Perceived Benefits and Limitations of Proposed AI Food Safety Monitoring Software in Food Service Sector.

Veronika Bulochova[1], Ellen W. Evans[1], Claire Haven-Tang[2] and Elizabeth C. Redmond[1]

(1) ZERO2FIVE Food Industry Centre, Cardiff Metropolitan University, Cardiff, United Kingdom
(2) Welsh Centre for Tourism Research, Cardiff School of Management, Cardiff Metropolitan University, Cardiff, United Kingdom
*Corresponding author: vbulochova@cardiffmet.ac.uk

Cardiff Metropolitan University | Prifysgol Metropolitan Caerdydd

Introduction

A lack of regular supervision and monitoring is considered to be one of the main barriers to minimising the risk of food handling malpractices in food service (1, 2, 5, 6). However, consistent visual observation of employee food safety practices during day-to-day operation in a food service business may be challenging. Although monitoring could be done by using technology, such as via recorded CCTV footage, previous studies conducted in food manufacturing have shown that it requires a detailed review to obtain valuable findings and may be too time-consuming (4).

Novel monitoring technologies utilising Artificial Intelligence (AI) could offer a solution and provide real-time feedback regarding the implementation of food safety practices in the food service industry. For example, for monitoring hand hygiene, a proposed AI software could analyse recorded video footage and identify compliant and non-compliant handwashing attempts, computing real-time statistics for the management team in a food service establishment.

A recent qualitative study suggested that the use of such novel technology may facilitate the recognition, rewarding and promoting of appropriate food safety implementation (3). It is suggested that real-time AI monitoring could positively influence food safety compliance, but only when it is perceived as beneficial.

There is a need to explore the perceptions of the food service industry stakeholders about the use of novel AI Monitoring Software to understand and inform the further development of such technology.

Purpose

To determine stakeholder perceptions regarding the benefits and limitations of novel AI food safety monitoring; and to identify the requirements of the intended users regarding the development of such technology.

Methods

Study design:
Interview schedules, informed by a preceding literature review were designed for this study. In-depth interviews were carried out with three groups of stakeholders:

- **Experts**, such as representatives of academia, regulatory authorities and environmental health officers (n=11);
- **Food service managers**, including owners, general managers, employees carrying out managerial duties (n=9);
- **Food service employees**, including chefs, waiters, baristas and workers in non-managerial roles (n=4).

Data Analysis:
All interviews were recorded, transcribed and the content of the interviews was qualitatively analysed. Perceptions of benefits and limitations of using novel AI monitoring, ideas and suggestions have been explored.

Ethical Approval: Approval was obtained from the Health Care and Food Ethics Committee at Cardiff Metropolitan University (Reference no.: PGR-5508).

Results

Benefits of novel AI monitoring technology

When discussing food safety monitoring the industry experts and food service managers acknowledged that monitoring must be consistent to be effective and to lead to improvement. They agreed that continuous monitoring "cannot be accomplished by only one person" in the establishment, such as a manager or an owner.

Therefore, an overall positive sentiment towards the application of monitoring technology utilising AI was expressed by these groups of respondents, as seen in Table 1.

Table 1. Perceived benefits of novel AI monitoring technology discussed by the industry stakeholders (n=24).

Perceived benefits of novel AI technology discussed by the industry stakeholders		
Benefit	**Key findings**	**Respondent comments**
Continuous real-time feedback	Industry experts acknowledged that continuous feedback replacing snapshot auditing would give a more in-depth data about the business.	"I think real-time feedback is beneficial." (Expert 21) "We're never going to be inspecting every single minute of every single day of what they're doing. It's just the snapshot[...] So, yeah, it sounds exciting." (Expert 10)
Effectiveness	Food service managers shared an opinion that using an AI software could be more effective when monitoring a team, allowing continuous monitoring which would not be practical if done in a traditional way via observation.	"If I'm the main one responsible for making sure everybody does that [handwashing], that's not possible for me to keep an eye on everybody. So, I actually like the sound of that!" (Manager 2)
Faster and more transparent monitoring	Speed of the AI-powered monitoring, allowing to highlight the issues automatically was perceived as beneficial by the food service managers and by the industry experts.	"We're limited with the time we have during the inspections. But as you said, the AI it sounds like that will shorten things up rather than someone reviewing the CCTV themselves." (Expert 10) "It would definitely help managers, it would speed up a process." (Supervisor 3)
Encouraging compliance	Food service managers suggested that having a novel monitoring tool may have a positive effect on employee food safety compliance, because employees would know that they are always being monitored.	"I think they'd understand the importance of, you know, doing everything according to the protocol." (Manager 29)

Other benefits such as "having control over compliance monitoring" whilst utilising a "passive way to collect data" and "getting visible output" were also perceived as important.

Shared opinions regarding benefits will inform future design of novel food safety CCTV monitoring tool utilising AI.

Limitations of novel AI monitoring technology

Although very interested in the novel monitoring opportunity using novel AI software, the industry experts and managers have also expressed various concerns and highlighted possible limitations of such technology, as seen in Table 2.

Table 2. Concerns and perceived limitations of the novel AI monitoring technology discussed by the industry stakeholders (n=24).

Concerns and perceived limitations of novel AI technology discussed by the industry stakeholders		
Concern	**Key findings**	**Respondent comments**
Financial investment	Cost of novel technology and the financial investment into installing and maintaining it was mentioned as one of the core limitations, perceived by the experts and managers. This was particularly worrying for smaller businesses that may not have resources to obtain such technology.	"Lots of expenses for owners as well, isn't it? To get all cameras and..." (Business owner 11)
Time investment	Food service managers highlighted the need to invest time to learn how to operate the novel software and to review the results obtained via monitoring.	"You are probably going to have to find the time to review and determine whether or not you need to take any further action, as a result of the findings." (Expert 25)
Doubt in feasibility	Several food service managers expressed doubt that real-time food safety monitoring is needed or that it could provide reliable results. Moreover, managers doubted its effect on employee food safety behaviour.	"I don't think personally it would make any difference, really. Because they [food service employees] are doing their job as it is.[...] I don't think filming would encourage them to do it any more than they already are. " (Manager 18)
Loss of responsibility	Concerns regarding the fact that the use of AI video monitoring may give a false sense of security and loss of responsibility to the management teams was highlighted by the managers.	"If I know that there's a camera watching, do I need to keep an eye that everyone should wash their hands?[...] We let doubt into the minds of people to feel like it's not any longer a part of their responsibility." (Manager 13)
Ethical questions	Managers and experts shared ethical concerns associated with video monitoring, such as taking advantage of the ability to identify employees and single them out based on their behaviour; and the intrusive nature of such monitoring.	"I think there are some managers, as well, that would use it as a tool to catch people out." (Employee 27) "That sounds a little bit intrusive" (Manager 29)

It is suggested that the concerns and limitations shared by the industry stakeholders in this study should be considered when developing novel CCTV monitoring tools utilising AI.

Ways to introduce novel technology

"You have to be very clear about what you're trying to do and what you're NOT trying to do" (Expert 4)

"If you have AI - be transparent with the employees." (Expert 26)

All interview participants discussed ways to introduce novel AI monitoring technology to a food service business. Two central points were highlighted by the food service industry representatives:

1. AI technology as a supplementary tool
Managers and experts stated that novel AI technology is beneficial when used as a supplementary tool which helps monitoring, and that it cannot be used to prevent poor practice by itself: "It could never fully replace a manager keeping an eye on something." (Expert 14); but "if added supplementarily [...] you'd still be gaining a lot from it, and being able to tell those patterns, behaviours and things that maybe need to be acted on" (Manager 13).

2. Making the purpose clear to everyone
All respondents spoke of importance of making the purpose of AI monitoring systems clear to the management and employees: "It can't be a police scenario" (Expert 4) and "It's more just to monitor and help and support, rather than to catch them [employees] out" (Employee 27).

Desired output ideas

All interviewees discussed the desired output ideas for the proposed handwashing AI monitoring software, which could be beneficial to them or their business. Features, warning food handlers of required handwashing time and alerting the managers of non-compliances were suggested. The ability to monitor handwashing frequency and to identify non-compliant individuals was also proposed as potentially useful.

However, further research is required to assess technological feasibility of novel AI monitoring in food service.

"I imagine that it would be beneficial if when you wash your hands it tells you straight away that this was not enough time." (Employee 8)

"Maybe it was like: washing hands done wrong 15 times, this is an Amber Alert." (Business owner 1)

"Maybe frequency [of handwashing] as well as the designated amount of time which should be considered." (Employee 27)

"Say I'm washing my hands, and I am too quick and I get the feedback: 10 more seconds?" (Expert 21)

"If there is a particular member of staff that is not washing their hands, I think it would be important. That is the main bit of data I would want to see." (Supervisor 3)

Significance of study

This study has identified perceptions of stakeholders about the use of AI monitoring software in food service, and practical considerations when developing such novel technology and introducing it to the business.

Importantly, benefits are seen by the stakeholders when technology is used supplementarily and when its purpose is clearly communicated to the personnel. However, limitations and concerns must be carefully considered when designing novel tools, so they are suitable for and accepted by the industry management and employees.

These findings could inform the future development of AI food safety monitoring technology to improve food safety in the food service sector.

Acknowledgements

References

1. Arendt, S. W., P. Paez, and C. Strohbehn. 2013. Food safety practices and managers' perceptions: A qualitative study in hospitality. Int. J. Contemp. Hosp. Manag. 25:124–139.
2. Clayton, M. L., K. C. Smith, R. A. Neff, K. M. Pollack, and M. Ensminger. 2015. Listening to food workers: Factors that impact proper health and hygiene practice in food service. Int. J. Occup. Environ. Health. Taylor & Francis 21:314–327.
3. Evans, E. W., V. Bulochova, A. Jayal, and C. Haven-Tang. 2023. Attitudes towards using artificial intelligence to determine real-time hand hygiene compliance in the food sector. Food Control. Elsevier Ltd 145:109439.
4. Evans, E. W., E. J. Samuel, and E. C. Redmond. 2020. A case study of food handler hand hygiene compliance in high-care and high-risk food manufacturing environments using covert-observation. Int. J. Environ. Health Res. Taylor & Francis 00:1–14.
5. Garayoa, R., C. Abundancia, M. Díez-Leturia, and A. I. Vitas. 2017. Essential tools for food safety surveillance in catering services: On-site inspections and control of high risk cross-contamination surfaces. Food Control. Elsevier Ltd 75:48–54.
6. Watson, S., and Y. Y. Gong. 2018. Risk behaviours and practices of food handlers in norovirus transmission. Br. Food J. 120:2510–2523.

@vbulochova
@Research_Ellen
@Lfoodsafety
@ClaireHavenTang
@ZERO2FIVE_
@CardiffMet
@CardiffMetCSSHS

International Association for Food Protection

SCAN TO DOWNLOAD POSTER

IAFP 2023 TORONTO · ONTARIO Canada July 16-19

linkedin.com/in/veronika-bulochova-73098219b/
linkedin.com/in/ellen-evans-zero2five
linkedin.com/in/dr-elizabeth-redmond
https://www.linkedin.com/in/claire-haven-tang-23a1a113/