

DEATHS AT SEA IN THE PACIFIC ISLANDS: CHALLENGES AND OPPORTUNITIES FOR CIVIL REGISTRATION AND VITAL STATISTICS SYSTEMS

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Accurate and reliable death statistics produced by civil registration and vital statistics systems are essential for health planning and programme evaluation. The quality of death registration data in Pacific island countries and territories remains suboptimal. Data on deaths occurring at sea are especially limited. While coastal and oceanic activities are the norm and essential to the livelihoods of Pacific island populations, such activities pose risks for accidents at sea, especially those involving small-scale vessels. In this paper, the scale of deaths at sea associated with small vessels in three Pacific island countries or territories over the period 2008-2017 is investigated using data from the health, civil registry, and police and fisheries departments, and reports produced by national statistics offices, ministries of health, the Pacific Community, the World Health Organization and media sources. Data on deaths at sea were found to be fragmented among multiple sources and missing key information on age, sex, and cause. Standardized procedures for reporting deaths and accidents at sea and harmonized data sharing between local communities and government agencies are urgently needed to improve civil registration and vital statistics systems and sea safety in the Pacific island subregion.

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I. INTRODUCTION

Mortality level is a key indicator of population health. Civil registration is the routine collection by governments of information on vital events, such as births and deaths, occurring within a country. Accurate and reliable mortality statistics produced by civil registration and vital statistics systems are essential for planning and evaluating policies and programmes, and to maximize the return on investments in health. Civil registration of death is integral to promoting individual rights, managing identity and providing social protection (United Nations, 2014). The availability and quality of death data from these systems in Pacific island countries and territories remain suboptimal. Critical weaknesses in the processes of reporting deaths to civil registration offices contribute to gaps in data on deaths; civil registration systems are generally considered to be incomplete in most Pacific island countries and territories.¹ Apart from a few countries where government agencies are designated informants, registration of deaths is largely done passively, relying on the relatives of the deceased to report the occurrence of a death to the responsible officials (Pacific Community, 2016; United Nations, 2014). The reliability of these reporting processes remains compromised in the absence of incentives to encourage the registration of deaths, such as the inheritance of land and property, and funeral and bereavement grants, as issued by the Governments of Nauru, Niue and the Cook Islands (Pacific Community, 2016). Obtaining accurate and timely data and statistics on death from civil registration records is further limited by the subregion's widely dispersed islands and sparse populations, inadequate technical and financial resources, and communication constraints (Brisbane Accord Group, 2015).

The scale of deaths that occur in the sea remains uncertain in Pacific island countries and territories, even though it is a well-recognized problem. Having accurate data on deaths at sea is especially needed as the Pacific Ocean forms the axis of economic and social activity of the Pacific island people. Ninety-eight per cent of the subregion is ocean, 27 per cent of households in the Pacific participate in fishing activities (Pacific Community, 2017), and formal and recreational sea sporting activities and inter-island transportation are the way of life. Given the intensity of maritime activities, vessel users are frequently exposed to numerous factors, including, among them, bad weather, engine failure, poor vessel construction, overloading, prolonged trips, and limited safety equipment, training or knowledge (WHO, 2014), which increase the risk of accidents at sea, such as collisions, groundings, drifting, fires, explosions,

¹ Coverage is a measure of the percentage of the population within a geographical area that the civil registration and vital statistics system reaches. Completeness is the estimated percentage of deaths covered by the civil registration and vital statistics system that is registered with cause of death information within a specified time period (United Nations, 2014).

and vessel loss. In particular, small-scale vessels² are used extensively by Pacific islanders for these water activities. As such, most maritime accidents³ involve small-scale fishers and vessels (Danielsson and others, 2010; Gillett, 2003). Though largely undocumented, sea accidents are believed to constitute a notable share of the morbidity and mortality in the region.

II. REGISTRATION OF DEATHS AT SEA

Particular challenges arise related to the registration of deaths that occur in the sea. Regarding deaths that take place aboard vessels, procedures to ensure that the captains of registered vessels report and facilitate the registration of such events could be considered relatively straightforward; however, processes for how such reporting should be carried out⁴ are not clearly set out in the civil registration laws of most countries in the Pacific. The efficiency and completeness of registration of deaths aboard vessels is also subject to whether such vessels are registered and how well governments (ports and maritime authorities) maintain records of vessels in the sea, including the identity of the passengers. Unfortunately, under-registration of deaths at sea are likely to occur among children (Carter and others, 2012), or among people who have low level of education, poor access to health services, or reside in hard-to-reach areas, rural households or lower-income households (Brisbane Accord Group, 2015; Rao, Bradshaw and Mathers, 2004; Powell, 1981), such as those engaged in small-scale fishing activities (Adams, 2012). Weak civil registration policies coupled with lack of understanding of the legal requirement and importance of death registration remains a fundamental challenge in this regard (Pacific Community, 2016; United Nations, 2014).

In addition, there are difficulties in certification and death registration for missing persons at sea. Incidents may be reported to the police, but most legislation requires a minimum time period (up to seven years) of disappearance before a missing person is registered as “deceased”. In most Pacific island countries and territories, unless there is

² The definition of small-scale vessels varies between Pacific island countries and territories. In this study small-scale vessels are considered to be locally based boats of less than 15 metres in length (Gillett, 2003).

³ “Accident” at sea refers to any occurrence on board a vessel, involving a vessel, or associated with the activities of a vessel at sea whereby (a) there is death or injury to any person on board, or any person is lost or falls overboard; (b) the vessel is lost or presumed to be lost at sea; or is materially damaged; or (c) taking into account its circumstances, the occurrence might have been liable to cause serious injury or damage to the health of any person (adapted from Danielsson and others (2010) and IMO (2008)). The term “accident” is also used in the International Statistical Classification of Diseases and Related Health Problems, tenth revision (ICD-10) for coding external causes of morbidity and mortality (WHO, 2017).

⁴ Including distinguishing procedures for registration of deaths occurring in territorial versus high seas.

direct evidence of death, such deaths at sea are not included in official national mortality statistics. A legal death certificate, however, is important for family members of the deceased as evidence of identity and family relationships, and for right to claim insurance and land inheritance benefits (Pacific Community, 2016; United Nations, 2014). A delay in the issuance of a death certificate can have serious social and economic impacts for family members of the missing person, especially if the person was the breadwinner. The cause of death at sea cannot be determined in the absence of a medical examination, and the individual is often presumed drowned.

III. CERTIFICATION OF CAUSE OF DEATH AT SEA

Accurate and comprehensive details on a death at sea are necessary to ensure precision in the subregion's cause of death statistics and to develop appropriate follow-up public health measures to address the problem. In accordance with the tenth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) rules set by the World Health Organization (WHO), all deaths should be registered with "all the diseases, morbid conditions or injuries which either resulted in or contributed to death and the circumstances of the accident or violence which produced such injuries" (WHO, 1993). From these reported conditions, a single cause known as the "underlying cause of death" is selected for tabulation and reporting purposes. The purpose of selecting the underlying cause of death is to identify the disease, injury or circumstance that is most amenable to prevention and intervention strategies from a public health perspective. Accordingly, it is extremely important that the circumstances surrounding a death at sea are well recorded and as detailed as possible.

Classification and coding of external causes of mortality (accidents, intentional self-harm, homicides, and those of undetermined intent) is provided in ICD-10, chapter XX (codes V01-Y98). In chapter XX of ICD-10, a range of possible causes of deaths at sea are discussed (table 1). For example, ICD-10 codes V90-V94 may be used for deaths resulting from accidents to vessels or on board vessels. Fourth-character subdivisions allow for the type of vessel to be specified, such as merchant ship (.0), passenger ship (.1) and fishing boat (.2), or unspecified (.9). Other causes of accidental injury at sea are drowning and submersion while in the water or following a fall into the water without accident to the vessel; fatal attacks from marine animals, such as sharks; and diving with insufficient air supply (table 1). The nature of the fatal injuries inflicted, such as head injuries, heatstroke, or decompression sickness, are covered by ICD-10 codes in chapter XIX. Codes from chapters XX and XIX should be used in cause of death tabulations.

Table 1. Causes of death which could occur in the sea

ICD-10 ^a code	ICD-10 ^a description
V90 ^b	Accident to watercraft causing drowning and submersion due to: <ul style="list-style-type: none"> • boat overturning or sinking • falling or jumping from burning ship or crushed watercraft • other accident to watercraft
V91 ^b	Accident to watercraft causing other injury including: <ul style="list-style-type: none"> • burned while ship on fire • crushed between colliding ships • crushed by lifeboat after abandoning ship • fall due to collision or other accident to watercraft • hit by falling object as a result of accident to watercraft • injured in watercraft accident involving collision of watercraft • struck by boat or part thereof after falling or jumping from damaged boat
V92 ^b	Water-transport-related drowning and submersion without accident to watercraft, but as a result of an accident, such as: <ul style="list-style-type: none"> • fall from gangplank, ship, or overboard • thrown overboard by motion of ship • washed overboard
V93 ^b	Accident on board watercraft without accident to watercraft, not causing drowning and submersion, including: <ul style="list-style-type: none"> • accidental poisoning by gases or fumes on ship • atomic reactor malfunction in watercraft • crushed by falling object on ship • excessive heat in boiler room, engine room, evaporator room or fire room • explosion of boiler on steamship • fall from one level to another in watercraft • fall on stairs or ladders in watercraft • injuries in watercraft caused by machinery • localized fire on ship • machinery accident in watercraft
V94 ^b	Other and unspecified water transport accidents, including: <ul style="list-style-type: none"> • accident to nonoccupant of watercraft • hit by boat while water-skiing
W16	Diving or jumping into water causing injury other than drowning or submersion including striking or hitting: <ul style="list-style-type: none"> • against bottom when jumping or diving into shallow water • wall or diving board of swimming-pool • water surface
W56	Contact with marine animal, including being bitten or struck by marine animal
W69	Drowning and submersion while in natural water including the open sea

Table 1. (continued)

ICD-10 ^a code	ICD-10 ^a description
W70	Drowning and submersion following fall into natural water
W74	Unspecified drowning and submersion including: <ul style="list-style-type: none">• drowning (not otherwise specified)• fall into water (not otherwise specified)
W81	Diving with insufficient air supply
W94	Effects of air pressure from diving
X71	Intentional self-harm by drowning and submersion
X92	Assault by drowning and submersion

Notes: ^a International Statistical Classification of Diseases and Related Health Problems, tenth revision, 2016 version.
^b Watercraft includes merchant ship, passenger ship (ferry-boat, liner), fishing boat, other powered watercraft (hovercraft on open water, jet skis), sailboat (yacht), canoe or kayak, inflatable craft (nonpowered), water-skis, other unpowered watercraft (surf-board, windsurfer), or other boat, ship or watercraft not otherwise specified.

A key deficiency in ICD-10 and the next revised version, ICD-11, is that classification and coding of the cause of deaths that occur in the sea are not easily distinguished from those occurring in other locations (WHO, 2017; 2019). A “place of occurrence” code in ICD-10, chapter XX enables the location where the external cause occurred to be identified; places, such as the home, school and street have specific codes. There is, however, no specific code for the sea; it is listed under the category of “other specified places” alongside other types of water bodies, such as lakes, pools, beaches and rivers, and unrelated places, such as desert and mountain. Notwithstanding the expanded list of external causes and dimensions of external causes under ICD-11, the sea is not specified as an extension code for the “type of place” and “part of a place” of occurrence, and only a few other water body types are specified under the category “countryside”. Incomplete information on the place of death and the type of water body can obscure deaths specifically occurring in the sea in national statistics. This, in turn, can limit the ability of policymakers to address deaths occurring in the sea from deaths occurring elsewhere.

Furthermore, despite the ICD-10 standards, water-body-related deaths in Pacific island countries and territories are commonly classified as having occurred because of drowning. It is important to note that an individual may not have died from drowning as a consequence of an accident to a vessel. Other causes include natural diseases, trauma, air embolism, alcohol or substance use, heat exposure, hypothermia, intentional self-harm, and assault, which may have occurred either before entering the open sea, from falling or being thrown into the sea, or while in the sea, and that may have contributed or directly led to death. In this regard, drowning is a diagnosis of exclusion (Byard, 2015). Accordingly, it is crucial that the bodies of the deceased are carefully

examined by a qualified medical practitioner or forensic pathologist to rule out other conditions. Few Pacific island countries or territories have adequate and well-developed medico-legal coroner and medical examination systems, which is available in Fiji, to investigate the manner and cause of unexpected and unnatural deaths. As such, the cause of a death that occurs in the sea may be certified by a nurse, magistrate, police officer, registrar, or other persons who lack the requisite medical or forensic specialist training. Lack of qualified professionals is a key limitation to the appropriate certification of drowning and other water-related incidents in Pacific island countries and territories. Non-medically certified cause of death data can pose challenges in deriving reliable and accurate mortality statistics. Moreover, for deaths at sea that result from suicide, practitioners in the Pacific may be uncomfortable with making this diagnosis as the underlying cause of death because of the stigma associated with suicides and its legal implications. As a result, accidental deaths tend to be overrepresented.

In cases in which medical certification of the cause of death is not possible, verbal autopsy is considered an option for determining the probable cause of death. Verbal autopsy involves an interview with close relatives of the deceased using a questionnaire to collect information about signs, symptoms, demographic characteristics, and events in the period prior to the death (WHO, 2007). The questionnaire is then reviewed by a physician or, increasingly, through automated methods to ascertain the underlying cause of death (Murray and others, 2014). Verbal autopsy has not been used in Pacific island countries and territories, except in Papua New Guinea (Gouda and others, 2016) and more recently in Solomon Islands. Selecting appropriate respondents and eliciting information on the circumstances of a death at sea, of sufficient accuracy and specificity, present unique challenges in conducting a verbal autopsy to determine the cause. In particular, deaths at sea associated with accidents to vessels have multiple proximal and distal contributing causes that are human-, vessel-, and environment-related. Factors, such as human error in navigation, extreme weather conditions, overload, fuel loss, poor vessel design and operational and technical failures need to be considered and should be recorded for the purposes of accident prevention (Danielsson and others, 2010). The accuracy of statistics related to deaths occurring in the sea are dependent on the availability and quality of information on the circumstances of the death, manner of death, type of injury, and location. The recording and reporting of these data may be inconsistent and subject to recall bias if there is a delay in reporting the death.

While reliable mortality statistics on populations in Pacific island countries and territories who are at-risk at sea remains limited, increased attention has been placed on improving the registration of deaths and the quality of cause of death data in the region. The Brisbane Accord Group was established in 2010 to spearhead improvements in civil registration and vital statistics in the subregion (Brisbane Accord Group, 2015). In addition, the Ministerial Conference on Civil Registration and Vital Statistics, held in Bangkok from 24 to 28 November 2014, endorsed the Regional Action Framework on Civil Registration and Vital Statistics in Asia and the Pacific (ESCAP, 2014), which

contains two overarching goals to be achieved by 2024: universal civil registration of births, deaths and other vital events; and production and dissemination of accurate, complete and timely vital statistics (including on causes of death) based on registration records. Also of note, drowning prevention has become a regional priority (WHO, 2015). While mortality because of accidents in the sea is not a specific focus area of the Sustainable Development Goals (Pacific Community and Brisbane Accord Group, 2016), the subregion's physical geography and the current anecdotally estimated burden of morbidity and mortality highlights the need for appropriate measures to monitor and curb deaths from this cause.

IV. DATA AND METHODS

Case studies: Fiji, Kiribati and Tuvalu

A small-scale study was conducted to determine the scale of deaths at sea in Fiji, Kiribati and Tuvalu over the past 10 years. A secondary research objective was to assess deaths associated with small-scale vessels. These countries represent the three regions in the Pacific (Melanesia, Micronesia and Polynesia). Distinctive contextual characteristics affect the functioning of civil registration and vital statistics systems and the status of sea safety (table 2). Distinct characteristics are the high dependence on single outboard engines, the dispersion of multiple islands, and the low-lying topography of Kiribati and Tuvalu, which limits the visibility of the islands for seafarers. Furthermore, the countries were selected based on the following: reports of diving accidents related to sea cucumber fishing in Fiji; small-scale fishing vessel accidents in 2017 in Kiribati, and the notable success of the sea safety emergency grab bag initiative in Tuvalu (Figueroa, James and Blanc, 2018).

The civil registration and vital statistics systems of the three study countries are distinct in the level of completeness and dependency between the constituent data collections, predominantly the civil registration offices and the ministries of health. The civil registration and vital statistics system of Fiji is estimated to have high coverage and completeness of more than 95 per cent (Fiji Bureau of Statistics, Registrar General's Office and Ministry of Health and Medical Services, 2019). The Ministry of Health and Medical Services death reporting system is more complete than the civil registration system; however, there is strong dependency between them, with approximately 90 per cent of deaths recorded by the Ministry captured by the civil registration offices (Fiji Bureau of Statistics, Registrar General's Office and Ministry of Health and Medical Services, 2019). Completeness of death registration in Kiribati and Tuvalu is lower. Both countries have higher proportions of deaths assigned to ill-defined causes (table 2). Consolidation of mortality data sources is necessary. In Kiribati, the Ministry of Health and Medical Services and the Civil Registration Office are largely independent with

Table 2. Key country attributes

Attribute	Fiji	Kiribati	Tuvalu
Population (census year)	884 887 (2017)	110 136 (2015)	10 837 (2012)
Income group, level of development ^a	Upper-middle income	Lower-middle income, least developed country	Upper-middle income, least developed country
Completeness of death registration with cause-of-death ^b	96.2% (3.3% ill-defined causes) (2012-2017) ^c	75.0% (17.8% ill-defined causes) (Health Information Unit); 74.8% (Civil Registration Office) (2012-2014) ^d	61.5% (12.0% ill-defined causes) (2012-2016) ^e
Geography ^f	322 islands and atolls including two large and several medium-sized high islands	33 low-lying atolls and reef islands	Nine low-lying atolls and reef islands
Engagement in fishing activities ^f	52% of rural households in subsistence fishing	>90% of the population own boats	74% of households in reef fishing
Vessels for small-scale coastal fishing ^g	>1 500 mainly small outboard powered	>4 500 skiffs or canoes, outboard motor powered; and larger outboard-powered craft	512 outboard powered canoes or boats

Notes: ^a Income group is by World Bank classifications. The United Nations classifies Kiribati and Tuvalu as “least developed countries”.

^b Coverage is a measure of the percentage of the population within a geographical area that the civil registration and vital statistics system reaches. Completeness is the estimated percentage of deaths covered by the civil registration and vital statistics (CRVS) system that are registered with cause of death information within a specified time period (United Nations, 2014).

^c *Source:* Fiji Bureau of Statistics, Registrar General's Office and Ministry of Health and Medical Services (2019)

^d *Source:* Kiribati National Statistics Office, Civil Registration Office and Health Information Unit (2018). In Kiribati, the Health information Unit and Civil Registration Office sources are independent with no direct data sharing (Carter and others, 2012).

^e *Source:* Tuvalu Central Statistics Division (2018).

^f *Source:* Gillett (2016).

^g *Source:* Welch (2016).

limited direct data sharing (Carter and others, 2012). In Tuvalu, the Ministry of Health reporting system is reportedly more complete than the system of the Civil Registration Office (Tuvalu Central Statistics Division, 2018).

Furthermore, these countries have different medico-legal death investigation systems. The system of Fiji is resourced with the magisterial service, police force and forensic pathologists to investigate the manner (accidents, suicides, homicides or undetermined) and cause of deaths that are unexpected, unnatural and suspicious, according to the Inquests Act of 1968 (Kalougivaki, 2015). By contrast, Tuvalu and Kiribati do not have these resources readily available; Australia and New Zealand can be called upon to assist with conducting autopsies, but it is only done on rare occasions and normally limited to cases involving assault because of the high costs.

For the present study, an analysis was conducted of the unit record death data provided by representatives of key agencies involved in death registration and the management of maritime accidents, namely the ministries of health, civil registration agencies, the police and fisheries departments. The data also included incidence reports published in media news sources, and grey literature, including Pacific Community reports, WHO reports, and government vital statistics and health reports.

Duplicate records of events at sea were identified between data sources using a combination of date of occurrence, age, sex, and cause of death where available to avoid double counting. In cases in which there were insufficient details to either match or separate two records, it was noted. The total numbers of reported deaths and accidents at sea, and the proportion of the total number of reported events that were captured by each source, were then calculated.

V. RESULTS

Between 2008 and 2017, 58 deaths at sea in Fiji, 81 deaths at sea in Kiribati, and seven deaths at sea in Tuvalu were identified from the data sources collated (table 3). The numbers fluctuated annually, reflecting variations in the frequency and severity of sea accidents. Based on these numbers, the average unadjusted mortality over the 2008-2017 period was 7.5 deaths per 100,000 in Kiribati and 17.6 per 100,000 in Tuvalu and 0.8 per 100,000 population in Fiji.

In Fiji, deaths at sea were identified from the collation of police accident reports and news sources. Police reports recorded 50 deaths, news sources reported 36 deaths; 28 deaths were recorded in both sources. Five deaths were also identified as being reported to the health facility based on news report details. Of annual drowning deaths, six out of 47 (13 per cent) in 2014, 14 out of 39 (36 per cent) in 2013 and 14 out of 75 (18.7 per cent) in 2012 occurred in the sea. Information was not available for other

Table 3. Reported deaths at sea in study countries, by age, sex, and source, 2008-2017

Variable	Fiji	Kiribati	Tuvalu
Age (years) ^a			
<10	5	18	..
10-29	5	5	..
30-49	7	4	..
>50	6	3	..
Unknown	35	51	..
Sex			
Men	24	34	7
Women	6	11	—
Unknown	28	36	—
Source ^b			
Police	50	14	..
News media	36	17	..
Health	..	35	7
Civil registry	..	17	7
Total	58	81	7

Notes: ^a Only six reported deaths in Tuvalu had data on age. Due to small numbers, age disaggregated data are not provided.

^b Based on news sources, 13 reported deaths at sea in Fiji were related to small vessel activities. News sources also indicated five deaths at sea in Fiji being reported to the health facility. Information linking small-vessel activity to the deaths could not be ascertained from the other sources in all study countries. Data from the Ministry of Health and Civil Registration Office in Fiji were not available at the time of the study.

years. The Fiji Bureau of Statistics report drowning cases over the period 1998-2016, sourced from police crime statistics reports (Fiji Bureau of Statistics, 2017), however no information is given on drowning at sea. The available health reports and the World Health Organization Global Drowning report only includes data for “injury and other external causes” (Fiji, Ministry of Health and Medical Services, 2016a; 2016b; WHO, 2014). Thirteen deaths at sea in Fiji reported by news media sources were related to small vessel activities.

In Kiribati, deaths at sea were identified from the collation of records of the Civil Registration Office, Ministry of Health and Medical Services records, police accident reports, and news sources. Reporting of deaths at sea through the health system was higher and more detailed than the reporting from the Civil Registration Office: 35 deaths

(43 per cent) versus 17 deaths (21 per cent). No death records were shared between the two institutions. Police records indicate 14 deaths (17 per cent), none of which are recorded in the Civil Registration Office or the Ministry of Health data. News sources report 17 deaths (21 per cent), of which two (2.5 per cent) are recorded by the Civil Registration Office or in the Ministry of Health and Medical Services data. Eight deaths could not be reconciled with the Civil Registration Office or the Ministry of Health and Medical services because of insufficient information. All 17 deaths registered with the Civil Registration Office are recorded as "lost at sea". In the Ministry of Health and Medical Services dataset, the causes of the deaths are drowning in 33 deaths (40.7 per cent), "lost at sea" in one death (1.23 per cent), and "diving-related" in one death. The most recent Health Bulletin (2015) attributes four deaths to "accidental drowning and submersion" (three males, one female) and three deaths to "unspecified drowning and submersion"; no information is specific to drowning in the sea (Kiribati, Ministry of Health and Medical Services, 2016). No statistics on drownings or deaths at sea have been found in other annual health reports. No sources included in the study have provided data on deaths related to small-scale vessels.

In Tuvalu, between 2008 and 2017, seven deaths at sea were recorded in the Civil Registration Office and Ministry of Health records; the Civil Registration Office and Ministry of Health records showed the same six deaths at sea, though the information provided by the Civil Registration Office was more comprehensive than that from the Ministry of Health. In the combined Civil Registration Office-Ministry of Health dataset, the causes are documented as drowning, one of whom was missing at sea and presumed drowned. All the deaths were males. None of the records from the police maritime unit or available news sources report any deaths at sea. The central statistics division has only published statistics on the leading causes of mortality from 1997 to 2007, and notably, these statistics do not feature drowning or deaths at sea. No sources included in the study provide data on deaths related to small-scale vessels.

VI. DISCUSSION

Data on deaths at sea in the three study countries are fragmented among multiple sources. The majority of reported deaths include no information on age. Data on small vessels involvement is also limited. These factors hamper measurement of the true burden of all at-sea mortality and limit inferences about risk groups.

In previous research, Murray and Carter (2017) developed a model to investigate the association of meteorological factors and holiday periods on monthly fatal drowning cases in Fiji between 2012 and 2015. The model included police and health records, and data from the Fiji Meteorological Services and the Bureau of Meteorology in Australia. Murray and Carter (2017) estimate that 187 drowning deaths (6.3 per 100 000 population) occurred yearly with 28 per cent in the sea; 135 cases (72 per cent) were

less than 35 years and 137 cases (73 per cent) were male. The disproportionately higher mortality in males found in the present study corroborates this research, although data on sex are missing in many cases in the present study. The present study is intended to ascertain the number of deaths reported by available sources, such as the Fiji Police Force reports and news media, rather than the number of deaths that are estimated to occur over time.

Regarding deaths at sea in Kiribati, the results show that reporting through the health system is more complete and comprehensive than to the Civil Registration Office. However, as death certificates are not issued in the majority of deaths in the country, the available data on causes of death are likely to be underrepresented and not accurately reflect specific underlying causes (Kiribati, Ministry of Health and Medical Services, 2016; Brisbane Accord Group, 2015). Moreover, contrary to other Pacific island countries and territories, deaths at sea reported through the Civil Registration Office are not reported in the Ministry of Health and Medical Services. The absent overlap in death records between the Civil Registration Office and the Ministry of Health and Medical Services in Kiribati was highlighted by Carter and others (2012). In Tuvalu, the information provided by the Civil Registration Office is more comprehensive than that from the Ministry of Health. Death registration is conducted at the local council level and collated at the national level (Brisbane Accord Group, 2015). Available published secondary information or news sources on mortality data are limited.

It is difficult to make a valid comparison between the three study countries. While data were not available from the health and civil registry departments for Fiji at the time of the study, a lot more data were available from police and maritime reports and informal data sources compared to Kiribati and Tuvalu. It is worth noting, however, that the mortality burden is higher in Kiribati and Tuvalu at the population level than in Fiji. This indicates that accidents at sea in small island populations can have a considerable impact compared to accidents in larger island populations. It highlights the importance of ensuring sustainable programme support for small island populations.

The paucity of death data related to small vessels across all study countries highlights a number of issues. Cause of death information is generally reported by the next of kin or a family member who may not know all the correct circumstances of the death, may consider the information sensitive, or may inadvertently provide the wrong information. Certifiers may only record the consequences of the injury or only the mode of dying (such as drowning) with no additional information on the external cause and circumstances leading to death. This affects the accuracy of mortality coding, and coders may not know how to identify additional information to assign an appropriate underlying cause of death. Another contributor is the lack of data sharing and synchronization of data systems among the police, the coroners' court, and the mortality coders, coupled with a lack of clear guidelines for such activities.

National legislation (specifically the Births, Deaths and Marriages Registration (Amendment) Act 2014 of Fiji, the Births, Deaths and Marriages Registration (Amendment) Act 2007 of Kiribati, and the Births, Deaths and Marriages Registration Act 2008 of Tuvalu),⁵ states that all deaths and their cause must be registered. A death certificate should be completed by a medical practitioner or other authorized person adhering to the WHO ICD-10 guidelines to ascertain the cause of death, and forwarded to the registrar. The legislations state that deaths that occur outside of the home are to be reported to the police, and any particulars concerning the death or findings of specific inquests into deaths are to be forwarded to the registrar. The Births, Deaths and Marriages Registration (Amendment) Act 2014 in Fiji makes a separate stipulation for deaths that occur on board a vessel at sea by requiring that they be reported to a chief customs officer who then will forward the information to the registrar. Also of note, anyone who fails to notify a death resulting from an accident may face penalties, including fees or imprisonment, in accordance with legislation, such as the Death and Fire Inquiries Ordinance 2008 of Kiribati, and the Death and Fire Inquiries Act 2008 of Tuvalu (Pacific Islands Legal Information Institute, 2019). In practice, the enforcement of this legislation is weak and there are no systematic responsibilities, obligations, or procedures in place for recording and compiling deaths that occur in the sea. Furthermore, under the Maritime Fiji Small Craft Code (2014) and the Pacific Maritime Legislation and Regulations (PIMLaws) (Secretariat of the Pacific Community, 2002), all accidents at sea must be recorded in the vessel log book and reported to an authority as soon as practicably possible. In this regard, provisions for small-scale fisheries remain insufficient in the countries' fisheries acts, while the shipping acts apply to large-scale vessels only.

To enhance the capacity of civil registration and vital statistics systems in capturing deaths at sea, legislation should have clear provisions that set out the following: the roles and responsibilities of provincial registrars; penalties and incentives linked to the reporting of deaths to government agencies within strict timeframes; collection of fundamental information for each death; and obligations of government agencies to share reports and data with national statistics offices (Pacific Community, 2016). There is also need to clearly describe collaborations among agencies and the coordination of their functions within the civil registration and vital statistics system. This includes delineating the needs and services among agencies requiring death registration data for legal purposes; for compiling statistics; for planning, implementing and evaluating public health programmes; and for other administrative purposes.

⁵ Copies of the legislation are available at www.pacii.org/index.shtml.

Limitations of the data sources

The results of this research are limited by gaps in the data sources and underreporting of events. As a result, the scale of deaths at sea is expected to be underestimated. As more data were available for some years (later in the 2008-2017 period), an assessment of mortality trends over the time period cannot be made. The ICD-10 coding system underestimates deaths at sea, as drowning deaths related to water transport, intentional cause, or other causes are coded to different cause categories (table 1). Including these causes could increase the true burden of all drowning mortality by 30 to 50 per cent (WHO, 2014). Data on non-fatal drownings are not routinely collected, thereby masking the burden of serious injury (WHO, 2014). Information on age was also limited in the data collated, hindering inferences about risk groups in deaths and accidents. In the present study, only online services in English are reviewed; any accidents reported in local newspapers or online reports in the local language are missed. It is also possible that individuals who were reported missing were subsequently found and an update of this was overlooked. A quality assessment of the data collated from all formal and informal sources needs to be carried out. Despite these limitations, this is the first attempt, to the authors' knowledge, to bring together mortality data from multiple data sources to assess the scale and registration of deaths at sea in selected Pacific island countries and territories. The study serves as the basis for which further studies linked to civil registration and vital statistics systems can be conducted. For example, extended field work and interviews with local fishers, their families and community organizations would likely strengthen the current findings. Such qualitative data would also help to identify socioeconomic incentives or disincentives for fishers and their families to report deaths and accidents at sea.

VII. CONCLUSION AND RECOMMENDATIONS

Data on deaths and accidents at sea in Fiji, Kiribati and Tuvalu are fragmented among multiple sources. There is a critical need to improve the recording, management, sharing and use of these data across government sectors, particularly among civil registration and vital statistics stakeholders to enhance understanding of the scale of deaths at sea in Pacific island countries and territories. In addition, the production of accurate and reliable statistics on deaths, accidents and their causes are crucial to inform the planning, implementation and monitoring of sea safety regulations, and strengthen the value and cost-savings of complementary sea safety initiatives in the Pacific island subregion (Figueroa, James and Blanc, 2018).

As with many international public health challenges, a multi-sectoral holistic approach and political commitment from all stakeholders is necessary. Evidently, strengthening sea safety programmes requires concomitant strengthening of civil registration and vital statistics systems. It is important to ensure sufficient and quality

information is collected and used effectively in resource-limited Pacific island countries and territories. It is equally important to address socioeconomic barriers among community members to report accidents that occur in the sea and register any deaths. Incentives and targeted community advocacy could help establish an enabling environment for this.

Below are recommendations for strengthening civil registration and vital statistics systems to more effectively capture deaths that occur in the sea:

- (a) Standardize regular collection and recording of comprehensive data on death and causes of death; and accessibility and utility of the data.
- (b) Consider revising the nomenclature of the fourth character codes in ICD-10 and ICD-11 to distinguish water body-related deaths.
- (c) Standardize and formalize roles and responsibilities for routine data collections on deaths at sea among civil registry, health, police, and maritime departments, medical-legal authorities, and statistics offices to harmonize the data.
- (d) Educate and motivate fisheries management, small vessel operators, families of the deceased, and community members about the importance of reporting deaths resulting from accidents at sea.
- (e) Establish standard streamlined procedures for reporting accidents at sea and recording the circumstances surrounding the event.

The development and implementation of an injury surveillance system, using the WHO Injury Surveillance Guidelines (Holder and others, 2001) may facilitate the efficient collection of reliable epidemiological data and detailed cause of death data useful for population-level interventions to prevent deaths occurring in sea, while maintaining compliance with ICD-10. The Fiji Injury Surveillance in Hospitals system (Wainiqolo and others, 2013) offers a potential model for other Pacific islands. The system was implemented in urban and rural hospitals in the main island of Fiji. It uses a form to capture data from medical records, including demographic information, injury circumstances and consequences (place of occurrence, activity, cause, intent, nature of the principal injury, length of stay, and status at discharge), and record information on other contributing risks, such as substance use. While there is no explicit target for reducing mortality at sea in the 2030 Agenda for Sustainable Development, improved data on deaths occurring in the sea is important for improving mortality statistics and contributing to health and development progress in the subregion.

REFERENCES

- Adams, Tim (2012). The characteristics of Pacific island small-scale fisheries. *SPC Fisheries Newsletter*, vol. 138, No. 138, pp. 37-43.
- Brisbane Accord Group (2015). Progress in the Pacific: CRVS achievements and challenges in the Pacific Islands. Available at <https://sdd.spc.int/media/117>.
- Byard, Roger (2015). Immersion deaths and drowning: issues arising in the investigation of bodies recovered from water. *Forensic Science, Medicine, and Pathology*, vol. 11, No. 3, pp. 323-325.
- Carter, Karen, and others (2012). Mortality and cause-of-death reporting and analysis systems in seven Pacific island countries. *BMC Public Health*, vol. 12, No. 1, p. 436.
- Danielsson, Per, and others (2010). Safety for fishermen: the way forward. In *Safety at Sea for Small-scale Fisheries in Developing countries*. Rome: FAO.
- Figueroa, Carah, Philip James, and Michel Blanc (2018). Cost-benefit analysis of the emergency 'grab bag' programme. *SPC Fisheries Newsletter*, vol. 155, pp. 37-43.
- Fiji Bureau of Statistics (2017). Fiji Bureau of Statistics – Key statistics: March 2017 – Table 12.7 Drowning cases in Fiji. Suva. Available at www.statsfiji.gov.fj/index.php/latest-releases/key-stats.
- Fiji Bureau of Statistics, Registrar General's Office, and Ministry of Health and Medical Services (2019). *Republic of Fiji Vital Statistics Report 2012-2017*. Suva: Fiji Bureau of Statistics and Pacific Community. Available at <https://sdd.spc.int/media/539>. Accessed 9 December 2019.
- Fiji, Ministry of Health and Medical Services (2016a). *Annual Report 2015*. Suva: S. Navunilawa. Available at www.aidsdatahub.org/sites/default/files/publication/Fiji_Annual_report_2015.pdf.
- _____. (2016b). *Health Status Report 2016*. Available at www.health.gov.fj/?page_id=198.
- Gillett, Robert (2003). Aspects of sea safety in the fisheries of Pacific island countries. Food and Agricultural Organization Fisheries Circular, No. 993. Rome: FAO.
- _____. (2016). *Fisheries in the Economies of Pacific Island Countries and Territories*. Noumea: Pacific Community.
- Gouda, N. Hebe, and others (2016). Whenever they cry, I cry with them: reciprocal relationships and the role of ethics in a verbal autopsy study in Papua New Guinea. *Social Science and Medicine*, vol. 163, pp. 1-9.
- Holder, Y., and others, eds. (2001). *Injury Surveillance Guidelines*. Geneva: WHO.
- International Maritime Organization (IMO) (2008). Guidance on near-miss reporting. MSC-MEPS.7/Circ.7.
- Kalougivaki, James (2015). Medico-legal death investigation systems in the Pacific and creating a stronger Pacific disaster victim identification network. *Journal of Forensic Research*, vol. 6, No. 1.
- Kiribati National Statistics Office, Civil Registration Office, and Health Information Unit (2018). *Kiribati Civil Registration and Vital Statistics Report 2012-2014*. Noumea: Pacific Community.
- Kiribati, Ministry of Health and Medical Services (2016). *Kiribati Annual Health Bulletin 2015*. Available at <https://reliefweb.int/report/kiribati/kiribati-annual-health-bulletin-2015>.
- Murray, Christopher J.L., and others (2014). Using verbal autopsy to measure causes of death: the comparative performance of existing methods. *BMC Medicine*, vol. 12, No. 5.

- Murray, Kathryn, and Peter Carter (2017). Fatal drownings in Fiji: an effective parsimonious model that can explain the number of cases from January 2012 to April 2015. *Asia Pacific Journal of Public Health*, vol. 29, No. 1, pp. 28-34.
- Pacific Community (2016). Legislation for civil registration and vital statistics in the Pacific – best practice guidelines and examples. Working paper. Available at www.pacific-crvs.org/docs.
- _____ (2017). Coastal Fisheries Report Card 2017. Noumea: Pacific Community.
- Pacific Community, and Brisbane Accord Group (2016). Civil registration and vital statistics (CRVS) and the Sustainable Development Goals (SDGs). Available at <https://sdd.spc.int/media/174>.
- Pacific Islands Legal Information Institute (2019). Pacific Islands Legal Information Institute Databases. Available at www.paccli.org/index.shtml. Accessed 11 May 2018.
- Powell, Nora P. (1981). Major obstacles to achieving satisfactory registration of vital events and the compilation of reliable vital statistics. Technical Report, No. 15. New York: International Institute for Vital Registration and Statistics.
- Rao, Chalapati, Debbie Bradshaw, and Colin D. Mathers (2004). Improving death registration and statistics in developing countries: lessons from sub-Saharan Africa. *Southern African Journal of Demography*, vol. 9, No. 2, pp. 81-99.
- Secretariat of the Pacific Community (2002). *Pacific Maritime Legislation & Regulations*, volume 1, *Maritime Administration-Shipping Act*. Noumea.
- Tuvalu Central Statistics Division (2018). *Tuvalu Civil Registration and Vital Statistics Report 2012-2016*. Funafuti. Available at <https://sdd.spc.int/news/2018/03/21/tuvalu-cvrs-report-2012-2016>.
- United Nations (2014). Principles and recommendations for a vital statistics system. Statistical Papers Series M, No. 19/Rev.3. New York: Department of Economic and Social Affairs, Statistics Division.
- United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP) (2014). Regional Action Framework on Civil Registration and Vital Statistics in Asia and the Pacific. Available at www.getinthepicture.org/regional-action-framework.
- Wainiqolo, Iris, and others (2013). Development and piloting of the Fiji Injury Surveillance in Hospitals System (TRIP Project-1). *Injury*, vol. 44, No. 1, pp. 26-131.
- Welch, David J. (2016). *A Small-Scale Vessel Registration System for Pacific Island Countries and Territories*. Noumea: Pacific Community.
- World Health Organization (WHO) (2007). *Verbal Autopsy Standards: Ascertaining and Attributing Cause of Death*. Geneva.
- _____ (2014). *Global Report on Drowning: Preventing a Leading Killer*. Geneva.
- _____ (2015). Mortality: guidelines for certification and rules for coding. In *International Statistical Classification of Diseases and Related Health Problems – 10th Revision*, 5th ed. Geneva.
- _____ (2016). *Regional Action Plan for Violence and Injury Prevention in the Western Pacific (2016-2020)*. Manila: WHO Regional Office for the Western Pacific.
- _____ (2017). ICD-10 version: 2016. Available at <http://apps.who.int/classifications/icd10/browse/2016/en>. Accessed 20 February 2018.
- _____ (2019). ICD-11 for Mortality and Morbidity Statistics (ICD-11 MMS) 2018 version. Available at <https://icd.who.int/browse11/l-m/en>. Accessed 25 November 2019.