Available online at www.sciencedirect.com

Resuscitation Plus

journal homepage: www.elsevier.com/locate/resuscitation-plus

Clinical paper

Feasibility study of the Utstein Style For Drowning to aid data collection on the resuscitation of drowning victims

Ogilvie Thom[a,b,*], Kym Roberts[a,b], Susan Devine[b], Peter A. Leggat[b,c], Richard C. Franklin[b,d]

Abstract

Aim: The revised Utstein Style For Drowning (USFD) was published in 2015. Core data were considered feasible to be reported in most health systems worldwide. We aimed to determine the suitability of the USFD as a template for reporting data from drowning research.

Method: Clinical records of 437 consecutive drowning presentations to the Sunshine Coast Hospital and Health Service Emergency Departments (ED) between 1/1/2015 and 31/12/2021 were examined for data availability to complete the USFD. The proportions of patients with each variable documented is reported. Time taken to record core and supplementary variables was recorded for 120 consecutive patients with severity of drowning Grade 1 or higher.

Results: There were 437 patients, including 227 (51.9%) aged less than 16 years. There were 253 (57.9%) males and 184 (42.1%) females. Sixty-one patients (13.9%) received cardiopulmonary resuscitation (CPR). There were nine (2.1%) deaths after presentation to the ED. Median time for data entry was 17 minutes for core variables and 6 min for supplementary. This increased to 29 + 6 minutes for patients in cardiac arrest. Sixteen (32.7%) of 49 core variables and four (13.3%) of 30 supplementary variables were documented 100% of the time. One (2.0%) core and seven (23.3%) supplementary variables were never documented. Duration of submersion was documented in 100 (22.9%) patients.

Conclusion: USFD is time consuming to complete. Data availability to enable completion of the USFD varies widely, even in a resource rich health system. These results should be considered in future revisions of the USFD.

Keywords: Utstein Style for Drowning, Resuscitation, Data availability, Feasibility

Introduction

Drowning is a leading cause of traumatic death globally with approximately 300,000 fatalities occurring annually, with low and middle-income countries disproportionately affected.[1] To help with the consistent reporting of data from studies of drowning incidents The Utstein Style for Drowning (USFD) was first published in 2003 in order to facilitate consistent data collection and outcome reporting when researching resuscitation of drowning victims.[2] It was subsequently revised and extended with the addition of three new tables in 2015: Pre-EMS Scene Information (lifeguard rescue and treatment), Time points and Time Intervals; and Quality of Resuscitation Factors.[3] With drowning being an infrequent presentation to individual hospitals, the development of multicentre and international registries is paramount to furthering clinical research in the treatment and understanding of outcomes of drowning patients.[4–6]

Patient registries are a first step in improving survival as has been demonstrated in the areas of cardiac arrest,[7] hypothermia[8] and trauma care.[9] Yet even in trauma, with well-established registries, data collection is problematic, often due to resource constraints.[10] For example; the Utstein Trauma Template, first published in in 1999, revised in 2008, which consists of 35 core and 4 subsidiary variables[11] and used across the globe, was found, in a multinational survey of 22 trauma centres and two trauma registries representing a total of 292 hospitals from Europe, North America and Australia, that

* Corresponding author at: Department of Emergency Medicine, Sunshine Coast Hospital and Health Service, Birtinya, QLD, Australia.
E-mail addresses: Ogilvie.Thom@my.jcu.edu.au (O. Thom), Kym.Roberts@health.qld.gov.au (K. Roberts), Sue.Devine@jcu.edu.au (S. Devine), Peter.Leggat@jcu.edu.au (P.A. Leggat), Richard.Franklin@jcu.edu.au (R.C. Franklin).

https://doi.org/10.1016/j.resplu.2023.100464
Received 14 May 2023; Received in revised form 13 August 2023; Accepted 21 August 2023

only one in three (13/36, 36.1%) of the variables were recorded by all centres.[10] Almost half of the participating centres/registries (11/24, 46%) used a different definition of survival to the trauma template, a scenario very familiar to drowning researchers.[12,13] Finally, the study reported that only three (8.3%) of the 35 core variables in the Utstein Trauma Template were recorded in all 783 study patients.[10] Compared with the Utstein Trauma Template, the USFD is much larger, consisting of 8 tables, with 49 core and 30 supplementary variables.[3] A previous study examining data from national drowning fatality databases found that while there were 13 variables consistently collected across three high income countries, this only included five USFD variables.[14] Uptake of the USFD in reporting treatment and outcomes of drowning has been limited, with a Medline search conducted June 20, 2023 without restrictions, resulting in 23 papers, one of which was a protocol.[6] Twenty one of these papers were published between 2003 and 2020, a small fraction of the 641 papers utilizing Utstein templates in the same time period.[15] A study of 14 publications utilizing USFD reported the number of USFD variables included in these papers varied widely, between 27% and 86%[16]. The USFD was developed to facilitate prospective research in drowning patients requiring resuscitation.[2,3] However, the large majority of studies that have used USFD are retrospective and include drowning patients other than those requiring resuscitation. The use of USFD as a guide for data collection in all drowning patients has not been examined. Despite the lack of comparative studies on the treatment and outcomes of drowning,[6] the development of large multicentre/multinational registries of drowning patients lags behind our trauma and intensive care colleagues[11,17] or the Extracorporeal Life Support Organization.[18] In an effort to help facilitate the development of such registries, we sought to examine the availability of the data necessary to complete the USFD in a cohort of consecutive drowning presentations to the Emergency Departments (ED) of the Sunshine Coast Hospital and Health Service (SCHHS) in Queensland, Australia.

Methods

This observational study was conducted at the EDs of Nambour Hospital and Sunshine Coast University Hospital, with the latter being the tertiary referral center for SCHHS. In 2022, the two departments had over 140,000 patient presentations. The Sunshine Coast is located 100 km north of the Queensland capital city, Brisbane. The Sunshine Coast has a population of 336,522[19] and there are many popular surf beaches along the coast. The Sunshine Coast is a popular destination for visitors with over 8.5 million visitor overnight stays and 4.5 million visitor day visits during the 2019/2020 financial year.[20]

This study received ethical approval and an exemption from obtaining patient consent from The Prince Charles Hospital Human Research and Ethics committee (Project no: 49754) and James Cook University Human Research Ethics Committee (H8104). The protocol for this study has been published previously[6] and this study is published following STROBE guidelines.[21]

The health records for consecutive drowning cases recruited between January 1st 2015 and December 31st 2021 were examined for availability of the USFD variables by two data abstractors (OT and KR). The data sources included the integrated electronic medical record, ED documentation, inpatient unit (including Intensive Care Unit) documentation, in-hospital pathology and radiology reporting systems, and Queensland Ambulance Service Case Records. Certain clinical variables, such as circulatory support or mechanical ventilation, were inferred to be present even when not documented in the health record. For example, circulatory support would be documented in the medical and nursing notes, as well as the medication history. Absence of such documentation was considered indicative that it was not used. Similarly, APO/ARDS was considered present when reported by radiologists. It was considered absent when radiology reports did not find it present or when the patients' clinical state did not warrant radiological examination. Laboratory findings, such as blood glucose, blood alcohol levels, potassium and lactate which cannot be inferred in the absence of testing, were considered absent if the test was not performed. The time taken for core and supplementary variables to be entered on to the standardized case report form[6] for the first 120 consecutive cases with a drowning severity of Grade 1 or above was recorded. These cases were reviewed by both authors for data availability. Differences were settled by consensus. The classification system described by Szpilman[22] was used to assess the severity of the drowning injury (Table 1).

Statistical analysis was conducted using IBM SPSS (version 27; IBM, Armonk, NY, USA). Descriptive statistics are presented as median and interquartile range (IQR) when they were not normally distributed. Categorical variables were described using frequencies and percentages. Children were classified as below 16 years of age. Results are presented for both the total population and children, given the over representation of children in drowning statistics and large number of publications (2925, Medline search August 7th 2023) focusing solely on children and drowning. The calculated variables of submersion duration or underwater to first treatment were cross tabulated with the duration of drowning reported by witnesses.

Results

There were 437 drowning presentations (see Table 2) with 253 (57.9%) males, 184 (42.1%) females, and 227 (51.9%) were children (aged under 16 years). Three-quarters (76.7%) of patients were transported to the ED by Emergency Medical Services (EMS), 138 (41.2%) of these were children. Drowning severity (please refer to Table 3, column 2) ranged from Grade 0 (asymptomatic) to Grade 6, of which 39.6% were asymptomatic and 10.1% experienced cardio-respiratory arrest secondary to drowning (Grade 6). Grade 4 (Bilateral pulmonary oedema and hypotension, $n = 3$) and Grade 5 (respiratory arrest, $n = 16$) were the least common categories. Twenty-nine (6.6%) patients were mechanically ventilated in the ED and 11.2% admitted to the Intensive Care Unit. One hundred and thirty patients (29.7%) were admitted to the Short Stay Unit (predicted duration of admission < 24 hours) and 75 (17.2%) were admitted to other inpatient units. One hundred and seventy-one (39.1%) patients were discharged directly home from the ED.

KR was the primary reviewer of a majority of health records (246) while OT reviewed 191. There are 9480 variables in the 120 cases reviewed by both abstractors and there were 23 (14 OT, 9 KR) variables initially recorded as missing that were subsequently found to be available on review. There were no false positives found. This gives a crude false negative rate of 0.24% ($(23/9480) \times 100$). The time taken for data collection for the first 120 consecutive patients drowning grade 1 and higher is presented in Table 3. The time taken was similar for both abstractors: Median, (IQR); Core: KR 17 min,[13–

Table 1 – Severity of drowning injury.[20]

Severity	Clinical features
Grade 0	Asymptomatic
Grade 1	Normal pulmonary auscultation with cough
Grade 2	Abnormal pulmonary auscultation with rales in some fields
Grade 3	Pulmonary auscultation of acute pulmonary oedema without arterial hypotension
Grade 4	Pulmonary auscultation of acute pulmonary oedema with arterial hypotension
Grade 5	Isolated respiratory arrest
Grade 6	Cardiopulmonary arrest

Table 2 – General characteristics.

	Male (all patients)	Female (all patients)	Children	All patients
N (%)	253 (57.9)	184 (42.1)	227 (51.9)	437
Age (years) Median (IQR)	15 (3–35)	14 (3–30)	3 (2–8)	15 (3–33)
EMS transfer	202 (79.8)	133 (72.3)	138 (60.7)	335 (76.7)
D/C from ED (%)	80 (31.6)	91(49.5)	106 (46.7)	171 (39.1)
LATC[1] (%)	9 (3.6)	1 (0.5)	3 (1.3)	10 (2.3)
IPU[2] Admission (%)	128 (50.6)	77 (41.8)	34 (14.9)	205 (46.9)
ICU[3] Admission (%)	36 (14.2)	13 (7.1)	18 (7.9)	49 (11.2)
Died (%)	5 (2.0)	4 (2.2)	4 (1.8)	9 (2.1)

[1] Left after treatment commenced.
[2] In-Patient Unit (excluding ICU).
[3] Intensive Care Unit.

Table 3 – Severity of drowning injury (22) and data abstraction times (min).

Drowning severity (22)	Total patients	Patient numbers with time recorded (%)	Abstraction time: Core dataMedian (IQR)	Abstraction time Supplementary dataMedian (IQR)
Grade 1	106	49 (46.2)	13 (12–15)	6 (6–6)
Grade 2	34	18 (52.9)	17 (14–21)	6 (6–6)
Grade 3	61	21 (34.4)	18 (17–20)	6 (6–6)
Grade 4	3	3 (100.0)	34 (–)	7 (–)
Grade 5	16	1 (6.3)	22 (–)	6 (–)
Grade 6	44	28 (63.6)	29 (24–40)	7 (6–10)
Total	264	120 (45.5)	17 (13–24)	6 (6–7)

[26] OT 18 min[15–22] and Supplementary: KR 6 min (6–6), OT 6 min (6–7). The median time taken to record the core variables increased with the severity of the drowning injury and ranged from 13 minutes for patients who had a cough (Grade 1) to approximately 30 minutes for patients who had sustained a cardiac arrest secondary to their drowning (Grade 6).

Sixteen core variables and four supplementary variables were documented 100% of the time. One core variable and seven supplementary variables were documented zero times. The data availability for each individual variable is presented in Table 4. While the different components of vital signs are presented individually, combined they form two variables: Utstein Table 2: Scene Vital Signs and Utstein Table 5: Hospital Course, Core Data, "First documented vital signs after hospital arrival".[3]

There was sufficient documentation of both witnessed time of submersion and time of removal from water to calculate a duration of submersion for 95 (21.7%) patients. This was more common for children (75/227, 33.0%, $p < 0.001$). Time frame from submersion until first EMS/CPR was able to be calculated for 77 patients. The calculated duration agreed with reported duration of submersion in a minority of patients (11/42, 26.2%) patients where both values were available. The calculated submersion duration was longer than the reported duration by 14 (1–35) minutes (median, IQR). An estimated duration of submersion reported by witnesses was recorded

Table 4 – USFD variables and data availability for adults and children (0–15 years).

Variable	Number of relevant cases (all patients)	Data availability all patients *n* (%)	Number of relevant cases (children)	Data availability children *n* (%)
USFD Table 1: Victim Information				
Identifier	437	437 (100)	227	227(100)
Sex	437	437 (100)	227	227 (100)
Age	437	437 (100)	227	227 (100)
*Race/ethnicity	437	0 (0.0)	227	0 (0.0)
Incident date	437	437 (100)	227	227 (100)
Incident time	437	252 (57.7)	227	139 (61.2)
Precipitating event	437	387 (88.6)	227	198 (87.2)
Face submerged	437	384 (87.9)	227	208 (91.6)
Pre-existing illness	437	429 (98.2)	227	224 (98.6)
USFD Table 2: Scene Information				
Water Temperature	437	0 (0.0)	227	0 (0.0)
Witnessed	437	429 (98.2)	227	224 (98.6)
Bystander CPR	437	436 (99.8)	227	226 (99.6)
CPR method	61	57 (93.4)	31	29 (93.5)
Bystander ventilation	61	51 (83.6)	31	25 (80.6)
Trained 1st responder	437	428 (97.9)	227	221 (97.4)
Vital status	437	432 (98.9)	227	226 (99.6)
Initial cardiac rhythm	335	210 (62.7)	138	74 (53.6)
*EMS Heart rate	335	320 (95.5)	138	131 (94.9)
*EMS Blood Pressure	335	292 (87.2)	138	107 (77.5)
*EMS Temperature	335	267 (79.7)	138	110 (79.7)
*EMS SaO_2	335	314 (93.7)	138	126 (91.3)
*Pulmonary Status	437	419 (95.8)	227	218 (96.0)
*Type of water	437	433 (99.1)	227	223 (98.2)
*Body of water	437	437 (100)	227	227 (100)
USFD Table 3: Pre-EMS Scene Information (Lifeguards and First Responders)				
Medical knowledge	437	431 (98.6)	227	219 (96.5)
Interventions	437	424 (97.0)	227	221 (97.4)
*Rescuer = care giver	437	263 (60.2)	227	146 (64.3)
*Number of lifeguards	437	170 (38.9)	227	121 (53.3)
*Water conditions	275	113 (41.1)	87	36 (41.4)
*Rescue Methods	437	356 (81.5)	227	201 (88.5)
USFD Table 4: Time points and Time Intervals from First Responder or EMS Data				
Time face underwater	437	159 (36.4)	227	83 (36.6)
Time removed from water	437	121 (27.7)	227	74 (32.6)
Time of first treatment	335	298 (89.0)	138	124 (89.9)
Time CPR begun	61	19 (31.1)	31	13 (41.9)
Time ROSC	61	25 (41.0)	31	17 (54.8)
Time first conscious	61	28 (45.9)	31	19 (61.3)
[$]Submersion duration	437	100 (22.9)	227	79 (34.8)
[$]Time underwater to first EMS treatment	437	83 (19.0)	227	40 (17.6)
USFD Table 5: Hospital Course, Core Data				
Date and Time	437	437 (100)	227	227 (100)
CPR ongoing	437	437 (100)	227	227 (100)
CPR duration	61	26 (42.6)	31	14 (45.2)
First Hospital Temperature	437	417 (95.4)	227	214 (94.3)
First Hospital Heart Rate	437	425 (97.3)	227	221 (97.4)
First Hospital Blood Pressure	437	361 (82.6)	227	154 (67.8)
First Hospital Respiratory Rate	437	416 (95.2)	227	217 (95.6)
First Hospital SaO2	437	425 (97.3)	227	218 (96.0)
Rhythm	437	220 (50.3)	227	71 (31.2)
GCS/AVPU	437	434 (99.3)	227	226 (99.6)
ABG	437	10 (02.3)	227	3 (01.3)
APO/ARDS	437	437 (100)	227	227 (100)
Airway/ventilation	437	435 (99.5)	227	227 (100)
ICU	437	437 (100)	227	227 (100)
Induced hypothermia	437	437 (100)	227	227 (100)

Table 4 (continued)

Variable	Number of relevant cases (all patients)	Data availability all patients n (%)	Number of relevant cases (children)	Data availability children n (%)
Targeted temperature management	437	437 (100)	227	227 (100)
Min and Max temp	437	237 (54.2)	227	114 (50.2)
BSL control 24 hrs	437	101 (23.1)	227	34 (15.0)
2 episodes hypotension	437	250 (57.2)	227	108 (47.6)
Circulatory support	437	437 (100)	227	227 (100)
ECMO/CPB	437	437 (100)	227	227 (100)
Best GCS	437	431 (98.6)	227	224 (98.7)
In hospital CPR	437	437 (100)	227	227 (100)
Complicating illness	437	437 (100)	227	227 (100)
USFD Table 6: Hospital Course, Supplementary Data				
*Reason CPR stopped prior to ED	59	58 (98.3)	31	30 (96.8)
*Time CPR stopped in ED	2	1 (50.0)	2	1(50.0)
*Defibrillations post arrival	437	437 (100)	227	227 (100)
*Four score	437	0 (0.0)	227	0 (0.0)
*Lactate	437	135 (30.9)	227	35 (15.4)
*Potassium	437	144 (32.9)	227	35 (15.4)
*Prior substance abuse	437	435 (99.5)	227	227 (100)
*BAL	437	8 (01.8)	227	2 (0.9)
*Oxygenation (post arrest patients)	61	45 (73.8)	31	16 (51.6)
*Temperature goal	30	30 (100)	8	8 (100)
*Neurologic function test	437	437 (100)	227	227 (100)
USFD Table 7: Disposition				
Discharge date	437	437 (100)	227	227 (100)
Vital status	437	435 (99.5)	227	226 (99.6)
Cause of death	9	9 (100)	4	4 (100)
Neurological outcome (scale)	437	3 (0.70)	227	2 (0.9)
*How did patient die	9	9 (100)	4	4 (100)
*Autopsy	9	5 (55.6)	4	2 (50)
*Channelopathy	437	0 (0.0)	227	0 (0.0)
*6 month follow up	437	0 (0.0)	227	0 (0.0)
USFD Table 8: Quality of Resuscitation Factors				
Ventilation method	61	46 (75.4)	31	29 (93.5)
*Ventilation rate	61	17 (27.8)	31	6 (19.3)
*Compression rate	61	15 (24.6)	31	5 (16.1)
*Compression fraction	61	0 (0.0)	31	0 (0.0)
*Compression depth	61	0 (0.0)	31	0 (0.0)
*Pre-shock pause interval	61	0 (0.0)	31	0 (0.0)

CPR = cardio-pulmonary resuscitation, EMS = emergency medical services, SaO_2 = peripheral arterial oxygen saturation, ROSC = return of spontaneous circulation, GCS = Glasgow Coma Scale, AVPU = alert, voice, pain, unresponsive, ABG = arterial blood gas, APO/ARDS = acute pulmonary oedema/acute respiratory distress syndrome, ICU = Intensive Care Unit, BSL = blood sugar level, ECMO/CPB = extracorporeal membrane oxygenation/cardio-pulmonary bypass, BAL = blood alcohol level.

* Supplementary variable.

$ Time interval calculated from recorded time variables.

for 228 (52.2%) patients, including 186 patients (42.5%) where a lack of documented time points prevented calculation of duration of submersion.

Discussion

The Utstein Style for Drowning is the current recommended framework for data collection when researching the treatment and resuscitation of patients suffering cardiac arrest secondary to drowning.[3] As such, it will likely form the basis for any multicenter registry of drowning cases presenting to either EMS or the ED. Our study demonstrates issues with USFD that impact its suitability for this purpose.

A key issue is the size of the USFD. With 79 variables (49 core and 30 supplementary), the USFD has twice as many variables as the Utstein Trauma Template, which has documented difficulties with the completeness of data in multiple trauma centers located in well-resourced health care systems.[10] The median time of 23–24 minutes for data collection for the USFD, which extended out to 36 minutes for drowning patients who have experienced cardio-respiratory arrest only includes the time taken for data abstraction. It does not include the time required to search for and correctly identify the patient records of drowning patients, a substantial process we have outlined previously.[6] Thus, data collection for the USFD will almost certainly require protected or funded data collection time, especially so in any center where drowning patients present with any frequency and will also create challenges in small busy centers with low frequency of drowning presentations. Future work will require the automation of the process to reduce data entry time.

Increasing submersion duration is associated with worse outcomes.[23] The use of documented times to calculate the duration of drowning in the USFD severely limited the information available. Duration of submersion (time face/airway is seen underwater until time of removal/commencing resuscitation) could only be calculated in approximately 20% of patients, as time of events were infrequently recorded in any clinical notes. However, witness estimates of the duration of submersion were available in over 50% of patients, and this is the variable found to best predict outcomes.[23] There have been previous calls for inclusion of witness estimates of drowning duration in USFD.[24] The difference between calculated duration and witness estimates of duration was of clinical significance. The calculated duration was 14 minutes longer than the witness estimates, a time frame associated with poor outcomes[23] that were not evident in our cohort with only 9 deaths. These differences in time frames may be due to initial efforts being focused on patient rescue and initial assessment, resulting in delays calling EMS. If estimated duration was included in future iterations of the USFD, it may result in a duration of submersion being available for an extra 40% of patients.

Sex was limited to male and female in the USFD. The issue of sex and gender (other than being male) in drowning is only just beginning to be explored.[25] In the 21st Century it is not appropriate for the USFD to limit sex/gender options to only male and female. We argue that you need to collect both biological sex and gender as two separate questions.

The categories recommended in the Race/Ethnicity variable of Table 1 are not routinely recorded at our institution. It does record whether a patient identifies as Aboriginal or Torres Straits Islander and we recommend that indigenous status be added to this variable as First Nations peoples are an at-risk group for death by drowning in many countries.[26–29]

Water temperature was the one core variable never recorded. The study was conducted in a sub-tropical location where icy water does not occur naturally. While there are isolated case reports of drowning survival after profound hypothermia,[30] the impact water temperature has on drowning outcomes is unclear.[23,31]

Over 50% of the 295,000 annual drowning deaths worldwide occur in countries with low resource health care systems[1] where access to the resources required to facilitate survival in these cases, such as extra-corporeal life support (ECLS), is limited. The use of ECLS, while easily abstracted from clinical records, is expensive[32] and uncommon[18] in the treatment of drowning patients. The utility of this variable will thus be limited to individual patients, rather than populations.

Scene details were dichotomized. The level of training of the person delivering care and the interventions used, were well documented. However, details such as the number of lifeguards attending the patient and whether the person who rescued the patient was subsequently involved in patient care were rarely available except when there was a single person performing the rescue and then providing care to the patient. Water conditions for rivers and the ocean were recorded less than half the time, but it is noticeable that lakes were excluded from this variable. While lakes are non-tidal, strong winds can certainly create conditions sufficiently adverse to cause drowning and sink water vessels. We would recommend that lakes be included in this variable.

Surprisingly we found issues with documentation of vital signs. This was especially so with cardiac rhythm and blood pressure documentation in young children. However, clinical documentation, even in patients with cardiac arrest[33] and especially with children[34,35] has long been recognised as an issue. This problem is more significant in low resource settings,[36,37] which also bear the largest burden of drowning globally.[1]

Arterial blood gases were rarely collected in our patients. It was far more common that peripheral venous blood gases were used than arterial ($n = 125$ vs 10). The discussion of whether venous blood gases or arterial blood gases best reflect the physiological state of the drowning victim is beyond the scope of this paper. However, including venous blood gases as an option may increase the clinical information available on any USFD study as in our experience, they are available earlier in the patient's time course as well as more frequently, than arterial blood gases. No patient had mention of investigation for channelopathy in their clinical notes and none of the 223 electrocardiograms recorded had criteria suggesting a channelopathy was present.

The options for recording vital status at hospital discharge on the USFD (survive: yes/no) does not align with the definition and outcomes of drowning published in 2005[38] or the draft definition of non-fatal drowning published recently.[12] Neurologic outcome was documented infrequently, probably reflecting clinical selection bias as the five patients in which it was documented were unable to be classified as "no morbidity".

Other than the mode of ventilation during CPR, documentation of resuscitation factors relied on reported ventilation/compression ratios, e.g. "30:2" and phrases such as "good quality CPR witnessed on arrival of EMS". Other variables, such as compression fraction or depth, were not recorded in the documentation.

The role of alcohol and drug intoxication in drowning is becoming more apparent.[39–41] Alcohol and drug intoxication are both currently included as options in the Table 1 variable 'Precipitating event' and they are both also included as supplementary variables in Table 6.[3] We found the wording of the variable 'Prior substance abuse' to be confusing and recommend it be clarified if it pertains directly to the drowning incident or any past history of substance abuse. Given their limited diagnostic and prognostic indications for individual patients, blood alcohol levels are rarely recorded in ED practice[42] and we recommend this variable be reviewed.

The USFD was designed to include core variables readily available in the health care systems of high income countries.[3] However, to collect all core variables there is a requirement to extrapolate data from multiple sources, such as lifeguard services, EMS documentation, ED and inpatient unit documentation, as well as radiology and pathology reporting systems. As we have demonstrated, this is a time-consuming activity, with limited information available pertaining to many variables. This was despite both data abstractors having protected time to conduct the study.

The data availability results must be interpreted with some caution. The USFD was designed to enhance research into drowning patients suffering cardiac arrest. Use of the USFD for all drowning patients will inevitably skew the data availability as less severely injured patients will clinically require less investigation and fewer therapeutic interventions. As illustrated in Table 2, there are many more drowning patients with Grade 1–3 injuries than Grade 5–6 injuries. We believe however, that our results reflect real issues with data availability. It is a standard of care in our EDs that all patients have a full set of vital signs recorded at the initial consultation. It is the same with our EMS service. Despite this, many patients did not have a full set of vital signs recorded.

A previous review of studies reporting the USFD also found inconsistencies with the USFD variables reported, with some variables not being used.[16] Tools such as the USFD must undergo constant review and revision, if necessary, to optimize their efficacy including clear definitions, justification of core variables and a wide array of variables for non-core variables. We hope the findings reported in this study aid that process.

Strengths and limitations

This study used multiple search strategies to enrol all drowning patients presenting to our EDs.[6] We believe this is the first study of its kind to document the full timeline of consecutive drowning patients from incident to hospital discharge, utilizing multiple sources of data. With an average of over one drowning patient presenting each week to our EDs during the study period, we are in a unique position to conduct this study.

The data abstractors used both protected research time funded through competitive research grants and department supported non-clinical time to conduct this study. Given the timeframes reported in this study, the ability to complete data abstraction without funded or protected research time is questionable. This study was conducted in two EDs within the same health service. Our practices, and thus the outcomes of this study, may not be reflected in other centres. However, we believe that the issues highlighted in this paper have validity in well-resourced health systems.

Conclusion

A further revision of the USFD may be indicated by our findings. Many parameters listed in the USFD are not routinely collected in a high resource health care setting. The time required to complete data collection for USFD is a significant burden. We recommend some USFD parameters be considered for redefinition and others be considered for future inclusion. We suggest a concerted effort to aid uptake of USFD in low and middle-income countries, where the global drowning burden is greatest. This could include representation during the next consultative process, as well as a review of the variables included in USFD to better reflect the data likely to be available in varying settings. Improving the ease of use and decreasing resource requirements for completion will hopefully facilitate more widespread uptake of the USFD.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This research is supported by Royal Life Saving Society – Australia to aid in the prevention of drowning. Research at Royal Life Saving Society – Australia is supported by the Australian Government.

Author contributions

Study concept and design (OT, KR, SD, PL, RF), design of data dictionary and case report form (KR, OT) acquisition of the data (KR, OT), analysis and interpretation of the data (OT, KR, RF), drafting of the manuscript (OT, KR), critical revision of the manuscript (SD, PL, RF,), acquisition of funding (OT, KR, SD, PL, RF)

Funding

The authors have received grants from the Emergency Medicine Foundation (EMLE-162R34-2020-THOM) and Wishlist Foundation (2020-05), Emergency Department treatment of the drowning victim) to conduct this study. The funding bodies had no role in the design conduct or reporting of this study.

Author details

[a]Department of Emergency Medicine, Sunshine Coast Hospital and Health Service, Birtinya, QLD, Australia [b]College of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville, Australia[c]School of Medicine, College of Medicine, Nursing and Health Sciences, University of Galway, Galway, Ireland [d]Royal Life Saving Society – Australia, Sydney, NSW, Australia

REFERENCES

1. Franklin RC, Peden AE, Hamilton EB, et al. The burden of drowning: global, regional and national estimates of mortality from the Global Burden of Disease 2017 Study. Injury Prevent 2017;2020:1–13.
2. Idris AH, Berg RA, Bierens J, et al. Recommended guidelines for uniform reporting of data from drowning: the "Utstein style". Resuscitation 2003;59:45–57.
3. Idris AH, Bierens J, Perkins GD, et al. 2015 revised Utstein-style recommended guidelines for uniform reporting of data from drowning-related resuscitation An ILCOR advisory statement. Resuscitation 2017;118:147–58.
4. Thom O, Roberts K, Devine S, Leggat PA, Franklin RC. Treatment of the lung injury of drowning: a systematic review. Crit Care 2021;25:253.
5. Champigneulle B, Bellenfant-Zegdi F, Follin A, et al. Extracorporeal life support (ECLS) for refractory cardiac arrest after drowning: an 11-year experience. Resuscitation 2015;88:126–31.
6. Thom O, Roberts K, Leggat PA, Devine S, Peden AE, Franklin RC. Addressing gaps in our understanding of the drowning patient: a protocol for the retrospective development of an Utstein style database and multicentre collaboration. BMJ Open 2023;13 e068380.
7. Eisenberg M. 10 steps for improving survival from cardiac arrest. Seattle, Washington: Resuscitation Academy; 2020.
8. Walpoth BH, Maeder MB, Courvoisier DS, et al. Hypothermic Cardiac Arrest – Retrospective cohort study from the International Hypothermia Registry. Resuscitation 2021;167:58–65.
9. Datta I, Findlay C, Kortbeek JB, Hameed SM. Evaluation of a regional trauma registry. Can J Surg 2007;50:210–3.

10. Ringdal KG, Lossius HM, Jones JM, et al. Collecting core data in severely injured patients using a consensus trauma template: an international multicentre study. Crit Care 2011;15:R237.
11. Ringdal KG, Coats TJ, Lefering R, et al. The Utstein template for uniform reporting of data following major trauma: a joint revision by SCANTEM, TARN, DGU-TR and RITG. Scand J Trauma Resusc Emerg Med 2008;16:7.
12. Beerman S, Bierens JJLM, Clemens T, Meddings D, Rahman A, Szpilman D. Clarification and categorization of non-fatal drowning. A draft position statement for review and input by the global drowning community. World Health Organization; 2022.
13. Papa L, Hoelle R, Idris A. Systematic review of definitions for drowning incidents. Resuscitation 2005;65:255–64.
14. Peden AE, Franklin RC, Clemens T. Exploring the burden of fatal drowning and data characteristics in three high income countries: Australia, Canada and New Zealand. BMC Public Health 2019;19:794.
15. Otto Q, Nolan JP, Chamberlain DA, Cummins RO, Soar J. Utstein Style for emergency care – the first 30 years. Resuscitation 2021;163:16–25.
16. Venema AM, Absalom AR, Idris AH, Bierens J. Review of 14 drowning publications based on the Utstein style for drowning. Scand J Trauma Resusc Emerg Med 2018:26.
17. Moran JL, Solomon PJ, Outcome ACf, Resource Evaluation of the A, New Zealand Intensive Care S. Statistical process control of mortality series in the Australian and New Zealand Intensive Care Society (ANZICS) adult patient database: implications of the data generating process. BMC Med Res Method 2013;13:66.
18. Burke CR, Chan T, Brogan TV, et al. Extracorporeal life support for victims of drowning. Resuscitation 2016;104:19–23.
19. Data by region [Internet]. Australian Bureau Of Statistics. 2022 [cited 08/03/2022]. Available from: https://dbr.abs.gov.au/region.html?lyr=sa4&rgn=316.
20. Tourism Visitor Summary [Internet]. 2020 [cited 01 october 2021]. Available from: https://economy.id.com.au/sunshine-coast/tourism-visitor-summary.
21. von Elm E, Altman DG, Egger M, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ 2007;335:806–8.
22. Szpilman D. Near-drowning and drowning classification: a proposal to stratify mortality based on the analysis of 1,831 cases. Chest 1997;112:660–5.
23. Quan L, Bierens J, Lis R, Rowhani-Rahbar A, Morley P, Perkins GD. Predicting outcome of drowning at the scene: a systematic review and meta-analyses. Resuscitation 2016;104:63–75.
24. Vahatalo R, Lunetta P, Olkkola KT, Suominen PK. Drowning in children: Utstein style reporting and outcome. Acta Anaesthesiol Scand 2014;58:604–10.
25. Roberts K, Thom O, Devine S, Leggat PA, Peden AE, Franklin RC. A scoping review of female drowning: an underexplored issue in five high-income countries. BMC Public Health 2021;21:1072.
26. Clemens T, Moreland B, Lee R. Persistent racial/ethnic disparities in fatal unintentional drowning rates among persons aged </=29 years – United States, 1999–2019. MMWR Morb Mortal Wkly Rep 2021;70:869–74.
27. Gilchrist J, Parker EM, Centers for Disease C, Prevention. Racial/ethnic disparities in fatal unintentional drowning among persons aged </= 29 years - United States, 1999–2010. MMWR Morb Mortal Wkly Rep 2014;63:421–6.
28. Wallis BA, Watt K, Franklin RC, Kimble RM. Drowning in Aboriginal and Torres Strait Islander children and adolescents in Queensland (Australia). BMC Public Health 2015;15:795.
29. Peden AE, Franklin RC, Clemens T. Can child drowning be eradicated? A compelling case for continued investment in prevention. Acta Paediatr 2021;110:2126–33.
30. Romlin BS, Winberg H, Janson M, et al. Excellent outcome with extracorporeal membrane oxygenation after accidental profound hypothermia (13.8 °C) and drowning. Crit Care Med 2015;43:e521–5.
31. Tipton MJ, Golden FS. A proposed decision-making guide for the search, rescue and resuscitation of submersion (head under) victims based on expert opinion. Resuscitation 2011;82:819–24.
32. Peek GJ, Mugford M, Tiruvoipati R, et al. Efficacy and economic assessment of conventional ventilatory support versus extracorporeal membrane oxygenation for severe adult respiratory failure (CESAR): a multicentre randomised controlled trial. Lancet 2009;374:1351–63.
33. Stevenson JE, Israelsson J, Nilsson GC, Petersson GI, Bath PA. Recording signs of deterioration in acute patients: The documentation of vital signs within electronic health records in patients who suffered in-hospital cardiac arrest. Health Inf J 2016;22:21–33.
34. Gravel J, Opatrny L, Gouin S. High rate of missing vital signs data at triage in a paediatric emergency department. Paediatr Child Health 2006;11:211–5.
35. Shinohara M, Muguruma T, Toida C, Gakumazawa M, Abe T, Takeuchi I. The association between age and vital signs documentation of trauma patients in prehospital settings: analysis of a nationwide database in Japan. BMC Emerg Med 2022;22:165.
36. Mehmood A, He S, Zafar W, Baig N, Sumalani F, Razzak J. How vital are the vital signs? A multi-center observational study from emergency departments of Pakistan. BMC Emerg Med 2015;15 (Suppl 2):S10.
37. Mohammed Z, Arafa A, Senosy S, et al. Completeness of medical records of trauma patients admitted to the emergency unit of a University Hospital, Upper Egypt. Int J Environ Res Public Health 2020;18.
38. Van Beeck EF, Branche CM, Szpilman D, Modell JH, Bierens JJLM. A new definition of drowning: Towards documentation and prevention of a global public health problem. Bull World Health Org 2005;83:853–6.
39. Hamilton K, Keech JJ, Peden AE, Hagger MS. Alcohol use, aquatic injury, and unintentional drowning: a systematic literature review. Drug Alcohol Rev 2018;37:752–73.
40. Pearn JH, Peden AE, Franklin RC. The influence of alcohol and drugs on drowning among victims of senior years. Safety 2019;5:8.
41. Peden AE, Franklin RC, Leggat PA. Alcohol and its contributory role in fatal drowning in Australian rivers, 2002–2012. Accid Anal Prev 2017;98:259–65.
42. Strayer RJ, Friedman BW, Haroz R, et al. Emergency Department Management of patients with alcohol intoxication, alcohol withdrawal, and alcohol use disorder: a white paper prepared for the American Academy of Emergency Medicine. J Emerg Med 2023.