Drowning Detection System Research Project:
Overall Summary and Next Steps

In 2019, ukactive were funded by Sport England to undertake a research project into the effectiveness of Drowning Detection Systems and their use alongside lifeguards. The project first aimed to build an evidence base on the use of DDS from the available literature on the topic. A key element was independent testing of various DDS to see how they perform against the ISO_20380 standard and a more stringent standard developed as part of the project. Throughout the project, an expert stakeholder group was consulted to advise on technical areas and to share knowledge and experience. This consisted of operators, DDS manufacturers, Sport England, Swim England, RLSS and ROSPA. This document details the key findings from the different project strands, and summarises the next steps that follow on from the project conclusions.

For this project, we took Drowning Detection Systems (DDS) to mean electronic systems that can assist with pool and swimmer surveillance, through the detection of potential drowning scenarios. This is achieved through underwater or overhead cameras being used at a pool, linked to software which can recognise when a person is potentially drowning. This then leads to an audible and/ or visual alert or alarm being activated to notify a lifeguard where the incident is happening so they can take appropriate action. Currently, DDS must reach an international standard ISO_20380. This specifies that a detection rate of 80% should be achieved in a full test of the system covering multiple tests across the entire pool area. To achieve a detection the alarm/ alert must sound within two seconds of the set off time which is pre-set and specific to each pool.

The project consisted of eight workstreams:

1. Literature Review
2. Product Landscape Mapping
3. Testing against ISO_20380 standard
4. Testing against standard (live)
5. Testing against an enhanced standard
6. Testing against an enhanced standard (live)
7. Lifeguard engagement
8. Operator engagement

1 Literature Review

From reviewing the literature that currently exists, it is clear there is little in the way of either qualitative research on the experiences of lifeguards and their interactions with DDS, or quantitative evidence showing DDS application to real-world scenarios. Claims expressing the risks of DDS negatively affecting lifeguarding performance should be further investigated, and efforts made across the industry to ensure all publicly available information and guidance surrounding DDS is current and up-to-date. Operators should ensure that the sources they are using for DDS research do not draw from predated editions of health and safety law and guidance. Co-operation is required between all with an interest in the improvement of pool safety, to share data, information and learning on DDS, including but not restricted to results and findings from any DDS standards tests carried out. By building and maintaining a robust evidence-base in this area, policy makers, operators, and suppliers can feel confident in their decision-making around the improvement of safety in public swimming pools.

2 Product Landscape Mapping

The landscape mapping exercise highlighted the three main types of surveillance system that are currently in use and the characteristics associated with these *(1. Surveillance, 2. Detection, and Alarm Raising, 3. Surveillance, Detection, and Alarm Raising).* This also helped to identify the four systems that we would be testing as part of this project, which are in the third category of full surveillance, detection and alarm raising.

3-6 Testing

Product testing was carried out at four locations, with each pool having a different DDS system installed. Each pool was tested four times, once with each of the following test types:

1. Standard testing according to ISO_20380
2. Version of standard test in live pool conditions
3. Enhanced version of test with more stringent conditions
4. Enhanced version of test in live pool conditions

The enhanced test procedure was developed from research gathered on elements of the standard test procedure, specifically areas where the standard was deemed not to be thorough enough. These included the type (size and shape) of dummy being used, the skin tone of the dummy and the swim wear worn. The stakeholder group offered their knowledge and insight in developing these considerations into an enhanced version of the test. This resulted in a modified version of the test being created, using a smaller dummy with more lifelike features and testing combinations of light and dark skin tones and clothing.

We designed the live test protocol with the difficulties associated with real life testing in mind, and found a solution which we felt would be able to be carried out with relative ease and minimal disruption to swimmers in the pool, whilst still gathering sufficient data to be able to draw conclusions. In practice, live testing worked well and by having a designated swimmer in the pool to move the dummy around we were able to carry out the tests quickly and efficiently without having to change the usual lane swimming pattern of the pool. Live versions of both tests were conducted with a minimum of ten swimmers in the pool.

Key Results

›› For the standard ISO_20380 detection test, the overall detection rate within the 2 second margin across the four pools was 46%. It should be noted that although this is below the ISO_20380 pass rate of 80%, there are two key factors that should be considered when interpreting this result. At one pool, there was also a series of performance issues with the standard test which will have brought down the overall average of the tests.

1) The rate of overall detections within 30 seconds was above this threshold at 84%. The difference between these figures was largely due to alerts being recorded ***too early*** e.g. more than 2 seconds before the set off time. The results show that when the threshold below the set off time is extended to five seconds (but the two second threshold over the set off time remains the same), the detection rate increases to 73%. There were a number of detections that occurred even earlier than five seconds before the set off time.

2) A second consideration is identifying the exact moment that the dummy becomes motionless on the bottom of the pool and starting the timing at the correct moment, which relies on the judgement of those carrying out the test. Starting timing too early, or too late, will have an impact on the time recorded. This has also been raised as an issue by a company who carry out tests against the standard and who have disregarded the 2 second threshold when calculating detection rates to allow for this error tolerance. When considering a five second allowance either side of the set off time, the required detection rate of 80% is reached across the pools.

›› The enhanced standard was tested using a smaller dummy with more lifelike features in four different scenarios: a light skin tone in light clothing, a light skin tone in dark clothing, a dark skin tone in light clothing and a dark skin tone in dark clothing. Whilst there was some differences in detection rate between these conditions, there was no relationship between performance in this test and performance in the repeated test in live conditions. This suggests that using a smaller dummy with more lifelike features is more important than the particular variation of clothing

or skin tone. There was little difference in detection performance between the standard test and the enhanced test under non-live conditions, a positive result suggesting the systems can detect the smaller dummy without performance decline.

>> When testing in live conditions, for the standard test there was little overall decline in overall detections within 30 seconds, but the detection rate within each of the time thresholds reduced. For the enhanced test, there was a larger decline both in overall 30 second detection performance and in each time threshold. This suggests that system performance can decline when detecting in live conditions and emphasises the importance of including some form of live testing into test routines and procedures. The smaller dummy with more lifelike features also offers a more stringent and thorough test of the system.

>> Whilst carrying out the tests there were some areas that performed worse than others in terms of detection. The additional tests we carried out on corners showed that this area (which is not part of the standard test) performed worse than the rest of the pool. This is an area that may require further manufacturer development in order to bring it up to the same standard as the main pool area. Where pools had a slope from the shallow to deep end, the detection rate was lower when the manikin was placed directly onto the slope.

7-8 Lifeguard/ Operator Engagement

In order to gain feedback from those who are involved with the use of DDS on a day to day basis, we engaged with both lifeguards and operators. An online survey for lifeguards was distributed, which saw over 7,000 responses received. This was followed up by lifeguard focus group sessions to further explore some of the key findings. We also held an operator focus group to get the opinion of a range of operator types on the use of DDS at their facility.

>> Of the factors included in the survey, those that most lifeguards said made their job harder were reflection, glare and busy pools.

>> Reaction towards DDS was generally positive- those who used it felt it was a good additional back up and could help with blind spots.

>> There was concern over the number of false alarms (both from those who used it and those who had not) and the potential that it could encourage complacency.

>> Lifeguards from different pools had a range of experiences with using technology and screens in relation to the 10:20 guideline, with no clear standardised way to incorporate screen scanning into the process.

>> Operators cited two main barriers to the installation of DDS: cost, and the number of false alarms.

>> Those operators that have DDS systems installed them for two primary reasons:
- To improve visibility across the entire pool
- To increase the quality and standard of lifeguarding

>> Feedback around the use of the system was mainly around the lack of awareness or guidance of how to incorporate the use of DDS into the 10:20 scanning routine.

10:20 is a lifeguarding standard which represents the time that a lifeguard should spend scanning their designated zone in the pool (10 seconds), and then respond to an incident and make a rescue if required (20 seconds).

Conclusions/ Next steps

The following points summarise the overall conclusions and findings from the project, and highlight the additional actions that will now be undertaken.

1. ukactive to lead on communication with ISO, sharing relevant results from the project to investigate:

- **a) the use of 2 second threshold in standard and why 2 seconds is used**
- **b) the use of a smaller dummy with more lifelike features in testing**
- **c) the importance of live testing as part of standard**
- **d) key results from other areas of the project including lifeguard engagement**

The aim of this is to share the relevant findings from our research with ISO, to provide evidence of real life application of the testing procedure and to enable discussion on the specific parts of the standard that have emerged as areas that require further attention.

a) According to the application of ISO:20380, the combined results from the four systems tested did not reach the required standard of 80% of detections within 2 seconds of the set off time. When testing, the early detection of alarms was a primary reason for not reaching this threshold. Systems were frequently detecting the dummy ahead of the 2 second window, which would be classed as a non detection according to the standard, but for example in a real life scenario could mean an incident was detected in 7.5 seconds rather than 8 seconds, which is a positive outcome.

Further complexity is added to the test as it relies on human vision and judgement to determine exactly when the dummy is stationary on the bottom of the pool and timing should begin. Given these factors, we intend to share our findings with ISO and understand what the research base behind using a 2 second threshold is, and how this was determined. A potential suggestion could be extending the allowance ***below*** the set off threshold so systems that detect quickly are not penalised for this, whilst still maintaining the 2 second tolerance above the threshold. In this scenario a balance between quick detections and false alarms would need to be considered.

b) The enhanced test saw a similar detection performance to the standard test in non-live conditions, leading to the suggestion that the smaller dummy with more lifelike features could be adopted for regular testing without a performance decline. The enhanced test achieved a lower detection rate than the standard test under live conditions, suggesting that if live testing is to be carried out (as recommended below), the smaller dummy with more lifelike features would be a better model to use as it offers a more rigorous test and is more applicable to real life scenarios. The test results indicated that the skin tone and swim wear colour did not lead to a noticeable *pattern* in the difference on detection performance (there were different detection results across the live and non-live versions of the tests) so the focus here should be on the size and design of the dummy rather than skin tone or swim wear colour.

c) The difference in performance between live and non-live conditions for the enhanced standard highlights the need for pools to be doing some element of live testing. The implementation of a full live test, as was carried out in this project, would not be practical for a regular test but could be carried out as an additional test when the standard six monthly full tests are carried out. In addition to this, and linked to recommendation number 2 below, is the need for pools to carry out some form of live testing as part of normal regular testing of the system (over and above any tests required by the ISO standard). Pools should already be carrying out daily testing of the system, and introducing a live test of some areas of the pool whilst the pool is quiet could be incorporated into this.

2. ukactive to create working group with relevant parties to work towards creating an industry guideline for testing and using DDS. This will include procedures for testing, including live testing, and a review of 10:20 and using technology as part of lifeguarding.

Whilst it is important to share our findings with ISO, the nature of an international standard means that multiple countries are involved in setting and reviewing these, and some degree of compromise across multiple stakeholders is always required. Therefore rather than attempt to change the ISO standard, we will instead focus on bringing together the right stakeholders from across the sector to produce an national industry standard for the use of DDS, including the testing of these and how they should work in conjunction with lifeguards. Ultimately this should lead to the creation of industry standards, which can be applied alongside ISO_20380.

As part of a move towards creating industry guidelines, there are three key areas from the project that this working group will seek to address:

1. Live Testing
The importance of live testing and the lack of current protocol around this is a topic that the group would seek to address through producing guidance on how to carry out live testing under operational conditions. This would be based upon learnings from the live testing elements of the project.

2. Awareness of importance and requirements for testing systems
Experience from carrying out tests at various pools, and attempting to collect previously recorded test results, suggest that there is little awareness of current DDS testing requirements across the sector. The ISO_20380 test is time consuming and requires significant set up and preparation time. Whilst it is not in itself difficult to carry out, it requires a high level of concentration and focus to ensure it is correctly implemented. New industry guidance would seek to ensure that testing is carried out regularly by creating tests that can be easily carried out by operators.

3. DDS and the 10:20 guideline
Feedback from lifeguards and operators highlighted the current inconsistencies with how DDS were being used within standard lifeguarding procedures, particularly with reference to 10:20. Pools are using their own adaptations of this guideline to incorporate checking the screens for incidents and alerts, with a variety of different adaptations including splitting the '10' segment further into 5:5 and using the screens as an 'additional' check at the end of the scan. This is an area where further support and guidance would be useful to ensure the most efficient, and safest, methods of scanning are being used where technology has been introduced to a pool. For this to happen, there needs to be agreement amongst the subject experts on the best way to proceed amongst. Industry guidance would seek to produce a standardised method for using DDS alongside lifeguarding guidelines.

3. ukactive to write to manufacturers, summarising results from testing and highlighting the negative impact of false alarms on lifeguards.

The aim of this is to make manufacturers aware that lifeguards find the number of false alarms distracting, with a view to improving the technology to reduce the frequency.

Feedback from users was that the false alarms from the systems were distracting and left lifeguards lacking trust in the system. A small number of false alarm incidents were witnessed during the testing of the pools. This is an area where manufacturers should work to improve the technology to reduce the frequency of false alarms. This was key feedback from the operators when exploring the barriers to installing DDS and operational issues surrounding its use. The letter to the manufacturers will also summarise the testing results with particular reference to the areas where detection performance was seen to decline e.g. corners of the pool.