Enhancing the detection of injuries and near-misses among patient care staff in a large pediatric hospital

Maurizio Macaluso, MD[1], **Lauren A Summerville, MS**[2], **Meredith E Tabangin, MPH**[1], **Nancy M Daraiseh, PhD**[1,2,3]

[1]Biostatistics and Epidemiology; Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA.

[2]James M. Anderson Center for Health Systems Excellence; Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

[3]Research in Patient Services; Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA.

Abstract

Objective—Compared to other industries, healthcare has one of the highest rates of non-fatal occupational injury/illness. Evidence indicates these rates are underestimated, highlighting the need for improved injury surveillance. This study aims to demonstrate the feasibility of integrating active data collection in a passive injury surveillance system to improve detection of injuries in a healthcare establishment.

Methods—Using digital voice recorders (DVR), pediatric healthcare providers prospectively recorded events throughout their shift for two weeks. This sample-based active injury surveillance was then integrated into an institutional surveillance system (ISS) centered on passive data collection initiated by employee reports.

Results—Injuries reported using DVR during two-week intervals from February 2014 to July 2015 were 40.7 times more frequent than what would be expected on the basis of the usual ISS reports. Psychological injuries (eg, stress, conflict) and near-misses were captured at a rate of 16.1 per 1000 days [95% confidence interval (CI) 14.1–18.3] and 35.6 per 1000 days (95% CI 32.7–38.8), respectively. Finally, 68% (95% CI 65–72%) of participants preferred using DVR either as an alternative or complement to the existing ISS.

Conclusions—This study showed that it is feasible to improve injury surveillance in a healthcare establishment by integrating active data collection based on voice recording within a passive injury surveillance system. Enhanced surveillance provides richer information that can guide the development of effective injury prevention strategies.

Keywords

active surveillance; injury detection; occupational injury; pediatrics; surveillance

Correspondence to: Nancy M Daraiseh, Research in Patient Services; Cincinnati Children's Hospital Medical Center, 3333 Burnet Ave. Cincinnati, OH 45229, USA. MLC 7014; [nancy.daraiseh@cchmc.org].

The United States Bureau of Labor Statistics (BLS) reports that healthcare has one of the highest rates of non-fatal occupational injury/illness in industry, with US$15 860 in average loss per claim settled (1). The Occupational Safety and Health Administration (OSHA) mandates that employers conduct surveillance of work-related injuries/illnesses (2), but evidence indicates that BLS injury rates underestimate the true risk by up to 70%, necessitating improved surveillance (3–5).

Injury under-reporting is widespread in healthcare (4, 6–11). One study observed that 40% of nurses would not report an injury (12). Others observed a reporting rate as low as 17% of the true value, identifying time constraints, reluctance to report, peer pressure, the "normalcy" of being injured, and reprimands as reasons for under-reporting (6–12). Attempts to enhance reporting through wellness initiatives, education, and incentives have made only minor improvements. Proactive improvements to injury reporting are needed to inform prevention strategies in healthcare.

Whereas common injury reporting systems rely on passive employee reporting (13–16), active surveillance seeks cases through direct contact with individuals (14, 17) or through a proactive search of medical records or databases (14, 18), leading to better detection of injuries (14). Despite its effectiveness, active surveillance is not commonly adopted by employers, probably because of higher resource requirements (17).

We assessed the feasibility of integrating active injury surveillance into a passive institutional surveillance system (ISS) by comparing the frequency of injuries detected via active surveillance with the frequency reported to the ISS.

Methods

Sample

Participants comprised registered nurses (RN), patient care assistants (PCA) in medical/surgical (med/surg) and psychiatry (psych) units, and mental health specialists (MHS, assigned only to psych units) with 0.6 full-time employment at a pediatric hospital. Med/surg units included gastroenterology/colorectal surgery, solid organ transplant, and cardiac step-down. Psych units included inpatient child, adolescent, neurological, and residential treatment.

The hospital's ISS records events reported by staff to a dedicated phone number. Call handlers ask key questions, and each call lasts 10–45 minutes. We did not alter these operations, but added active voice recording by randomly sampling employees.

Procedure

The Institutional Review Board approved the study protocol. We collected data on sociodemographic and employment characteristics. Participants learned how to operate handheld digital voice recorders (DVR) to record near-misses or injuries sustained at work during a two-week period. Hospital policy defines an injury as "an event that inflicts physical damage as a result of an employee performing work-related duties, including any exposure to a blood-borne pathogen". We defined a near-miss as "an incident that did not

reach a staff member" (eg, trip but no fall) or "an incident that reached staff but did not cause harm" (eg, a bite by an aggressive patient that did not cause harm due to use of Kevlar gloves) (19). Participants received a laminated card with examples of injuries and near-misses. Full-time employees recorded events for six shifts and part-time staff recorded events for eight shifts. We aimed to collect recordings for 1000 two-week periods to ensure adequate precision [This sample size yields a 95% confidence interval (CI) of 0.48%–1.8% for a rate of 1%]. To assess the acceptability of active surveillance, after each interval we asked participants whether they preferred voice recording, the ISS, or a combined system. Participants were reimbursed $50. Focus groups or interviews with 40 randomly selected participants sought feedback on effectiveness and ease-of-use of voice recording, and preferences. These participants were reimbursed $10.

Data management

Research staff transcribed voice recordings, uploaded the transcripts into a database using NVIVO 10 (QSR International, Melbourne, Australia), and coded events as injuries or near-misses. To ensure that injury coding was comparable to that of the ISS, two members of the ISS team observed three coding sessions and advised on coding practices. At the end of the project, we selected 20 recordings representative of the range of reports and requested independent coding by the ISS team, obtaining 100% agreement.

Analysis

We followed grounded theory to develop codes from recording transcripts. Three independent coders reached consensus regarding discrepancies so that each code had a clear definition. We summarized counts of injuries and near-misses coded from the transcripts for each day in a two-week recording interval to compute incidence rates as events per 1000 days and computed 95% CI assuming that the numerator of the rate followed the Poisson distribution. We report rates of physical and psychological injuries and near-misses according to sociodemographic and employment characteristics of the participants. We tested the association between each characteristic and physical or psychological injury rates by fitting Poisson regression models with random subject effects to account for correlation among reports of employees sampled repeatedly.

To assess the validity of active surveillance, we compared the number of events reported during the active data collection intervals with the number of events expected from the ISS. For this comparison, we used ISS data for the 18-month observation period as the referent. We computed job group- and unit type-specific injury rates (per two-week period) using the ISS data, and multiplied the rate by the number of active two-week intervals in the corresponding stratum of participants. Observed-to-expected ratios measured the impact of active recording on injury detection. To test whether voice recording captured events reported to the ISS, we compared the injury reports collected by voice recording with the injuries that the same employees reported to the ISS.

We analyzed responses to the question about recording preference and compared the number of employees who prefer voice recording (including those who preferred combined digital

and ISS reporting) with the number who prefer ISS reporting only, and tested the null hypothesis that the proportion preferring the ISS only was 50%.

We assessed the feasibility of active surveillance using three a priori criteria: (i) over 50% of the participants prefer voice recording as determined from the survey question, (ii) voice recording identifies a substantial number of near-miss events (>5 per 100 employees/year), and (iii) the number of injury reports from voice recordings is significantly larger than the number expected from the ISS.

Results

Sampling of participants and recording periods occurred from 11 February 11 to 31 July 2015. The majority of participants (86%) were women, white (81%), <30 years old (55%), with a college degree or higher education (80%), unmarried (61%), and without dependents (59%) (table 1). Most were RN (72%) in med/surg units (74%) with a median of two years in the current job (mode=1, range 0–32, mean= 3.8, SD=4.5). Eighteen eligible employees refused to participate: one PCA from med/surg; one MHS from psych; and 10 RN, six med/surg and four psych. Six non-participants did not provide demographic information.

Participants reported 1043 injuries in 14 762 recording days, for an average rate of 70.7 injuries/1000 days (95% CI 66.4–75.1) (table 2). Physical injuries were most common (784 events, rate: 53.1, 95% CI 49.5–57.0). Common physical injuries were musculoskeletal (eg, low-back and shoulder pain); due to patient aggression (eg, patient pinched, punched, kicked or bit staff); or falls to the floor. Although psychological injuries are rarely reported through the ISS, active surveillance detected 238 events for an average rate of 16.1 injuries/1000 days (95% CI 14.1–18.3). Finally, 526 near-misses were recorded (rate: 35.6, 95% CI 32.7–38.8), most referring to potential physical harm (table 2). Common near-misses included: patient trying to hit staff without contact and staff tripping but not falling. We limit the further presentation of results to injuries.

Physical injury rates varied by baseline characteristics (table 3): staff between 30–34 years of age (95.4, 95% CI 84.2–107.8) and women (57.4, 95% CI 53.3–61.8) had relatively high rates, whereas African-American employees experienced lower rates (23.0, 95% CI 16.8–30.7) compared to other groups. The incidence of physical injuries increased with level of education and was highest among employees with post-graduate education (107.3, 95% CI 90.0–127.0). Rates were high among employees who never married (69.1, 95% CI 63.3–75.3) or had no dependents (70.4, 95% CI 64.9–76.2). Physical injury rates were similar in psych units and med/surg units, and PCA experienced lower rates than the other job groups (23.9, 95% CI 17.8–31.3). Physical injury rates were significantly associated with all characteristics except unit of employment.

Psychological injury rates were higher among women than men, increased with age, from 7.5 (95% CI 4.9–11.0) in the youngest group to 33.5 (95% CI 25.2–43.7) in the oldest. The incidence of psychological injuries was not associated with race/ethnicity, education, marital status or with having dependents, but rates were considerably higher in psych units (29.5, 95% CI 24.6–35.2) than in med/surg units. PCAs experienced considerably lower rates of

psychological injuries than the other job groups (7.8, 95% CI 4.5–12.5). Psychological injury rates were significantly associated with age, education, job group and unit of employment.

The comparison of counts of injuries reported by voice recording with counts expected from the ISS excluded psychological injuries because these are not routinely reported to the ISS. The number of injuries reported using DVR was 40.7 times higher than that expected on the basis of the ISS (table 4). Statistically significant observed-to-expected injury ratios ranged from about 6 for RN in psych units (6.4, 95% CI 5.1–8.1) to >100 (108.4, 95% CI 99.4–118.1) for RNs in med/surg units. All were significantly larger than the null value of 1.

We identified 45 incidents that were reported to the ISS and detected 41 matching reports (91%). Thus, active reporting captured nearly all incidents reported to the ISS. The 4 events missed by the recordings were; a near-miss (needle-stick); a blood-borne pathogen exposure; a pregnant employee exposed to the parvovirus B19; and a pulled hamstring.

We surveyed participants at the end of the first recording period (N=557) on their reporting preference. A total of 161 (29%) stated that they preferred voice recording; 174 (31%) preferred the ISS; and 219 (39%) thought that both systems were necessary to capture injuries and near-misses. Thus, 68% (95% CI 65–72%) preferred using the DVR as an alternative or a complement to the ISS, a significantly larger proportion than the null value of 50% (P<0.0001). A total of 199 employees participated in more than one recording period. The proportion of those who preferred digital recording alone or integrated with the ISS increased from 71.7% at the first survey to 78.3% at the second.

The focus group or interview comprised 5 men and 35 women, 20 participants from psych and 20 from med/surg units; 16 individuals participated in six groups, but difficulties in removing staff from units resulted in 24 one-on-one interviews. Participants reported that they were able to use DVR to capture some or all injuries (56%), near-misses (49%), and psychological injuries (30%) with 40% preferring voice recording to the ISS. The underestimation of psychological harm is understandable as healthcare providers are not accustomed to reporting these types of outcomes. Ninety percent stated that using DVR did not impede their work and were not bulky or hard to use (83%, N=29). When asked about barriers to voice recording, respondents cited the difficulty of finding the right time or place to record during their shift or forgetting to record. Some participants mentioned the convenience of recording at the end of the shift, while others found it feasible during work hours. Finally, when asked if they preferred to call a live person, respondents mentioned that the ISS would be less likely to capture minor incidents ("I think that if your requirement would be a call you would probably pick up less of the very small things…") but would be necessary to discuss serious injuries ("…if it was a huge event clearly I would want to speak to another human being… I felt like I wanted some advice of what I needed to do about that injury") (table 5).

Discussion

In 2010, the healthcare and social assistance industry reported more injuries and illnesses than any other private industry sector (20). Healthcare providers, however, frequently under-report work environment hazards and injuries, so improving injury surveillance should be a high priority in this sector. We assessed the feasibility of integrating sample-based active injury surveillance into our passive ISS and showed that pediatric healthcare providers experience a high frequency of injuries that they do not report to the ISS. Pompeii et al (21) observed that workers report workplace violence informally to co-workers, managers, and in patient medical records, but not in not in OSHA-mandated reporting systems.

The average employee in our population experiences 26 injuries/year, 19 physical and 6 psychological, and 13 near-misses/year. The number of physical injuries reported through active voice recording is over 40 times higher than the number expected in the same timeframe according to the ISS.

We found significant associations between the incidence of injuries and several demographic and employment variables. Interestingly, injury risk increased with increasing educational level. It is possible that more educated employees are assigned to riskier tasks (eg, care of complex patients). It is also possible that the more educated participants reported injuries more accurately. Other studies show inconsistent associations between injury rates and education (22): thus, this issue warrants further research.

Although it is known that active surveillance is more accurate than passive surveillance (13, 15, 16), the vast difference we observed is surprising. We aligned our coding methods to the ISS and observed high concordance in evaluations of the recording transcripts: thus, misclassification of non-injury events as injuries is unlikely. Busy employees may under-report to avoid discussing details in lengthy phone calls, as noted in our focus groups/interviews. Such a large number of unreported incidents may reduce productivity, increase use of sick-leave, and cause adverse health effects and turnover among the employees, as one participant stated: "Speaking from personal experience I can say that I, uh, I had to go out and seek therapeutic intervention in the community due to a long series of near misses… I would say that was a large factor in why I'm now in out-patient med/surg versus still in psychiatry."

We established the feasibility of integrating the ISS with sample-based active surveillance using three criteria. First, voice recording is acceptable to employees. More than 50% of the participants (68%, P<0.0001) prefer using the DVR as an alternative or a complement to the ISS. Second, voice recording detects a sufficient number of near-misses – 36/1000 days or 1314/100 employees/year. Third, the system detects over 40 times more injuries than the ISS. These findings indicate that integrating our ISS with sample-based active surveillance would improve injury surveillance at our institution. Our focus groups/interviews showed staff support for using DVR to record injuries and near-misses. Feasibility of active surveillance is historically supported by experience with adverse drug reactions (23–25), which resulted in an increase in reported cases (27). Dement et al (27) integrated active and passive methods to improve a surveillance system.

Prior to this work, few studies assessed the risk of injury in pediatric healthcare (28–34). Contrary to the belief that the pediatric work environment is safer than the adult counterpart (32, 34), pediatric providers have comparable injury rates, with physical injuries comprising 75% of all reports. Musculoskeletal disorder rates in adult care vary from 43–63% (35–37) and may be as high as 89% (38). Psychological injuries were also common in the few studies that addressed the topic (38, 39).

Measuring the incidence of near-misses has theoretical advantages: increased potential to identify causal pathways leading to injury; increased acceptability of reporting an event without actual injury to patient or worker; and reduced concern that the employee may be at fault. Reporting near-misses has long been integrated in high-risk industries such as aviation and nuclear power (40–42) because each occurrence can identify failures in systems, equipment, and processes that may lead to injury (12, 40, 42–44). Our findings indicate that voice recording is an effective surveillance method that can produce rich information on near-misses.

Stressful workplace conditions cause psychological injury, which in turn may increase the risk of physical harm, reduce attendance and productivity, and may cause medical errors, threatening the safety of patients. We included stress, anxiety, fear, intimidation, bullying, and conflict as psychological injuries to be reported. The incidence of 16.1 events/1000 days indicates that these outcomes are common and employees are willing to report them. Neither near-misses nor psychological injuries are routinely captured by surveillance systems in healthcare.

This study had some limitations. First, no gold standard was available to assess the validity of the active surveillance. We do not know the true incidence of injuries and near-misses in the population studied and cannot measure the accuracy of our methods. The large number of events detected by voice recording, however, indicates that active surveillance is superior to the ISS. Second, our data do not allow for assessing injury severity, and we could not identify OSHA-recordable events. Comparison of OSHA-recordable events detected by active surveillance with those detected by the ISS would provide stronger evidence. We did confirm that most of the injuries reported to the ISS had matching reports in the voice recordings. Third, although we used rigorous feasibility criteria, we did not evaluate the cost/sustainability of active surveillance. Cost estimation should include the impact of improved injury detection on the institutional ability to strengthen employee safety programs. We provided an overview of the results but did not evaluate associations with specific risk factors to make causal inference. We note that implementation of this sample-based active surveillance system shows statistically significant variation of risk according to participant characteristics, indicating that in-depth analyses of the data will be informative and facilitate the development of strategies to reduce risk.

The limitations mentioned above are offset by important strengths. To our knowledge, no previous studies have evaluated an active data collection process simultaneously with passive detection of injury cases, allowing for a direct comparison. Second, we were able to compute incidence rates, and future reports will assess the impact of specific risk factors on the incidence of injuries and near misses. In addition, we were able to assess the frequency

of psychological injuries and near-misses, both of which escape detection through current systems. Finally, we found that employees are willing to use DVR to detect outcomes and potential risk factors.

Concluding remarks

It is feasible to integrate a passive ISS with active data collection using voice recording. The latter provides rich information that can assist the development of more effective injury prevention strategies. Sample-based active surveillance may make be more acceptable to staff and more affordable for the institution. Reporting near-misses and psychological injuries further enriches the system.

Acknowledgments

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Table 1.

Sociodemographic and employment characteristics of the study. Group at baseline (N=607)

	N	%
Gender		
Male	75	12
Female	522	86
Missing	10	2
Age (years)		
<25	144	24
25–29	189	31
30–34	106	17
35–44	90	15
45	61	10
Race/ethnicity		
Non-Hispanic white	493	81
Non-Hispanic black	76	13
Other groups	23	4
Education		
High school	5	1
Associate/vocational	43	7
Some college	74	12
College degree	423	70
Post-graduate	61	10
Marital status		
Never married	316	52
Married	240	39
Divorced/separated	37	6
Widow	2	<1
Dependents		
No	357	59
Yes	236	39
Current position		
Registered nurse	437	72
Mental health specialist	81	13
Patient care attendant	89	15
Shift type		
8-hour	187	31
12-hour	242	40
Both 8-and 12-hour	177	29
Other schedules	1	<1
Unit of employment		
Medical-surgical	447	74

	N	%
Psychiatry	160	26
Years in current position[a]	601	

[a] Median =2 (mode=1, range 0–32). Frequencies may not add to 607 (missing values not reported).

Table 2.

Incident injury and near-misses. N=14 762 recording days, N=927 two-week recording intervals.

Event type	Injuries reported	Rate per 1000 days	95% CI
All injuries combined	1043	70.7	66.4–75.1
Physical	784	53.1	49.5–57.0
Psychological	238	16.1	14.1–18.3
Bodily fluid exposure	21	1.4	0.9–2.2
All near-misses combined	526	35.6	32.7–38.8
Physical	480	32.5	29.7–35.6
Bodily fluid exposure	38	2.6	1.8–3.5
Other	8	0.5	0.2–1.0

[CI=confidence interval]

Table 3.

Physical and psychological incident injuries (rate per 1000 days). N=14 762 recording days, N=927 two-week recording intervals.

Characteristic	Physical injuries[a]			Psychological injuries		
	Events reported	Rate (95% CI)	P-value[b]	Events reported	Rate (95% CI)	P-value[b]
Gender						
Male	94	44.4 (36.2–54.3)	0.02	27	12.7 (8.7–18.6)	0.15
Female	710	57.4 (53.3–61.8)		209	16.9 (14.8–19.4)	
Age (years)						
<25	151	43.7 (37.3–51.3)	<0.0001	26	7.5 (5.1–11.1)	<0.0001
25–29	237	54.0 (47.5–61.3)		57	13.0 (10.0–16.8)	
30–34	259	95.4 (84.5–107.8)		42	15.5 (11.4–20.9)	
35–44	90	41.5 (33.8–51.1)		57	26.3 (20.3–34.1)	
45	57	35.4 (27.3–45.9)		54	33.5 (25.7–43.8)	
Race/ethnicity						
Non-Hispanic white	722	60.9 (56.5–65.5)	<0.0001	185	15.6 (13.5–18.0)	0.15
Non-Hispanic black	46	23.0 (17.2–30.7)		36	18.0 (13.0–25.0)	
Other groups	34	60.6 (43.3–84.8)		15	26.7 (16.1–44.4)	
Education						
High school	3	29.1 (9.4–90.3)	<0.0001	0	0	0.04
Associate/vocational	38	36.4 (26.5–50.0)		16	15.3 (9.4–25.0)	
Some college	76	41.5 (33.1–51.9)		40	21.8 (16.0–29.8)	
College degree	551	53.6 (49.3–58.3)		152	14.8 (12.6–17.3)	
Post-graduate	136	107.3 (90.7–127.0)		30	23.7 (16.6–33.9)	
Marital status						
Never married	520	69.1 (63.4–75.3)	<0.0001	119	15.8 (13.2–18.9)	0.76
Married	257	43.7 (38.6–49.4)		100	17.0 (14.0–20.7)	
Divorced/separated	27	25.7 (17.6–37.5)		16	15.2 (9.3–24.9)	
Widow	0			1	47.6 (6.7–338.0)	
Dependents						
Yes	192	33.6 (29.2–38.7)	<0.0001	101	17.7 (14.6–21.5)	0.32
No	612	70.4 (65.0–76.2)		135	15.5 (13.1–18.4)	

Characteristic	Physical injuries[a]			Psychological injuries		
	Events reported	Rate (95% CI)	P-value[b]	Events reported	Rate (95% CI)	P-value[b]
Current position						
Registered nurse	608	60.1 (55.5–65.1)	<0.0001	178	17.6 (15.2–20.4)	0.0009
Mental health specialist	144	64.2 (54.6–75.6)		43	19.2 (14.2–25.9)	
Patient care attendant	52	23.9 (18.2–31.3)		17	7.8 (4.8–12.5)	
Unit of employment						
Medical-surgical	579	55.8 (51.5–60.6)	0.68	115	11.1 (9.2–13.3)	<0.0001
Psychiatry	225	54.0 (47.4–61.6)		123	29.5 (24.8–35.2)	

[a]Includes exposure to bodily fluids.

[b]Test of the null hypothesis of no association between the characteristic and the injury rates.

[CI=confidence interval]

Table 4.

Incident injuries reported by voice recording (observed). Numbers expected on the basis of ISS rates. N=14 762 recording days and N=927 two-week recording intervals.

Job group [a]	Work area	Observed	Expected	O/E	95% CI	P-value
All	All	805	19.8	40.7	37.9–43.6	<0.0001
All	Med/Surg	579	5.4	106.5	92.0–115.5	<0.0001
All	Psych	225	30.5	7.4	6.4–8.4	<0.0001
MHS	Psych	144	18.9	7.6	6.4–9.0	<0.0001
PCA	All	52	0.94	55.1	41.1–72.3	<0.0001
PCA	Med/Surg	48	0.68	70.0	51.6–92.9	<0.0001
PCA	Psych	4	0.48	8.3	2.2–21.2	0.002
RN	All	608	9.6	63.1	58.2–68.3	<0.0001
RN	Med/Surg	531	4.9	108.4	99.4–118.1	<0.0001
RN	Psych	77	11.9	6.4	5.1–8.1	<0.0001

[O/E= observed/expected ratio, test of the null hypothesis that O/E=1; CI=confidence interval; MHS=mental health specialist: PCA=patient care attendant; RN=registered nurse.]

Table 5.

Key questions addressed in focus groups and qualitative interviews, with representative answers.

Q: Were there barriers to reporting?

"The barriers would probably be just finding somewhere quiet or somewhere where you don't have all of the commotion going on in the background. So I used to go in the bathroom most of the times. Just wait till everybody clears out the staff office, but then literally you would have to wait for that to happen."

"Um, not for me personally, but I know like our floor is very high acuity so it's very busy. So I don't know, there could have been times when nurses didn't have time to record right away just from the, you know, the nature of the work."

"Um, no, no barriers beyond, you know, my own forgetfulness."

Q: Did you develop a pattern of recording?

"I did it more at the end of the day, just time frame and everything like that."

"No, not easy to record when they happened. But I don't feel like I, I don't think I actually forgot to do it at the end of the day or at the beginning, but not when it happened ……Um, looking back at the day and recording."

"I would tend to record in between, like if I had some down time, especially when I was charting I would try to record and then kind of like recap at the end of the day."

Q: Do you prefer speaking to an actual person when recording a near-miss or injury?

"I think that if your requirement would be a call you would probably pick up less of the very small things where I'm like I don't know if this is worth an entire phone call. Whereas I might record it on the recorder if it's just in my pocket and it's going to take ten seconds to do it."

"Um, yeah. And I think that there's certain instances in which like if it was a huge event clearly I would want to speak to another human being.

"It would depend on the injury and I felt like I wanted some advice of what I needed to do about that injury. If it was just a simple injury that I was recording because I was worried I would wake up tomorrow and something hurt, recording into, a non-person would be fine. But if I actually knew that I got injured I would want to talk to a real person."