# Need for consistent beach lifeguard data collection: results from an international survey

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## ABSTRACT

**Background** Lifeguards are integral to beach safety and collect data which is used for a variety of purposes, although guidelines and best practice have yet to be established. This study served to identify and characterise existing beach lifeguard service provider (BLSP) data collection procedures in order to identify the degree of uniformity and areas for improvement.

**Methods** The 'International Beach Lifeguard Data Collection and Reporting' online survey was distributed via the International Drowning Researchers' Alliance to BLSP supervisors and managers. The survey included questions on beach conditions and lifeguard activity data collection practices, and respondent's opinions on their own BLSP's methods.

**Results** Variability in data collection practices was evident in surveys obtained from 55 lifeguard leaders in 12 countries. Discrepancies exist in definitions for 'rescue' among BLSPs, a significant amount of information related to beach conditions are recorded and beach visitation is primarily obtained by visual estimate. Respondents expressed challenges with getting frontline staff to collect information in the field and ensuring reporting consistency between recorders. They identified rescue victim demographic factors as key data they would like to collect in the future.

**Conclusions** Inconsistencies in lifeguard data collection present challenges to operations, safety education and prevention efforts, research and policy relying on these data. Variation in definitions, methods and collected variables generally restricts analysis to a single BLSP with limited generalisability to other beach settings. Some gaps in lifeguard data collection may soon be addressed by technology, but developing uniform, internationally acceptable standards and definitions should be prioritised.

## BACKGROUND

Drowning is a major global health problem, and the placement of trained lifeguards on recreational beaches is a principle prevention strategy.[1 2] Globally, beach lifeguard or lifesaving service providers (BLSPs) range in size and scope, vary in their utilisation of technology and specialised equipment, may function with volunteers and/or professionals under different qualification standards, and manage risk through a variety of methods. Regardless of the differences, a core responsibility of most BLSPs is to record data on daily activities and physical, meteorological and social beach conditions.

These data are important for a variety of purposes. Daily registered operational data allow for time series analysis of activity trends that are useful for planning the fluid deployment of lifeguard resources and assets, can be used for systems improvement and are the basis of public-facing annual reports.[3–5] Injury prevention and public health communities rely on these data for epidemiological research and primary prevention efforts.[6–9] Researchers also use lifeguard recorded information to investigate physical and socioenvironmental controls on the occurrence of surf-zone injuries and drowning,[10–12] particularly in relation to rip currents, which are considered the main hazard to bathers and swimmers on surf beaches.[13]

Collectively, these efforts share the goal of using accurate, precise data to reduce the burden of drowning and injury. Although lifeguard data are often the basis for research and operational decision-making, their collection remains problematic. The experience of the authors working with BLSPs has identified significant variability in the quality and content of existing data collection practice by lifeguards. Although data collection is an established core responsibility, the reasons for collecting particular variables at any given BLSP are not clear. Moreover, recording data may conflict with supervision responsibilities, presenting major barriers to the quality of lifeguard collected data.[14]

Currently, no international recommendations exist on how BLSPs should collect or report data. BLSPs may not be collecting the same variables, reporting in the same way, or using the same methodologies or definitions. Some may not collect data at all or gather only rudimentary summary counts which limit reproducibility. This lack of standardisation has hampered research related to open water lifesaving activities by limiting studies to a single BLSPs' collection system, thereby resulting in outcomes that are specific to particular geographic regions and environmental conditions and lack generalisability.

This study aimed to identify and characterise existing data collection procedures used by global beach lifeguard service providers in order to identify key data gaps, inconsistencies and opportunities for improvement. As the first attempt to describe such procedures, this study focused on common lifeguard data categories including beach conditions, rescues and crowd counts.

## METHODS

To better understand existing lifeguard data collection methods and practice around the world, a convenience sample of BLSP leadership representatives (eg, lifeguard chiefs, managers or supervisors—referred to as 'respondents' herein) was surveyed using an online survey in Google Forms. The 'International Beach Lifeguard Data Collection and Reporting' survey included a total of 35 questions containing multiple-choice, Likert scale, number inputs and open answer questions. Survey questions collected information related to six themes: (1) the BLSP represented; data collection practices related to (2) weather and ocean conditions (beach conditions henceforward); (3) preventative actions, (4) rescues; (5) other lifeguard activity; and (6) opinions on lifeguard data collection. The full survey is provided in online supplementary file 1.

The online survey was piloted by two lifeguard leaders who offered recommendations and identified technical problems with the form, and reported that the survey took approximately 30 min to complete. Respondents were required to represent a lifeguard department, agency, or organisation (BLSP) responsible for providing lifeguards at a particular surf beach, or larger geographical region that included surf beaches. Participants were directed to a written participant information statement at the start of the survey, which provided details on the survey, including consent.

The online survey began receiving responses at LGDataSurvey.com on 8 April 2019 and remained open through 18 November 2019. The survey link was disseminated via email and social media through the International Drowning Researchers' Alliance, a non-profit network of researchers and practitioners dedicated to promoting safer aquatic environments through evidence-based research. As such, it was not possible to determine the response rate using this dissemination method. It was hoped that surveys would be obtained from at least 25 unique BLSPs.

Responses to multiple-choice questions were coded according to the responses available for each question and summarised for analysis. For this exploratory descriptive study, we reported frequencies, sums and percentages for multiple choice and Likert scale questions. We used theoretical thematic analysis to evaluate answers to open-ended questions in order to provide more in-depth understanding for the following aspects of the survey: rescue definitions, future data collection items and data collection challenges in the BLSP.[15] The online form automatically collated survey responses into a spreadsheet, which was then loaded for analysis in Microsoft Excel V.16.35, Tableau Desktop V.2020.1, and R Studio V.4.0.1 (Computer Software).

## RESULTS

A total of 57 respondents from 12 different countries completed surveys and 55 were used in analysis; one participant identified they did not represent a BLSP and did not complete the survey, and one survey was excluded as researchers were not able to verify that it actually represented a BLSP. The majority were from the USA and Australia (n=24, 43.6%; and n=17, 10.9%; respectively); three responses (5.45%) came from the Ireland, two (3.6%) each from Spain and South Africa, and one (1.8%) each from Argentina, Brazil, Italy, the Netherlands, New Zealand, Sweden and the UK. Forty-five respondents (81.9%) were the only representative from their BLSP; 10 (18.1%) identified as working for the same organisation as another respondent, but were included for analysis as their job title and work location indicated different responsibilities and geographical areas of responsibility. Respondents were mostly male (n=49; 89%) and collectively represented over 8400 professional (paid) and 6300 volunteer lifeguards.

Respondents reported wide-ranging practices related to the recording of beach conditions, rescue data and crowd counts (figures 1–3, respectively). Multiple definitions for 'rescue' were reported. Many respondents (n=22, 40%) indicated a rescue required physical assistance or contact from a lifeguard, while some others (n=3, 5.4%) noted any help from a lifeguard counted as a rescue without providing further descriptive information. Multiple respondents (n=9, 16.3%) defined rescue as only those situations of extreme consequence, using subjective descriptors such as 'life-threatening', 'loss of life', 'imminent peril', 'grave danger' and 'serious injury or death'. Still, others (n=5, 9.1%) clarified that a rescue required use of equipment such as a rescue buoy, board or jet ski.

Respondents reported varied levels of confidence in their BLSP data collection culture and accuracy (figure 4). When asked which key data points they would like to see added to their collection practice, 21.8% (n=12) mentioned person-related demographic factors (eg, age, gender, residence, ethnicity, etc) of those rescued or aided. Other responses described a desire to move towards accurate time and location information and a way to determine the severity of the rescue. Responses to a question about challenges in lifeguard data collection included comments on: difficulties with staff training and diligence of employees to collect data (n=13, 23.6%), crowd count methodologies (n=10, 18.2%), inconsistency in methodology and definitions (n=7, 12.7%), the time it takes to document given that lifeguards are busy (n=5, 9.1%) and issues with data accuracy (n=5, 9.1%).

## DISCUSSION

This study is the first effort to describe global data collection practices of BLSPs. Accurate and precise data are important for defining injury risk factors which inform countermeasures.[16] Interventions, programmes and policies which seek to reduce the incidence and burden of injury and drowning on ocean beaches therefore require high-quality information from these settings. High variability exists among the studied BLSPs in terms of the type of data recorded, definitions of key variables such as rescue, and the methodologies employed to gather these data; similar to data recording challenges reported from other emergency services.[17 18] Here, we frame implications of these findings with reference to lifeguard recorded data on beach conditions, rescues and crowd counts; culminating in recommendations and broad considerations for the lifeguard and beach safety communities.

### Beach conditions data

Most BLSPs collect data on beach condition variables, primarily recorded day to day by different lifeguards and usually by visual estimates. While lifeguards are typically experienced beach persons, measurement error likely exists due to subjective collection methods. First, interobserver reliability, the agreement among environmental condition measurements between different recorders, is unknown, but likely to reflect some inconsistency. Second, the validity of these measurements, the degree to which the recorded data reflects the truth, has not been established. In fact, recent work from New Zealand found systematic underprediction of breaking wave height by lifeguards; bias potentially induced, not reduced, by ocean experience.[19] Beach conditions data are important for operations management and beach safety research, and lifeguards spend significant time manually registering these data while other external monitoring systems potentially capture

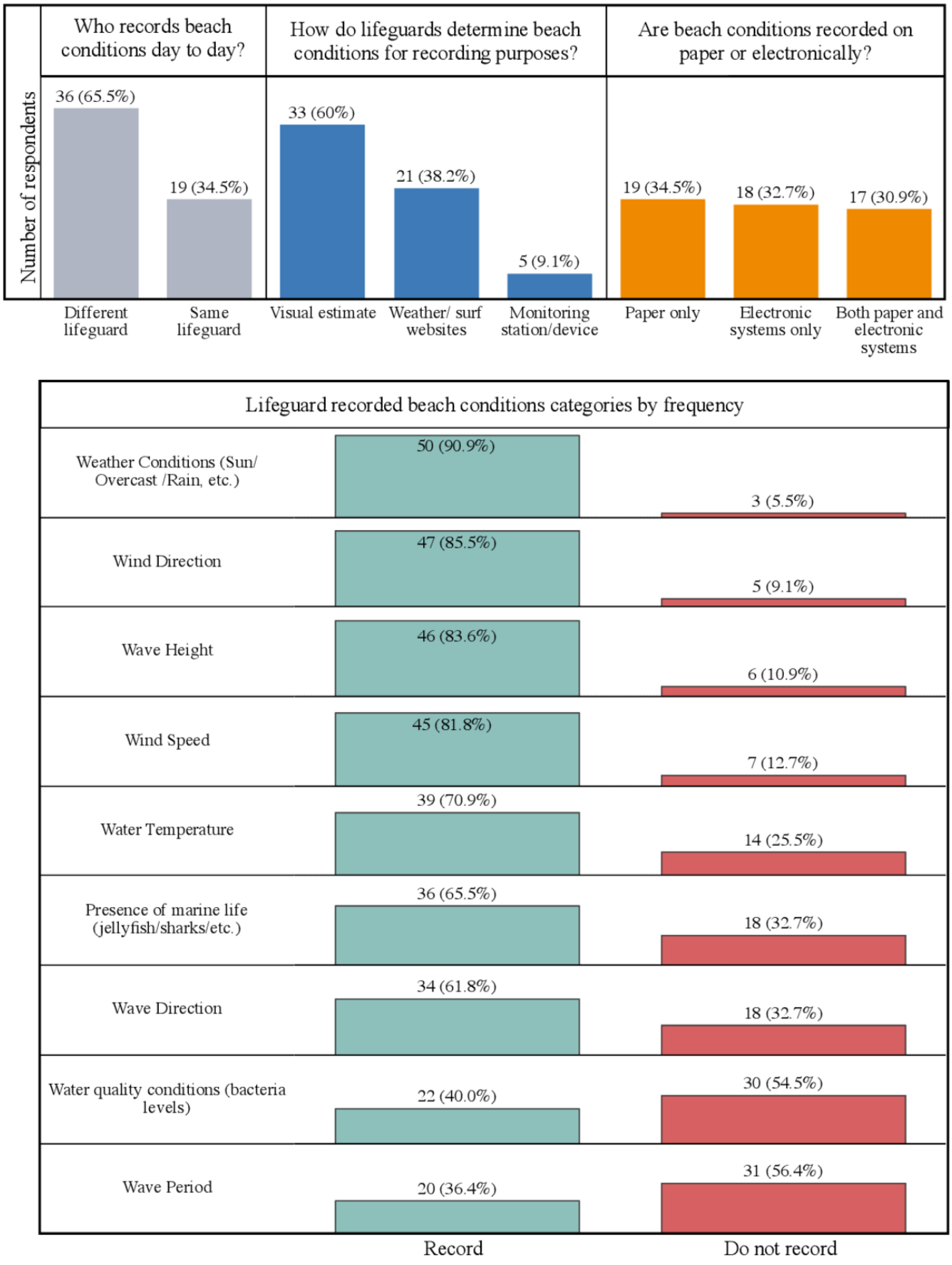


**Figure 1** Lifeguard data collection practices related to beach conditions information. Note: categories may not add to 100% due to missing values or multiple items selected. 'Both paper and electronic systems' refers to BLSP who use both or a combination of paper and electronic recording instruments.

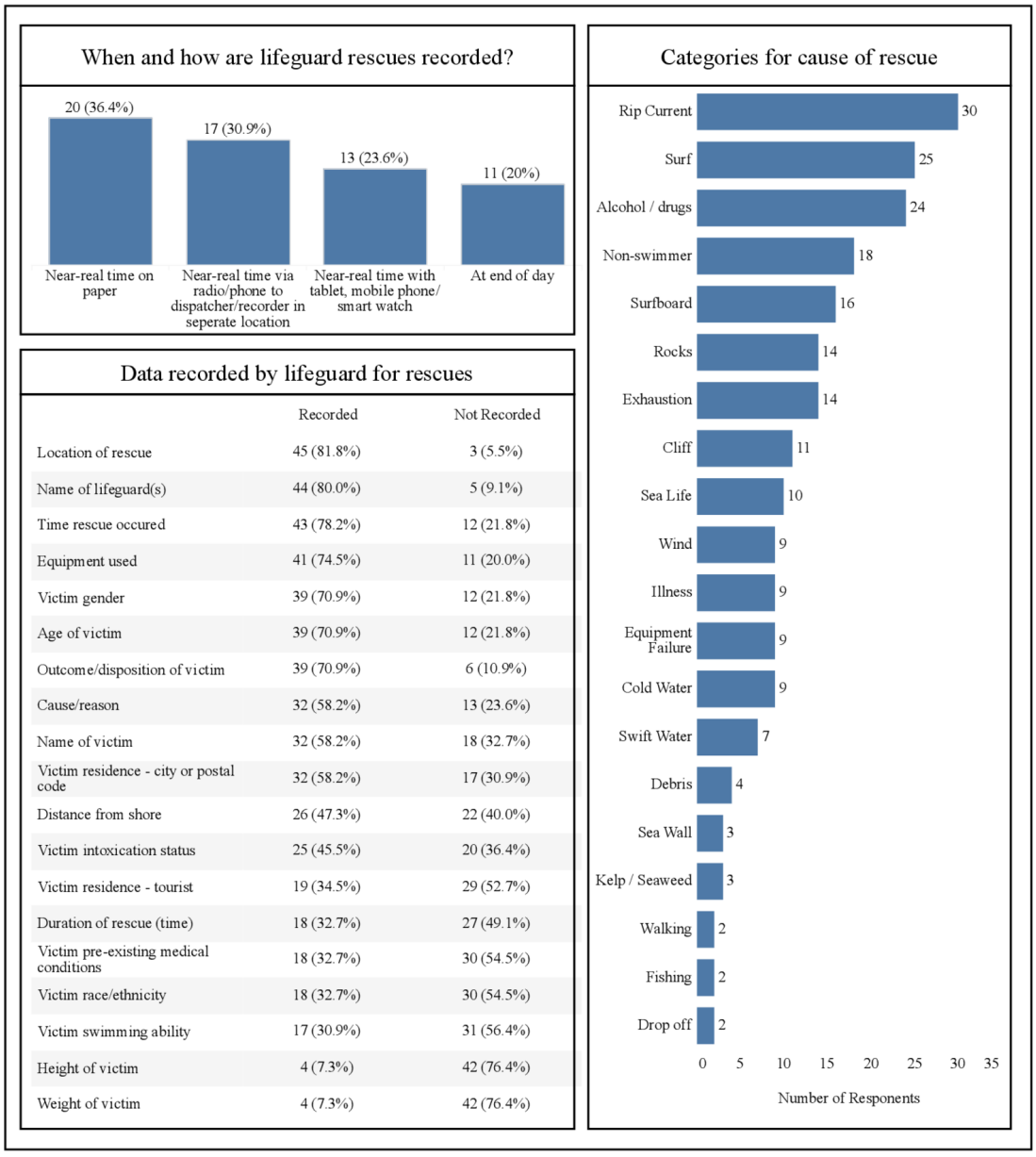


**Figure 2** Data and collection practices related to lifeguard rescues. Note: categories may not add to 100% due to missing values or multiple items selected. The survey identified 49 unique Cause for Rescue categories; this figure shows the top 20.

this information more consistently and accurately. This raises an important question: do lifeguards still need to subjectively collect and record beach conditions information?

## Lifeguard rescue data

We found wide variability in how BLSPs defined rescue. Both the 2006 and 2014 editions of *Drowning* discussed the issue and a specific call for consensus agreement on rescue terminology was the closing recommendation of *The Science of Beach Lifeguarding*,[20–22] yet no further standardisation efforts have occurred. Physical assistance from a lifeguard delineates rescue from other activities for many BLSPs; however, others count only the most serious life-threatening events as rescues. Political, budgetary or cultural factors may influence a BLSPs utilisation of definitions that are more or less sensitive or specific.

Regardless of rescue definition antecedents, these discrepancies make data comparisons between lifeguard BLSPs difficult and introduce elements of unreliability in any assessments undertaken at a regional, national or international scale. For example, the limiting nature of the non-standardised definitions was evident in our dataset as any question related to rescue information from the respondent's BLSP was dependent on their own definition. Thus, information on data collection practices presented in figure 2 may relate to rescue incidents that vary in severity and response.

Considering aforementioned limitations, wide-ranging practices for rescue data collection were reported. Lifeguards collect several data points related to the person rescued which have previously been identified as risk factors for drowning including age,[23] gender,[24] alcohol,[25] residence location,[26] swimming ability[27] and ethnicity.[28] Environmental conditions that lifeguards record during rescue events have been documented as risk factors via analysis of drowning or rescue events to a lesser extent,[6 29 30] and still some rescue-related information collected by lifeguards has no link with current evidence-based data. Of

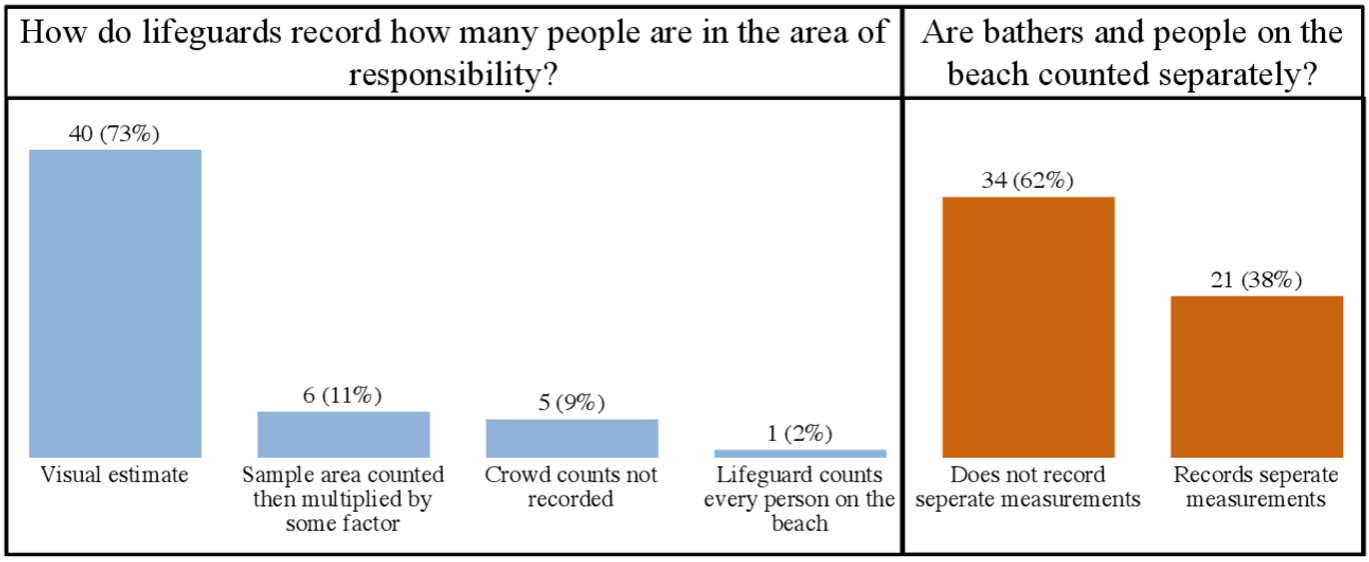


**Figure 3** Lifeguard data collection practices for counting beach crowds.

note, no study to our knowledge has evaluated the interaction between environmental and person-based factors, which would greatly advance our understanding of rescue aetiology.

Additionally, some respondents (n=12, 21.8%) reported not recording the time the rescue took place, a critical element required to link rescue data to potential environmental contributing factors such as ocean (wave, tide) and weather conditions. Striving to record rescue data in near real time also likely reduces reporting error due to recall bias. This limitation to data accuracy was supported by comments from some of the lifeguard manager respondents who identified challenges involved in getting lifeguards to "remember everything that happens over the eight hour day" *[Respondent 5]* or "report their entire day of activity at the end of the day" [*Respondent 26*].

Rescued person demographics, important for prevention and education efforts, were the most frequently cited type of desired data identified by respondents and acknowledged as difficult to acquire. Accurate recording of these data has also proven difficult in EMS settings as providers are focused on care and patients in distress might not be able to give accurate demographic information.[31] In the beach lifeguard context, Williamson noted difficulties in locating the person for interview post rescue,[14] and respondents in our survey cited privacy concerns, uncooperative victims and time constraints during high activity periods as additional barriers to collecting accurate demographic data. For example, [*Respondent 21*] commented: "If details of a victim can be obtained, they are sometimes recorded, it depends on the seriousness of the incident. Time-wise, …, sometimes it is too busy to record information". Although important, it may be an unrealistic expectation to include the collection and documentation of rescue victim demographic data in all routine lifeguard surveillance systems. If needed for research or education purposes, researchers and lifeguard managers could plan active location and BLSP-specific collection methods and consider the use of non-lifeguard data collectors,[14] or sampling techniques to reduce the burden on lifeguards.

## Crowd count data

Visual estimation is the predominant practice for documenting beach visitation and was recognised by survey respondents and previous research as being imprecise.[32] This information is essential for operational purposes and many respondents expressed a desire for more than an "attendance guestimate" [*Respondent 12*] in the future. Accurate beach and in-water crowd counts are useful for government and land management services and are critical for epidemiological and environmental research in relation to determining hazard exposure. Video imaging for coastal management purposes has been used to estimate beach attendance for over a decade,[33] and emerging technology may make accurate crowd counts more accessible for BLSPs and researchers in the future.[34]

## Recommendations

In the absence of established guidelines or best practices, results from this study support three important recommendations: (1) development of standardised 'case' definitions for lifeguards; (2) recording of timestamped activity; and (3) transition from less precise manual based to more precise technology-based data recording.

Evidence of inconsistencies here underscore the need for consensus-based definitions of relevant lifeguard data terms. This study focused on rescue as a first step in documenting lifeguard data practices but the vast majority of lifeguard interventions are preventative,[4 8] and their recording may be even more problematic than the easier to quantify rescue event. Defining relevant terms and identifying core and supplemental data variables to be collected, similar to the Utstein-style for the Uniform Reporting of Data from Drowning,[35] could make lifeguards more efficient in their operations and greatly assist related research activities.

Records of individual activities, particularly rescues, with associated times and other available metadata are required for robust research.[36] Time-stamped event records allow for linkage to other datasets including hospital and EMS records, or weather and ocean monitoring systems. Accurate and precise collection of these data is critical for research related to lifeguard management and effectiveness, and linking for events to environmental factors related to beach hazards and safety. Without comprising water safety responsibilities, BLSP should strive to record data in as near real time as possible to reduce recall bias and improve validity.

New technology, and innovative uses of existing technology, have potential for substantial impact on lifeguard operations

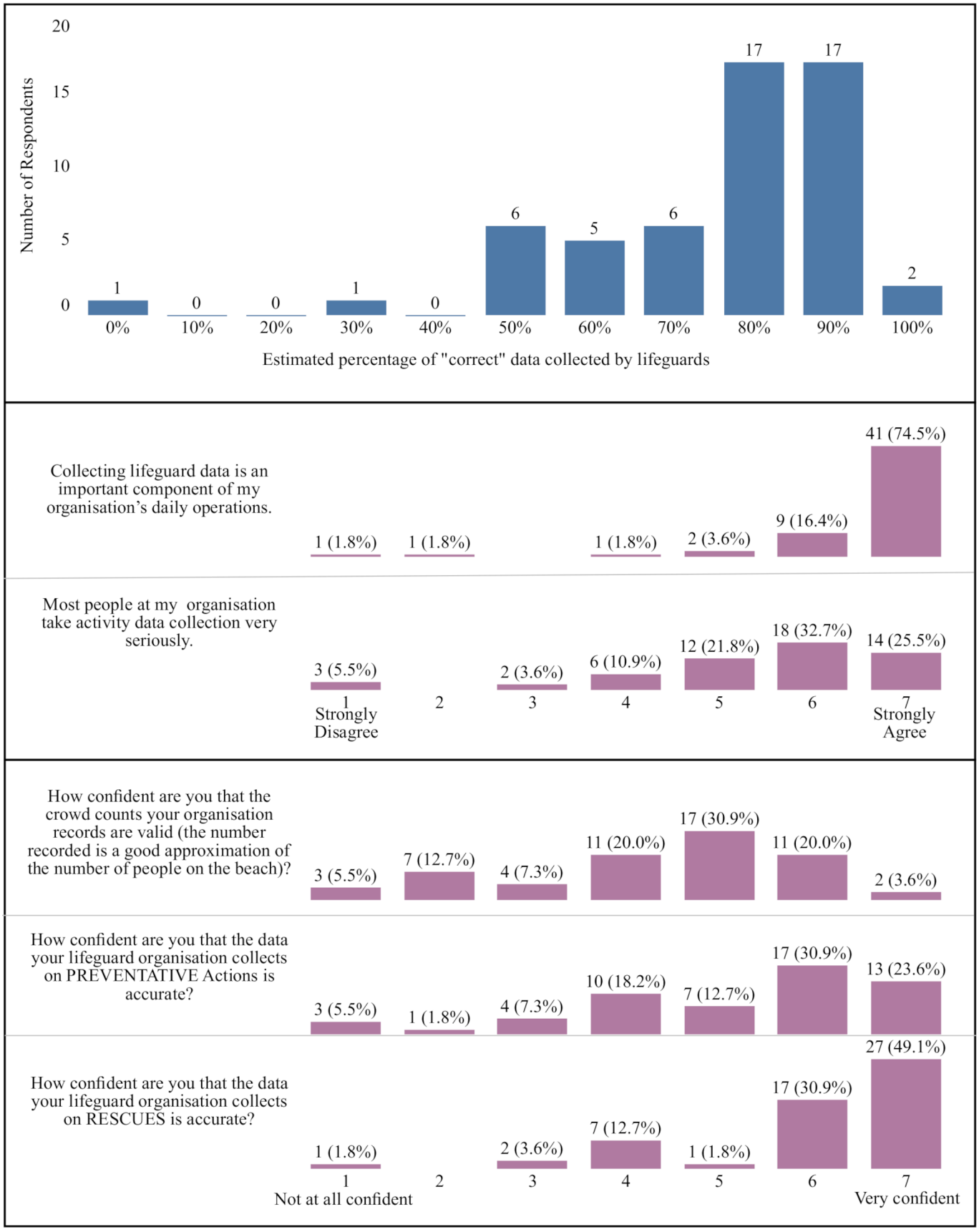


**Figure 4** Respondent perspectives on lifeguard data collection.

globally. Computer-aided dispatch systems,[4] tablet computers[37] and smart phones/watches are allowing for faster, more efficient and precise recording of lifeguard activities. Additionally, the availability of environmental data captured by existing publicly available weather and ocean monitoring systems represents an opportunity for major reduction in lifeguard workload. Where these systems exist, the elimination of routine visual/manual recording of beach, ocean and weather conditions is possible.

Technology has the potential to: (1) substantially reduce documentation time of lifeguard activity in the field, which is known barrier to data collection; (2) provide timely updates on activity, which is vital for managers and decision-makers; and (3) allow for seamless automatic linkage to other data systems, streamlining the first two recommendations. Although potentially 'game-changing' technological solutions may still be in developmental stages, standardisation across the beach lifeguard industry, especially regarding case definitions, should remain a priority.

Finally, several respondents noted difficulties in getting lifeguard staff to participate in data collection and acknowledged some uncertainty regarding the quality of existing data obtained (figure 4). Acceptance of data collection duties as a core component of the job is crucial for lifeguard improvement in this area.[36] Motivated focus on data collection, standard operating procedures and training have improved reporting in EMS and hospital settings.[38–40] Acceptance may also be bolstered by inclusion in a feedback process where lifeguards see and understand the results of their data collection activities. Lifeguard data recorders, not just managers, should be included in the design, evaluation and improvement of collection systems, especially as new technology becomes available.

### Limitations

This online survey may be subject to precision errors and forms of selection and response bias as it did not undergo test–retest validation procedures, was disseminated through the authors' networks and via social media and received a limited number of responses. As previously discussed, not providing a specific definition for rescue severely limited the information gathered on those activities, but provided useful insight, nonetheless. Although the responses from this survey were predominantly from Australia and the USA, both countries have multiple BLSPs with different lifeguard reporting practices and also extend across a range of ocean beach and wave climate environments. If more countries were represented in this survey, we would expect to find more, not less, variability in data collection practices. The most important limitation of this work is the fact that all respondents were from high or upper middle income counties, which account for a small percentage of the global drowning burden and likely do not reflect the reality of lifeguard originations operating in lower resource settings.

## CONCLUSIONS

Inconsistencies in data variable collection, methods and definitions present barriers to the expansion of evidence in beach lifeguarding, a field already lacking scientific basis for many activities. This information is critical for evidence-based decision-making by lifeguard managers. Understanding the nature of commonly occurring beach hazards guides interventions that seek to reduce the occurrence of rescue, injury and drowning. Efforts to establish consensuses guidelines and definitions for lifeguard data collection would have far-reaching effects in the field of beach lifeguarding and related physical, social and hazards-based research and injury and drowning prevention activities.

### What is already known on this subject

- Recording valid, reliable and unbiased data is a major challenge for open water lifeguards.
- Data collected by lifeguards are used in a variety of disciplines and are important to injury and drowning prevention efforts.
- No formal national or international lifeguard data collection guidelines exist.

### What this study adds

- There is substantial variability in beach lifeguard data collection practices.
- A uniform definition of the term 'rescue' would improve multicentre research and data collection.
- Recommendations to improve data collection among beach lifeguards is summarised in three points: (1) develop standardised 'case' definitions for lifeguards; (2) record timestamped lifeguard activity; and (3) transition from manual-based to technology-based data recording.

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**Patient consent for publication** Not required.

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