genuine concerns with prescribers and their practises. Significant anxiety for the practice by some retail pharmacists of supplying antibiotics over the counter without prescriptions. Retail pharmacists highlighted huge issues with individuals only purchasing a few days antibiotic treatment in place of a full course due to unaffordability. All pharmacists were effective in listing the benefits of AMS but were forthcoming with the obstacles of AMS. Some areas of concern for successful AMS implementation included human resources, finances, awareness, time, poor community health, and population literacy. Common inappropriate use of antibiotics was noted for treatment of headaches, pain and 'flu'. Major contributor for the unnecessary supply of antibiotics is patient pressure. Almost all respondents acknowledged that AMR in Fiji was already a serious problem. Accepted that marginal use of microbiological testing for prescribing guidance, and the practise of using strong broad-spectrum antibiotics empirically, have been major contributors to AMR in Fiji.

The problem areas for successful AMS implementation included deficiencies in human resources, finances, awareness, time, poor community health, and literacy.

A concern for many physicians in Fiji is patient pressure on physicians to prescribe antibiotics unnecessarily.[49,50,51] The study by Pickmere et al[49] proved the physicians' concerns were not unfounded. Findings from this study are presented in Table 17. When some clinic physicians depleted their antibiotic supplies, they requested donations from Taiwan against National Donation Guidelines.[49] Physicians were faced with several recurring issues that impacted on their management of AMR. These included poor access to AMR

resources including Standard Therapeutic Guidelines (STG),[49,52] timely access to some antibiotics, and stock-outs of medications. [51,52,53]

Table 17: Findings from a study by Pickmere et al [49] examining the knowledge and use of antibiotics at five outpatient clinics in Fiji.

Study	Authors	Study Design	Study Findings
2015 Fijian Study investigating knowledge and use of antibiotics at five outpatient clinics.[49]	Pickmere A, Macalinao, Nargina Martaika J, Snell B	One week of antibiotic prescriptions dispensed by pharmacies, were collected and reviewed.	Prevalence of infections being treated consisted primarily of SSI and respiratory infections.
		Patient questionnaire was distributed seeking patients' understanding of the role of antibiotics and how they should be used. The sample size for the patient questionnaire was 4,997 (over the age of 18 years old).	The patient survey finds urgent need for ongoing community education of role and use of antibiotics, as well as when and how they should be taken.
		Prescribing physician questionnaire seeking their perceptions of antibiotic guidelines and restrictions, patient pressure and other motivations for antibiotic prescribing.	Frequently physicians were pressured to prescribe antibiotics for patients. Physicians identified that there were AMR resources available however, they were poorly accessible and seldomly used, including STG. Physicians stressed that maintaining reliable supplies of appropriate stock was an issue. Clinic physicians had been requesting donations of antibiotics from Taiwan against National Fiji Donation Guidelines.

The studies also found areas for improvement to assist physicians in managing AMR. Policies have been introduced by healthcare facilities to manage AMR that are being followed ad-hoc by physicians. Some physicians lack compliance with these policies. One such policy is the Meropenem Use at Divisional Hospitals Policy in Fijian healthcare. This policy requires confirmation of an infective organism by microbiological culture before administration of the antibiotic meropenem. Meropenem is classified as a 'watch' antibiotic under WHO's AWaRe classification system.[48] A study for the Fijian Ministry of Health was conducted assessing the compliance of physicians with this policy. The findings from this study are presented in *Table 20.* Of the patients prescribed meropenem, 40% had no specimen collected. In the same study, required documentation for administering a restricted antimicrobial was incomplete in more than half the patients.

In the study of colistin use in a major Fijian hospital, Pickmere *et al* found that incomplete or inadequate documentation was a common obstacle to the completion of some of these studies.[53] These findings are presented in *Table 18*. Major Fijian hospital microbiology laboratories do not use the pathology computer system because it doesn't generate resistance statistics. Results are recorded in registers, transcribed onto yellow results slips and then signed off by the Microbiology senior. Patient information and results are not easily accessible and requires time-consuming practises for retrieval.

Table 18: Findings from a study by Pickmere et al analysing the use of colistin in a major Fijian hospital. [52]

Study	Authors	Study Design	Study Findings
2015 Colistin Usage in Fiji.[52]	Pickmere A, Macalinao N, Mataika J, Gounder R, Snell B.	Records reviewed of patients who had been treated with colistin during this period.	Of the 25 patients treated with colistin, 14 had died from their conditions. All patients had been in ICU. Bacterial organisms of interest were isolated from blood cultures, respiratory aspirates, peritoneal fluid, IDC tips, and wound swabs. *Acinetobacter baumanii* isolated in 76% of cases Organisms isolated are presented in *Table 21* Drug use evaluation studies could not be performed because patient records were not comprehensively maintained or readily retrievable. Patients suffering from infections that could warrant prompt treatment with colistin.
		Review of treatment cost issues. Resistance patterns of the suspected disease-causing bacteria were reviewed. Sample size was small: 25 patients of which 24 were >16 years old. 6 patients had a completed medical record profile.	
		Interviews with IPC, microbiology/infectious diseases teams.	There were many stock outs (no remaining stock) of medications and IPC consumable equipment in the hospital wards, in addition to stock outs with laboratory supplies. IPC was grossly deficient. There was very detailed record keeping in contradiction to inadequate monitoring with little intervention.
		Information obtained from physicians regarding their colistin treatment choice. to their use of colistin as treatment.	There was a substandard understanding of treatment protocols and STG by prescribing physicians. Documentation was not always readily accessible. Colistin use protocols were not readily available or not consulted. When colistin therapy was indicated, timely access to the antibiotic was unsatisfactory. Some physicians perceived a need for empirical use of colistin.

Table 19: Pickmere et al study- Organisms of infection isolated from ICU patients requiring colistin treatment.[52]

Organism of infection	**Patient infection cases**
Acinetobacter baumanii	19
Acinetobacter junii	2
Pseudomonas aeruginosa	3
Unidentified MRO	1
Total	25

Lack of availability of antibiotics is just one of the stock-out issues. There are often stock-outs of essential IPC materials and equipment. In the study commissioned by the Fijian Ministry of Health, IPC staff stated that paper towel is commonly in short supply in the hospital, so it is often shared or reused. Gloves are only worn by nurses whilst performing a medical procedure and not during patient care. No audit protocols exist for hand hygiene or for IPC essentials such as antibacterial soap and gel, and paper towel. In most hospitals, IPC nurses are not solely dedicated to IPC and cover staff shortages in other departments. There are frequent outbreaks in healthcare facilities in Fiji. One major hospital outbreak involved a meropenem-resistant *Acinetobacter baumanii* strain. The mode of spread of this organism was discovered to be the reuse of ventilator tubing. Reuse of the tubing was a result of supply issues. In a separate incident, despite a ward closure by IPC due to an outbreak, 7 patients who were infected with a MDRO were moved between different wards potentially spreading the organism.

This study emphasised the critical gaps in both staffing and IPC/AMR awareness that exist.

Table 20: Findings from a study commissioned by the Fijian Ministry of Health assessing the use of meropenem in a major Fijian hospital.[53]

Study	Authors	Study design	Study findings
2014 Meropenem usage in Fiji's major hospital.[53]	Fiji Ministry of Health and Medical Services.	Retrospective observational cohort study of three ICU wards in Fiji's main hospital October 2013 to October 2014. This study consisted of a cohort of 88 patients. Eleven of the 22 wards housed patients being treated with meropenem: 28.7% adult ICU patients and 32.2% paediatric patients.	Requirement of the Meropenem Use at Divisional Hospitals Policy (Fiji) that confirmation of infective organism by blood or any other relevant body fluid culture is required. 37.9% of patients treated with meropenem had no blood or relevant body fluid culture collected, and 18% had no specimen collected at all. 52.3% of the patients', had incomplete essential 'Restricted Antimicrobial Request Form' with no justification of therapy. 7% of cases, justification for meropenem treatment due to other in-vitro sensitive antibiotics were out of stock. 40% of cases the justification was that culture results showed organism was susceptible to meropenem. 26% of cases, after no improvement with other antibiotics, meropenem was the preferred treatment option. Most common organism isolated from culture was Klebsiella pneumoniae with an extended spectrum beta lactamase (KPN ESBL). This made up 32% of all positive culture results. 72 organisms from 55 patients were isolated. 4 organisms were resistant to all available antibiotics. IPC ward closure rules were ignored. IPC nurses are not solely dedicated to IPC and cover staff shortages in other departments. Frequent outbreaks occur. Staff IPC training undertaken 1-2 times a year and in-house training is carried out every 1-2 weeks due to limited IPC staff and resources. No protocols exist for hand hygiene audits or audits on IPC essentials such as antibacterial soap and gel, and paper towel.
		Surveys and interviews conducted with hospital prescribers, and staff from Microbiology, Infectious Diseases, IPC, and pharmacy departments to identify issues contributing to AMR spread.	Microbiology does not use the pathology computer system because it doesn't generate resistance statistics. Results are recorded in registers, transcribed onto yellow results slips and then signed off by the Microbiology senior. Susceptibility testing is performed on all culture positive specimens. All the antibiotic susceptibilities in the antibiotic panel are tested and reported for every sample. Microbiology senior concerned that the panels contained antibiotics that were no longer used in the hospital, and some of the newer antibiotics that were being clinically used in the hospital were not being tested, example colistin. The greatest meropenem resistance problem was due to *Acinetobacter baumanii*. Currently no written protocol for when antibiotics are low or out of stock. Pharmacy attempts to restrict the usage of low stock antibiotics and releases it to only vital departments. Depending on the level of distribution of an antibiotic, the hospital can procure it from excess stock at another healthcare facility, or from local suppliers. A usage report is completed annually and not on a more regular basis. The infectious disease physician indicated that 'essential medicines being out of stock is so standard that is hardly seems worthy to report'.

Figure 4: Fiji's largest and oldest hospital - Colonial War Memorial Hospital, Suva. It has a total of 1117 staff consisting of 133 doctors, 534 nurses, 173 paramedical and management staff, and a support team of 277.[54]

4 Discussion

This study evaluated the National AMR Action Plans of the developing island countries and territories of the South Pacific using a governance framework adapted from that published by Anderson *el al*.[23] There is only one NAP developed for this region and recorded in the WHO library of NAPs. A governance framework analysis of the NAP of Fiji was performed. Furthermore, five survey years of responses were compiled and assessed from the Tripartite AMR Country Self-Assessment Survey (TrACSS) to monitor the progress of AMR in the PICTs. This study also evaluated AMS findings from studies performed in PICTs between 2014 to 2021 to gain an understanding of significant drivers of AMR.

The importance of undertaking this study

There is little published data available involving AMR governance for the developing Pacific Islands Countries and Territories (PICTs). To my knowledge, there are no published studies that have assessed AMR National Action Plans (NAP) for developing PICTs applying this governance framework, nor is there a compilation and assessment of PICT's responses to the Tripartite AMR Country Self-Assessment Survey. This information is important to inform future decisions and provide confidence and clarity to targets that need to be met in the south Pacific.

The value of an AMR governance framework and a One Health Approach

A lack of available resources has impacted on Fiji, resulting in the adoption of a less developed plan than some resource-rich countries. Resource-poor countries often find an incremental plan that more easily facilitates small, manageable S.M.A.R.T. targets more attainable.[23]

The Fiji NAP also proved a little challenging to navigate due to poor numbering of objectives with non-sequential and duplicate numbering. This did not reflect confidence in the legitimacy of the NAP.

The WHO stated clearly in their guidance for NAPs that all relevant entities of the One Health approach should be involved.[55] The multi-sectoral One Health approach was addressed in Fiji's NAP. It recognised that a collaborative effort from multiple sectors would achieve better public health outcomes and improves

management of AMR. The NAP however does not adopt S.M.A.R.T. targets to achieve the objectives.

Coordination in a One Health approach necessitates both a horizontal and vertical focus and cooperation between the multisectoral stakeholders. Apart from the roles performed by the various sectors in their network, each sector operates at multiple levels in a hierarchical top-bottom vertical relationship. When Fiji finds effective ways to combine these two approaches, it will lead to a more successful collaborative effort for both the sustainability and effectiveness of their NAP.[56]

Fiji's NAP conveys comprehensive participation by several stakeholders during both the conception and implementation phase. This is a vital aspect of the governance process, however without the support of an operational plan with clear S.M.A.R.T. targets, it is difficult to assess the NAP's potential. There was no accountability addressed in the NAP. Accountability provides an opportunity for questions. regarding decisions and actions, to be clearly answered and understood.[23]

During the development, implementation and evaluation process of the NAP, the public should have access to not only the NAP but any progress reports and funding allocation. I was unable to locate the strategic operational plan that was stated in the NAP implementation framework. Had this information been made publicly available in a clear understandable format, public awareness and involvement in the policy would have been encouraged and supported.[23]

LMICs – Inequity, and funding for AMR

Potentially, Fiji's NAP is a positive benefaction to its public health framework. Fiji should be aiming for consistency and maintenance of its NAP. There is no focus on a dedicated budget for development, implementation, or evaluation of the NAP. National health challenges have evolved in PICTs as a result of their fragile health status and impacts from climate change.[57] National health budgets are under increasing pressure from these impacts whilst the public's expectation for good healthcare delivery increases. The WHO has committed to providing support for an overall strategic direction in The Pacific Island Countries and Areas–WHO Cooperation Strategy 2018–2022.[57] Funding for AMR research and

initiatives in LMICs has significantly increased recently. Foreign aid is an important means of financial support to PICTs.[17] The Australian Government's Health Security Initiative for the Indo-Pacific region is but one of the foreign donor funds' projects addressing health threats such as AMR.[17] In March 2021 the initiative, Combat AMR, was officially launched in Fiji. This is a two-and-a-half-year project led by the Doherty Institute (Australia) as part of a program to mitigate the risk of AMR in PICTs. This project group aims to work collaboratively with the National AMR Committee in Fiji, along with public health and regional stakeholders (including the WHO and the Fleming Fund) to ensure that projects and activities align with the NAP, whilst promoting sustainability. [6,8] They aim to employ capacity building and training to provide support under the NAP framework for prevention, diagnosis, surveillance, and management of AMR.[58] Fiji has one of the highest bacterial infection rates globally.[59] The burden of health issues such as diabetic infections and TB, sees a greater need for the use of antibiotics and, potentially increasing the risk of AMR.[59]

It is anticipated that AMR will bring about four times more deaths annually than occurred from COVID-19 during 2020.[60] Inequity through lack of access to antimicrobials, frequent stock-outs of antimicrobials and healthcare products, and the inability to provide basic health interventions such as IPC that assist in reducing the spread of AMR are frequently experienced.[60] There is a belief that contextual needs such as behavioural drivers and the inclusion of stakeholders, is often overlooked for their importance in developing solutions to tackle AMR, especially in LMIC.[61] . Expectations and targets set by international policymakers and organisations need to reflect the resource limitations of the PICTs.[61]

Surveillance – Data that drives decision

A fundamental component of a NAP is surveillance. This impacts planning, management and evaluation of AMR policies.[23] Reliable and regular surveillance affords a current and accurate understanding of AMR prevalence and changes. Fiji and most PICTs lacked access to a centralised system to record AMR data. They rely on a paper-based recording system that is cumbersome and unreliable when researching data retrospectively. This local data however, can be used to inform targeted AMR policies if utilised appropriately.[17] None of the PICTs who

participated in the TrACSS contributed to a global reporting system such as GLASS. In comparison, a study of analysing NAPs from neighbouring South-East Asia revealed that most countries had enrolled in GLASS, enabling surveillance data to be shared globally.[22] GLASS, with support from WHO, have the capacity to contribute technical support in building national laboratory capacities in LMIC.[62]

To support countries and territories in the WHO Western Pacific Region to implement surveillance systems and their NAPs, a Technical Working Group for AMR (TWG-AMR) was established. This group is represented across different divisions and disease programs with leadership from Division of Health Systems. TWG-AMR identified priorities in AMR surveillance development such as enhancing laboratory capacities, and strengthening national AMR surveillance networks.[63] There was a paucity of information about activities relating to TWG-AMR in PICTs. It is essential that PICTs develop the capacity of a least one centralised laboratory to both culture and perform quality-controlled antibiotic susceptibility testing. AST. Whilst this laboratory is being developed, there needs to be a suitable referral system to a neighbouring country that has an established capability.[64] The Fleming Fund, who support LMICs to produce, share and use data to improve the use of antimicrobials[65], maintain that there must be an increase in data generation from healthcare facilities, an increase in microbiological testing, and more demand for data in local healthcare facilities to adequately understand the authentic impact of AMR. Findings from the study by Murray *et al* [5] restated that the highest burden of AMR is found in low-resource settings. They found that there were serious data gaps in these settings highlighting the need to expand microbiology laboratory capacity as well as developing data collection systems that would improve our understanding of AMR as a serious health threat.

Critical to the success of tackling AMR is understanding the motivations and drivers of the microbiology laboratory.[66] The efforts of generating and sharing AMR surveillance data, including antimicrobial use and consumption, are squandered if this information is not translated into practices and policies for AMR reduction. PICTs require more practical support in the generation and use of data. They require support in interpreting emerging global experiences and lessons into national policies and region-specific policy actions.[67] Surveillance capacity

for animal and plant health in PICTs is further underdeveloped or non-existent. Four PICTs are member countries of OIE [68] and only Fiji reports that data is collected to farm level in TrACSS.[17,25]

The role of antimicrobial stewardship (AMS) in PICTs

Consistent with most LMICs, Fiji's antibiotic prescription and use are under the influence of socio-economic and socio-culture drivers.[61] It is suggested that if these drivers are not considered, understood, and addressed then AMR will continue to emerge and spread through populations irrespective of any newly discovered antibiotics.[61] When developing antimicrobial use strategies, despite the existence of evidence -based recommendations, it is important to recognise the influence of some healthcare hierarchies on antibiotic use and prescribing practices.[61]

The association between antimicrobial use and AMR has been well-documented. Available evidence suggests that antimicrobial consumption in humans has globally increased in the past two decades primarily driven by increased use in LMICs.[69] Even though detailed estimates are lacking, OECD have indicated that as many as half of the antimicrobials used in the healthcare of humans can be considered inappropriate.[69] In their report on Antibiotic Use and Surveillance 2018, the WHO has revealed that LMICs frequently experience limited access to antimicrobials and significant unaffordability for full courses of antibiotics. This results in a greater number of partially treated infections, inappropriate treatment regimes, or use of falsified or substandard medication. The WHO's findings were supported by the findings of the studies examined in this paper.[69] Gaps in AMS in the PICT were also highlighted. Updated Antibiotic STG documentation and education for all prescribers will improve AMS compliance. Fiji National Medicines Product Policy (NMPP) identifies STG as a guide to the prescription of antimicrobials. However, the studies reviewed showed that prescribers use this document ad-hoc.[51] The slow test turn-around times for laboratory microbiology results was identified as another obstacle. This often led to empirical use of second line or last line antibiotics.[49,53] If prescribers could access preliminary culture results in a timely manner it may assist in the antimicrobial treatment decision making process. The studies also revealed that the patient pressure

mounted on prescribers to prescribe antibiotics gratuitously, highlighted the need for ongoing education of health professionals and the public.

One of the greatest problems in compliance with AMS in Fiji is stock maintenance. Pickmere[52] suggests that this can be easily solved by employing such practises as documenting patients' medical conditions and, appropriate antimicrobial therapies to treat those conditions, thereby forming the basis of stock reordering.

It was revealed by Mataika and Yim[50] that regulatory control is lacking in Fiji with some pharmacists dispensing antibiotics without a prescription. Enforcement needs to be strict.[51] Nevertheless, AMS programs should not be solely centred on the restricted use of antimicrobials but should also address facilitating equitable and timely access to appropriate antimicrobials.[23]

Infection Prevention and Control

Fiji's NAP includes measures that implement IPC policies especially hand hygiene. When AMS and IPC measures are implemented synergistically, it has been proven to be more successful than each program being implemented singularly.[23,70] A standardised program to support implementation of IPC measures across medical facilities and the community would be ideal. The model should include training and education, monitoring and feedback, as well as establishment of communication systems that operate across a range of global settings. The focus of IPC concerning AMR is all too often narrowly centred on controlling the spread of AMR in healthcare settings. Evidence suggests that by addressing inequality of social structure and resources, the impact on AMR will be more relevant.[60]

A report from AMR Review demonstrated how the introduction of water and sanitation infrastructure (WaSH) could reduce the number of diarrhoeal cases in LMICs requiring antibiotic therapy by 60%.[4] Diarrhoea is a substantial burden to LMICs and yet the WaSH program remains grossly underfunded. Diarrhoeal illness is caused by viral infections in 70% of cases so treatment with antibiotics is inappropriate and results in a substantial volume of unnecessary antibiotic consumption.[4] In the TrACSS only five countries acknowledged implementing the WaSH program.

The TrACSS illustrates that most of the PICTs have some activities in place to develop and promote good animal production practices. Optimising IPC on farms such as improving animal housing conditions and food quality to reduce illness in animals is critical. This potentially offsets the need for antibiotics to be used for growth promotion in animals for food production.[60] This practice would require funding for the resource-poor farmers of PICTs.

In 2006 the Pacific Public Health Surveillance Network (PHSN) officially launched PICNet.[33] This web-based communication tool was used for sharing experiences and innovations in IPC in a resource-poor environment. The formation of PHSN was in response to lessons learnt from the SARS outbreak. IPC issues in PICTs required addressing at facility, national, and regional levels. IPC was identified as a critical component in interrupting pathogen transmission of not only SARS but other infectious diseases in the region. In 2010 the Pacific Public Health Surveillance Network published IPC guidelines as part of this initiative. These guidelines were intended for adaptation to guide any PICTs with development and implementation of a national IPC policy. The guidelines are practical and simple, and tailored to be used as a reference for development of individual IPC guidelines unique to healthcare environments.[33] Fiji's Infection Control Manual for Health Facilities 2002 and Fiji Guidelines for Infection Control (2002) were used as guidance for the development of this document.[33]

Disease prevention through immunisation programs are practised in Fiji. Their immunisation schedule includes Tuberculosis; Diphtheria; Hepatitis B; HIB meningitis, pneumonia and sepsis; Polio; Rotavirus gastroenteritis; Tetanus; Measles; Pneumococcal meningitis, pneumonia and sepsis; Rubella; Pertussis; HPV (Human Papilloma Virus).[71]

Education and public awareness of AMR in PICTs

Education is key to developing and implementing standards, enabling control policies, and appropriately facilitating guidelines across One Health sectors.[23] Continuing education is imperative for all professionals who are involved in prescribing or influencing the use of antimicrobials. There are no AMR dedicated courses at educational institutions in PICTs[72], however there are alternative

methods of AMR education such as online resources and educational courses, and downloadable AMS apps.

Public awareness of AMR and its prevention programs can be effectively disseminated through public awareness campaigns. These programs should be implemented locally, nationally and regionally. To combine public awareness campaigns with cultural festivals such as the Hibiscus Festival held in Fiji, ensures greater audience scope. These programs should be implemented nationally, regionally, and locally to ensure widespread coverage. Some PICTs participate in AMR Awareness Week activities annually. However, awareness campaigns should be considered as a continuous strategy and ideally be incorporated into the school curriculum as was addressed in the Fijian NAP. The NAP also considered employing the use of influential people such as local sports celebrities to be involved in AMR awareness campaigns on several media platforms. Campaigning via a combination of media platforms has proven effective according to findings from studies in behavioural science and education disciplines.[23]

Regulations and the role they play in managing AMR

Some PICTs have regulations in place to conserve antimicrobials. However, deficiencies exist in implementing and monitoring adherence to these regulations by an accountable regulating body.[51] Regulations are necessary for the conservation of antimicrobials, and vital in limiting the use of critically important human health antimicrobials in animal health. Regulations help control the selling of substandard, expired or counterfeit antimicrobials online or in person. They are also required for both the effective disposal of antimicrobials to minimise environmental impact, and to abolish direct consumer advertising of medicines.[23]

Compliance to regulations can be achieved by implementing various systems including laws, accreditations, or financial initiatives and penalties.[23] Regulations must be well-designed and involve appropriate legislative mandates, have a clear legal framework, and be overseen by an accountable regulating body who can implement and monitor compliance.[23]

Incentivising antimicrobial prescribers to meet prespecified targets for reduced use of unnecessary antibiotics is a constructive component of a comprehensive

NAP.[73] Lack of resources in PICTs would present constraints to implementing this approach. Impact and correlation studies would offer data to drive this decision. The Fijian NAP consults the National Medicinal Products Policy that was developed to provide advice on the Fijian medicine supply process. This policy was developed with assistance from the WHO and addresses the over-prescription or inappropriate use of antimicrobials leading to shortages of supply.[74]

The potential impact of AMR research and development to the PICTs

AMR research and development in regard to LMICs requires thorough and thoughtful consideration for the lack of resources. Results achieved in HICs cannot be assigned to LMICs without constraints. Fostering more equitable research partnerships between HICs and PICTs enables bilateral learning and exchange of knowledge built on mutual trust and respect.[61] The PICTs have a number of research partnerships with neighbouring Australia and New Zealand, as well as a consortium of organisations from around the globe.[6] HICs have a responsibility to foster research and development in LMICs by speaking up for the underrepresented and championing for LMICs to share the global platform.[61]

In the past decade, scientists were incentivised to develop rapid point-of-care diagnostic tests that would differentiate between bacterial and viral infections, and potentially lead to a dramatic reduction in unnecessary antibiotic use.[75] Currently physicians are requesting more information from these tests, such as bacterial identification and any resistance mechanisms present, in an effort to provide the best treatment plan for their patient.[75] With the increase in AMR, especially in LMICs, there is strong opinion that new tests need to be developed and be available to frontline professionals. It is not uncommon for products designed for sale in HICs to be impractical for use in LMICs.[75] Investors need to be incentivised to allocate their funding to areas of greatest need and optimal impact.

Monitoring and evaluation of AMR

The omission of a publicly available progress report on the activities of their NAP, creates a void in Fiji's monitoring and evaluation mechanisms. This report would serve useful to other neighbouring PICTs and provide regional AMR analysis to international public health agencies.[23] Reporting and feedback mechanisms are

an essential aspect of a NAP. For the surveillance of AMR to be effective, feedback mechanisms should involve local stakeholders in the assessment of data, needs, and improvements required. The feedback mechanisms should be aligned to set deadlines and targets.[23] Within the Fiji NAP, there is no outline of the methods to be used in measuring the effectiveness of the policy. This is not always straightforward in a resource poor environment, however, it is important to establish which activities and policies are cost-effective. Cost-effectiveness analysis is strongly recommended to rationalise funding decisions.[23]

Limitations of this study

There were some limitations to my study that deserve noting. The information used in my assessment was to some extent underpowered due to the paucity of information available online. Unavailability of some documents and policies limited the generalisability of my findings. For the TrACSS to be a valuable resource, I am relying on the responses to be genuine and knowledgeable. Despite these limitations, these findings demonstrate that PICTs are facing substantial challenges to implementing and improving the governance of NAPs and tackling AMR as a region.

5 Conclusion

It was remarkable to find that only one NAP from the South Pacific developing island countries and territories had been developed and published in the publicly available WHO NAP library. Considering the urgency of the AMR crisis, the WHO gave ample time for member countries to develop an AMR NAP. It was also disconcerting to find that Fiji had not amended the formatting errors in their NAP after seven years, suggesting a begrudging obligation to develop the NAP. Improved compliance for developing and implementing National Action Plans that are aligned with objectives of the Global Action Plan will drive better outcomes when challenging AMR in the south Pacific region.

PICTs are resource-poor, and this will not improve in the short term. The CoVID-19 pandemic is currently commandeering global resources and deflecting global attention from AMR. Perhaps the most crucial aspect of AMR that impedes any progress in PICTs is the lack of development and planning processes - the fundamental role of a NAP. Within the constraints of the PICTs resources, there is still a capacity to improve the management of AMR at the local level. This can be achieved with AMR awareness campaigns, implementation of methodical well-planned stock monitoring systems, rudimentary surveillance of MROs, and notably, open and honest communication between individual Pacific Island countries and territories, similar to the PICNet model developed for IPC policies in PICTs. Incrementally PICTs will continue to be assisted by neighbouring countries such as Australia and New Zealand, and foreign aid organisations who invest their resources to encourage and drive action to manage AMR. It will be difficult to recover from CoVID-19 globally and depletion of resources will severely impact the momentum of AMR management, however it is now more important than ever that high income countries support the resource poor countries. Support necessitates mutual sharing of information and resources, whilst respecting and considering the constraints faced by LMICs. It is imperative to have a collaborative effort to manage the AMR global problem.

6 References

1. Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: A global multifaceted phenomenon. *Pathog Glob Health*. 2015;109(7):309-318. doi:10.1179/2047773215Y.0000000030

2. Nawrat A. Tackling the 'silent pandemic' of AMR: WHO launches the Global Leaders Group. Pharma Technology Focus. https://pharma.nridigital.com/pharma_feb21/pandemic_amr_who. Published 2021. Accessed February 21, 2021.

3. Mitsakakis K, Kaman WE, Elshout G, Specht M, Hays JP. Challenges in identifying antibiotic resistance targets for point-of-care diagnostics in general practice. *Future Microbiol*. 2018;13(10):1157-1164. doi:10.2217/fmb-2018-0084

4. Review On Antimicrobial Resistance. *Tackling Drug-Resistant Infections Globally: Final Report and Recommendations.* `; 2016. https://amr-review.org/sites/default/files/160525_Final paper_with cover.pdf.

5. Murray CJ, Ikuta KS, Sharara F, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet*. 2022;6736(21). doi:10.1016/s0140-6736(21)02724-0

6. Burnet Institute. COMBAT AMR: Mitigating the threat of Antimicrobial Resistance in Pacific Island Countries. News and Events. https://www.burnet.edu.au/projects/471_combat_amr_mitigating_the_threat_of_antimicrobial_resistance_in_pacific_island_countries. Published 2021. Accessed July 14, 2021.

7. OCED Food Agriculture and Fisheries. *Assessing National Action Plans on Antimicrobial Resistance in Animal Production: What Lessons Can Be Drawn?*; 2021. https://www.oecd-ilibrary.org/docserver/83ccac56-en.pdf?expires=1617339932&id=id&accname=guest&checksum=6F47FF5C01AB51A8A00D935BECC17368.

8. Combat AMR. COMBAT-AMR officially launches project in Fiji. Combat AMR. https://www.combatamr.org.au/news-events/combat-amr-officially-launches-project-in-fiji. Published 2021. Accessed June 4, 2021.

9. World Health Organization. Supporting countries with national action plan implementation. World Health Organization. https://www.who.int/activities/supporting-countries-with-national-action-plan-implementation. Published 2021. Accessed March 12, 2021.

10. Interagency Coordination Group on Antimicrobial Resistance. Antimicrobial resistance: national action plans. 2018. https://www.who.int/antimicrobial-resistance/interagency-coordination-group/IACG_AMR_National_Action_Plans_110618.pdf.

11. World Health Organization, Food and Agriculture Organization of the United Nations, World Organisation for Animal Health. *Monitoring and Evaluation of the Global Action Plan on Antimicrobial Resistance - Framework and Recommended Indicators.*; 2019.

12. World Health Organization. Tripartite AMR Country Self-Assessment Survey (TrACSS) 2019-2020. WHO Publications. https://www.who.int/publications/m/item/tripartite-amr-country-self-assessment-survey-(tracss)-2019-2020. Published 2021. Accessed November 10, 2021.

13. The World Bank. The World Bank In Pacific Islands. The World Bank - Where we work. https://www.worldbank.org/en/country/pacificislands/overview#1. Published 2021. Accessed December 12, 2021.

14. Foxlee ND, Townell N, Tosul MAL, McIver L, Lau CL. Bacteriology and antimicrobial resistance in vanuatu: January 2017 to december 2019. *Antibiotics*. 2020;9(4):1-14. doi:10.3390/antibiotics9040151

15. Lata S. Perceptions of Future Climate Change in a Vulnerable Community and Its Implications for Future Adaptation: a Case Study of the Rewa Delta, Fiji. 2010;(July). doi:10.13140/RG.2.1.2678.3849

16. The World Bank. World Bank Country and Lending Groups. Data. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups#:~:text= For the current,those with a GNI per. Published 2021. Accessed October 3, 2021.

17. Loftus M, Stewardson A, Naidu R, et al. Antimicrobial resistance in the Pacific Island countries and territories. *BMJ Glob Heal*. 2020;5(4):1-8. doi:10.1136/bmjgh-2020-002418

18. The World Bank. International tourism, number of arrivals - Pacific island small states. International Tourism Data. https://data.worldbank.org/indicator/ST.INT.ARVL?locations=S2. Published 2021. Accessed December 5, 2021.

19. Klein EY, Van Boeckel TP, Martinez EM, et al. Global increase and geographic convergence in antibiotic consumption between 2000 and 2015. *Proc Natl Acad Sci U S A*. 2018;115(15):E3463-E3470. doi:10.1073/pnas.1717295115

20. World Health Organization. Global Antimicrobial Resistance and Use Surveillance System (GLASS). Initiatives-Global Antimicrobial Resistance and Use Surveillance System (GLASS). https://www.who.int/initiatives/glass. Published 2021. Accessed November 10, 2021.

21. The Lancet. Antimicrobial resistance: time to repurpose the Global Fund. *Lancet*. 2022;399(10322):335. doi:10.1016/S0140-6736(22)00091-5

22. Chua AQ, Verma M, Hsu LY, Legido-Quigley H. An analysis of national action plans on antimicrobial resistance in Southeast Asia using a governance framework approach. *Lancet Reg Heal - West Pacific*. 2021;7:100084. doi:10.1016/j.lanwpc.2020.100084

23. Anderson M, Schulze K, Cassini A, Plachouras D, Mossialos E. A governance framework for development and assessment of national action plans on antimicrobial resistance. *Lancet Infect Dis*. 2019;19(11):e371-e384. doi:10.1016/S1473-3099(19)30415-3

24. World Health Organisation. *Global Action Plan on Antimicrobial Resistance*.; 2015. https://www.who.int/antimicrobial-resistance/global-action-plan/en/. Accessed April 20, 2021.

25. Food and Agriculture Organization of the United Nations; World Organization for Animal Health; World Health Organization. Global Database for the Tripartite Antimicrobial Resistance (AMR) Country Self-assessment Survey (TrACSS). Global Database for the Tripartite Antimicrobial Resistance (AMR) Country Self-assessment Survey (TrACSS). https://amrcountryprogress.org/#/response-overview. Published 2021. Accessed March 10, 2021.

26. Food and Agriculture Organization of the United Nations; World Organization for Animal Health; World Health Organization. Tripartite AMR Country Self-Assessment Survey (TrACSS) Guidance note to accompany TrACSS 2019-20 (version 4). WHO Publications. https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/tracss/2019-2020/tripartite-amr-country-self-assessment-survey-2019-20-questionnaire-english.pdf?sfvrsn=f657c75_22&download=true. Published 2021. Accessed November 10, 2021.

27. Snell B. *Analysis of AMR Plans in the Western Pacific and South-East Asia Regions*. Penang, Malaysia; 2019. https://www.twn.my/title2/series/amr/pdf/amr002.pdf.

28. Government of Fiji. *Fiji National Antimicrobial Resistance Action Plan 2015*. Fiji; 2015. http://extwprlegs1.fao.org/docs/pdf/fij169634.pdf.

29. World Health Organization. Fiji: An Antimicrobial Resistance Country Profile. Features from Around the World. https://www.who.int/campaigns/world-antimicrobial-awareness-week/2018/features-from-around-the-world/amr-and-fiji-a-country-profile. Published 2018. Accessed June 4, 2021.

30. Ministry of Health Medical Services. National Strategic Plan 2016-2020. WHO MiNDbank Country Resources. http://www.health.gov.fj/PDFs/Corporate Plan/Strategic Plan 2016-2020 Executive Version.pdf. Published 2015. Accessed June 4, 2021.

31. World Health Organization. *FIJI – WHO Country Cooperation Strategy 2018 – 2022*. Suva; 2017. http://iris.wpro.who.int/handle/10665.1/13942.

32. World Health Organization. Fiji Launches National Antimicrobial Resistance Action Plan. Division of Pacific Technical Support. https://www.who.int/westernpacific/about/how-we-work/pacific-support/news/detail/18-11-2015-fiji-launches-national-antimicrobial-resistance-action-plan. Published 2015. Accessed January 10, 2022.

33. Pacific Public Health Surveillance Network. Infection Prevention and Control Guidelines. 2010:vi-vii. https://www.pphsn.net/Activities/PICNet/IC_Guidelines/PPHSN-infection-prevention-control-guidelines-2010-rev.pdf.

34. Tuisawana V. Effectiveness and Efficiency of the Two Trolley System as an Infection Control Mechanism in the Operating Theatre. *Pac Health Dialog*. 2009;15(2). http://pacifichealthdialog.org.fj/Volume2015/v15no2/Original20Papers/Effectiveness20and20effi20ciency20of20the20two20Trolley20System20as20an20infection20Control20Mechanism.pdf.

35. World Health Organization. GLASS Country Participation. Initiatives. https://www.who.int/initiatives/glass/country-participation. Published 2021. Accessed July 6, 2021.

36. World Health Organization. Water, sanitation and hygiene (WaSH). Health Topics. https://www.who.int/health-topics/water-sanitation-and-hygiene-wash. Published 2021. Accessed December 12, 2021.

37. Worldometer. Fiji Population. Worldometer. https://www.worldometers.info/world-population/fiji-population/. Published 2021. Accessed September 13, 2021.

38. The World Bank. World Bank Country and Lending Groups. Data. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups. Published 2021. Accessed October 3, 2021.

39. Worldometer. Micronesia population. Worldometer. https://www.worldometers.info/world-population/micronesia-population/. Published 2021. Accessed September 13, 2021.

40. Worldometer. Solomon Islands Population. https://www.worldometers.info/world-population/solomon-islands-population/. Published 2021. Accessed October 3, 2021.

41. Worldometer. Palau Population. Worldometer. https://www.worldometers.info/world-population/palau-population/. Published 2021. Accessed September 13, 2021.

42. Worldometer. Tuvalu Population. Worldometer. https://www.worldometers.info/world-population/tuvalu-population/. Published 2021. Accessed September 13, 2021.

43. Worldometer. Tonga Population. Worldometer. https://www.worldometers.info/world-population/tonga-population/. Published 2021. Accessed September 13, 2021.

44. Worldometer. Cook Islands Population. Worldometer. https://www.worldometers.info/world-population/cook-islands-population/. Published 2021. Accessed September 13, 2021.

45. World Health Organization. Library of AMR national action plans. Teams. https://www.who.int/teams/surveillance-prevention-control-AMR/national-action-plan-monitoring-evaluation/library-of-national-action-plans. Published 2020. Accessed December 12, 2020.

46. Iji P. Delivering veterinary doctors to Fiji and the Pacific Islands. News, Fiji National University. https://www.fnu.ac.fj/blog/news/delivering-veterinary-doctors-to-fiji-and-the-pacific-islands/. Published 2020. Accessed November 15, 2021.

47. Christensen J. Epidemiological Concepts Regarding Disease Monitoring and Surveillance. *Acta Vet Scand*. 2001;(SUPPL. 94):11-16. doi:10.1186/1751-0147-42-s1-s11

48. World Health Organization. 2021 AWaRe classification. WHO publications. https://www.who.int/publications/i/item/2021-aware-classification. Published 2021. Accessed November 15, 2021.

49. Pickmere A, Macalinao, Nargina Martaika J, Snell B. *Investigating Knowledge and Use of Antibiotics at Five Divisional Health Centre Out-Patient Clinics in Fiji, November, 2015.* Suva; 2015.

50. Mataika J, Yim C. *Antibiotic Awareness Survey in the Fijian Community*. Suva; 2015. https://ozpharmavols.files.wordpress.com/2015/12/antibiotic-awareness-survey-report-final.pdf.

51. Pickmere A, Booth K. Antimicrobial Stewardship in Fiji. In: *The Mathew Peck Travelling Scholarship*. Melbourne; 2017. https://monash.edu/__data/assets/pdf_file/0011/918182/MattPeckPresentationFiji30May2017.pdf.

52. Pickmere A, Macalinao N, Mataika J, Gounder R, Snell B. *Investigating Colistin Usage in Fiji at the Colonial War Memorial Hospital , Lautoka Hospital and Labasa Hospital from August*. Suva; 2016. https://www.health.gov.fj/wp-content/uploads/2018/02/Medicine-Use-Evaluation_Colistin-2016.pdf.

53. Fiji Ministry of Health and Medical Services. *Investigating Meropenem Usage at the Colonial War Memorial Hospital from October 2013 to October 2014*. Suva; 2015. https://docplayer.net/15931281-Drug-use-evaluation-report-investigating-meropenem-usage-at-the-colonial-war-memorial-hospital-from-october-2013-to-october-2014.html.

54. Doctors Assisting in the South Pacific Islands. Colonial War Memorial Hospital, Suva, Fiji. DAISI. https://daisi.com.au/colonial-war-memmorial-hospital-suva/. Accessed January 16, 2022.

55. World Health Organization, Food and Agriculture Organization of the United Nations, World Organization for Animal Health. Antimicrobial Resistance: A Manual for Developing National Action Plans. *World Heal Organ Antimicrob Resist*. 2016;(February). doi:10.1001/jama.2016.11764

56. Goddard M, Mannion R. The Role of Horizontal and Vertical Approaches to Performance Measurement and Improvement in the UK Public Sector. *Public Perform Manag Rev*. 2004;28(1):75-95. http://www.jstor.org/stable/3381210.

57. World Health Organization Western Pacific Region. Pacific Island Countries and Areas–WHO Cooperation Strategy 2018–2022. 2017. https://iris.wpro.who.int/bitstream/handle/10665.1/14097/WPRO-2017-DPM-027-pic-eng.pdf.

58. Combat-AMR. Combat-AMR. About Combat-AMR. https://www.combatamr.org.au/. Published 2021. Accessed November 15, 2021.

59. Commonwealth Scientific and Industrial Research Organisation (CSIRO). Enhancing the Management of Antimicrobial Resistance in Fiji. EMAr Fiji. https://research.csiro.au/fiji/. Accessed November 15, 2021.

60. Mendelson M. Vanguard Report: Inequality and antibiotic resistance. British Society for Antimicrobial Chemotherapy. https://bsac.org.uk/inequality-and-antibiotic-resistance/. Published 2021. Accessed December 9, 2021.

61. Charani E. Vanguard Report: Why culture matters in antibiotic resistance. British Society for Antimicrobial Chemotherapy. https://bsac.org.uk/vanguard-report-why-culture-matters-in-antibiotic-resistance/. Published 2021. Accessed December 9, 2021.

62. World Health Organization. WHO AMR Surveillance and Quality Assessment Collaborating Centres Network. Initiatives-Global Antimicrobial Resistance and Use Surveillance System (GLASS). https://www.who.int/initiatives/glass/network. Published 2021. Accessed August 10, 2021.

63. World Health Organization. *Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report -Early Implementation 2016-2017*.; 2017. https://www.who.int/docs/default-source/searo/amr/global-antimicrobial-resistance-surveillance-system-(glass)-report-early-implementation-2016-2017.pdfsfvrsn=ea19cc4a_2.

64. Ferguson JK, Joseph J, Kangapu S, et al. Quality microbiological diagnostics and antimicrobial susceptibility testing, an essential component of antimicrobial resistance surveillance and control efforts in Pacific island nations. *West Pacific Surveill response J WPSAR*. 2020;11(1):41-46. doi:10.5365/wpsar.2018.9.3.004

65. The Fleming Fund. The Fleming Fund Aims and Values. The Fleming Fund - About Us. https://www.flemingfund.org/about-us/our-aims/. Published 2018. Accessed November 15, 2021.

66. Raghu S. Engaging Hospital Management in Improving Microbiology Services. The Fleming Fund-Knowledge and Resources. https://www.flemingfund.org/publications/engaging-hospital-management-in-improving-microbiology-services/. Published 2021. Accessed November 15, 2021.

67. Sarkar S. The imperative of linking the ‘technical’ with the ‘social’ to drive policy and advocacy. The Fleming Fund - Knowledge and Resources. https://www.flemingfund.org/publications/the-imperative-of-linking-the-technical-with-the-social-to-drive-policy-and-advocacy/. Published 2021. Accessed November 15, 2021.

68. Organisation for Economic Co-operation and Development. International Regulatory Co-operation: The Role of International Organisations in Fostering Better Rules of Globalisation,. 2017:2. doi:http://dx.doi.org/10.1787/9789264244047-en

69. WHO/FAO. *WHO Report on Surveillance of Antibiotic Consumption*.; 2018. http://apps.who.int/iris%0Ahttps://apps.who.int/iris/bitstream/handle/10665/277359/9789241514880-eng.pdf.

70. Gilbert GL, Kerridge I. Hospital Infection Prevention and Control (IPC) and Antimicrobial Stewardship (AMS): Dual Strategies to Reduce Antibiotic Resistance (ABR) in Hospitals. In: Jamrozik E, Selgelid M, eds. *Ethics and Drug Resistance: Collective Responsibility for Global Public Health*. Cham: Springer International Publishing; 2020:89-108. doi:10.1007/978-3-030-27874-8_6

71. Ministry of Health Medical Services Fiji. Immunisation. Ministry of Health and Medical Services. http://www.health.gov.fj/immunisation/. Published 2014. Accessed June 14, 2021.

72. World Health Organization. Mapping educational opportunities and resources for health-care workers to learn about antimicrobial resistance and stewardship. 2017:13-14. https://apps.who.int/iris/bitstream/handle/10665/259362/9789241512787-eng.pdf?sequence=1.

73. Lawandi A, Kadri SS. Can financial rewards for stewardship in primary care curb antibiotic resistance? *Lancet Infect Dis*. 2021;21(12):1618-1620. doi:10.1016/S1473-3099(21)00169-9

74. Fiji Ministry of Health. The National Medicinal Products Policy of the Republic of Fiji 2013. 2013. http://www.health.gov.fj/wp-content/uploads/2018/02/Fiji-National-Medicinal-Products-Policy-2013.pdf.

75. Hayward G, Turner P. Vanguard Report: Antimicrobial resistance and the future of diagnostic testing. British Society for Antimicrobial Chemotherapy. https://bsac.org.uk/vanguard-report-amr-and-the-future-of-diagnostic-testing/. Published 2021. Accessed December 9, 2021.