

Rapid Response to Identify and Control *Listeria monocytogenes* in a Ready-to-Eat Foods Manufacturer Supplying the UK Retail Sector.

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Introduction

Presence and persistence of *Listeria monocytogenes* can be problematic in food manufacturing environments.^{1,2} Continued environmental presence and end-product contamination of *L. monocytogenes* can have severe consequences for ready-to-eat (RTE) food manufacturers with loss of customer confidence and business closure.

Complete elimination of post-processing *L. monocytogenes* contamination is challenging as the pathogen is common ubiquitous and can persist in food processing environments for years.³ The presence of *L. monocytogenes* in RTE foods generally occurs because⁴:

- There is no/insufficient lethality step in the food manufacturing process.
- Products intended to undergo a listericidal treatment are processed incorrectly.
- The product is exposed to the processing environment, and has been contaminated or from the processing environment.

The seek-and-destroy process is a systematic approach to finding sites of persistent strains (niches) in food processing plants, with the goal of either eradicating or mitigating effects of these strains.³ It is essential that a RTE food manufacturer is operating an effective seek-and-destroy process to prevent cross-contamination of finished product.

Combining technical risk analysis with behavioural sciences can develop bespoke interventions to enhance and embed a culture of food safety in a business.^{5,6}

Purpose

The purpose of this study is to implement an independent rapid response intervention within a high care RTE food manufacturing company that had identified issues relating to *Listeria* spp., to effectively implement a 'seek and destroy' approach to reduce and eliminate the sources of *Listeria* spp. using a multidisciplinary Listeria Action Team.

Methods

To address the aim of the research, the project was completed in six weeks in a number of phases using quantitative and qualitative methods:

- **Phase one:** a desk-based review of historic pathogen environmental monitoring data and product testing results ($n=2566$) to identify *Listeria* spp. 'hotspots' in the High Care manufacturing facility.

A multidisciplinary Listeria Action Team was created.

- **Phase two:** a mixed-methods approach included site inspection and factory floor observation ($n=30$) which included:
 - Observation of food safety behaviour of staff in identified 'hotspots'.
 - Observational assessment of good manufacturing practices (GMP).
 - Review of site layout, fabrication and equipment design.
 - Observation of good hygiene practices (GHP).
 - Observation of product and packaging transfer into High Care.
 - Microbiological assessment of equipment, environment, raw materials and product.

Findings from phase two were combined to give a report of non-conformities which supported the presence of *Listeria* spp. in the environment and finished product.

- **Phase three:** The multidisciplinary Listeria Action Team collaborated to determine 'root cause' of the non-conformities identified in phase two and implement and monitor appropriate interventions i.e. 'corrections' and corrective actions.

This study was funded by and supported by the manufacturing business.

Results

Phase one: Review of *Listeria* spp. presence in finished products

Cumulatively, 3733 finished products were tested over a seven month period for *Listeria* spp. and analysed by a UKAS accredited laboratory, in the UK.

A total of 2566 *Listeria* spp. tests were completed with 46 results out of specification i.e. 2% of the product samples. One manufacturing area and one product range presented the highest incidence of *Listeria* spp. As indicated in Table 1, it was identified that products from production Area 4 had the highest incidence of positive *Listeria* spp.

Table 1. Finished product *Listeria* spp. positive results by production area ($n=2566$).

Month	Production area					<i>Listeria</i> spp. identified	Total
	Area 1	Area 2	Area 3	Area 4	Area 5		
1	0	0	0	0	1	<i>L. innocua</i>	1
2	0	0	1	0	0	<i>L. innocua</i>	1
3	0	0	0	2	0	<i>L. monocytogenes</i>	2
4	0	0	0	1	0	<i>L. monocytogenes</i>	1
5	0	0	0	3	0	<i>L. monocytogenes</i>	3
6	2	1	0	16	0	<i>L. innocua</i> and <i>L. monocytogenes</i>	19
7	0	0	1	9	2	<i>L. welshimeri</i> and <i>L. monocytogenes</i>	12
8	0	0	0	7	0	<i>L. monocytogenes</i>	7
Total	2	1	2	38	3	N/A	46

The review of *Listeria* spp. finished product testing results led to the creation of a multi-disciplinary Listeria Action Team (LAT) to tackle the increased incidence of positive product results in Area 4.

The LAT included members of senior management, engineering staff, hygiene operatives and food handlers along with an independent technical specialist with experience of managing *L. monocytogenes* in food manufacturing environments.

Table 2. Expertise of the multi-disciplinary Listeria Action Team

LISTERIA ACTION TEAM (LAT)	
ROLE	EXPERTISE
Production manager	Greater than 10 years knowledge of process, product, people and environment. Working knowledge of operations procedures, production planning, scheduling and inter process cleaning.
Quality Assurance manager	Greater than 10 years knowledge of process, product category, procedures and environment. Understanding of microbiological loading of environment, HACCP and management of microbiological monitoring and analysis.
Quality Assurance operator	Working knowledge of verification of GMP on shop floor. Verification of cleaning, ATP and microbiological swabbing of environment.
Process engineer	Working knowledge of plant and equipment for processing products, plant hygiene facilities and capabilities, hygienic design of Area 4.
Hygiene supervisor	Working knowledge of GHP from inter-process to deep cleans.
Hygiene operator	Practical knowledge of hygiene practices in Area 4.
Production operator	Greater than 5 years Practical working knowledge of manufacturing procedures and GMP in Area 4.
Independent technical specialist	Greater than 20 years experience in food manufacturing, working in high care / risk environments assessing, controlling and managing risk of <i>L. monocytogenes</i> in the environment

Phase two: Development of intervention actions to address observed non-conformities

Members of the LAT and the independent technical specialist completed documented observations of GMP and GHP in Area 4 twice a day over a 4 week period ($n=40$).

All non-conformity observations were communicated to the LAT and management of area 4 daily. The findings were reviewed and categorised according to six classifications namely people, GMP, equipment, environment, GHP and fabrication.

To address the observed non-conformities, suitable actions as indicated in Table 3, were identified by the LAT and agreed upon.

Table 3. Intervention actions implemented to address observed non-conformities in Area 4 according to six categories.

Category	Non-conformity observed	Intervention actions
1. People	<ul style="list-style-type: none"> • Staff movement between high care and low risk • Lack of supervision in area • Operators touching floor • Poor hand wash practices 	<ul style="list-style-type: none"> • Barrier system to be re-engineered to prevent movement of staff • Supervision levels increased • Listeria Awareness training for all staff
	2. Good Manufacturing Practices	<ul style="list-style-type: none"> • Stacking ingredient trays - increased risk of pathogen cross contact • Excess packaging in Area 4 • Ingredient handling and storage on floor
3. Equipment		<ul style="list-style-type: none"> • Equipment and utensils stored on floor
	4. Environment	<ul style="list-style-type: none"> • No evidence of transfer of decontaminated raw materials into Area 4
5. Good Hygiene Practices		<ul style="list-style-type: none"> • Wet production floor • Use of medium pressure hose for inter process clean
	6. Fabrication	<ul style="list-style-type: none"> • Product contact transfer equipment, seam welds damaged • Floor damaged, uneven, water pooling • Floor / kerb junction cracking wet • Entry to low risk open

To effectively action the above issues and improve the food safety culture in the business the LAT and senior management were able to focus the above six categories into two cultural dimensions⁵:

1. **People:** Education, training and effective communication to technical and non-technical staff together with, increased supervision and routine status reporting of risk related issues had a positive impact on the business.
2. **Hazard and risk awareness:** actions by members of the LAT on the shop floor were impactful to the team in Area 4. Improving the supervision, awareness and understanding was key to 'bottom up' engagement.

Phase three: Implementation of intervention actions via the multidisciplinary LAT

Interrogated data from phase two was utilised to develop and implement the following interventions to reduce the incidence of *L. monocytogenes* in the environment and finished product.

In order to validate the effectiveness of the interventions a 'zonal' Listeria Environmental Monitoring plan was devised by the LAT. Increasing the number of inspection/swabbing points by 80% ($n=136$) in order to evidence the niches of *Listeria* spp. have been destroyed. The inspection points were swabbed and sampled post-clean and mid-production.

This study has followed a focused and culture based approach to address the increased incidence of *Listeria* spp. in the environment and product manufactured in Area 4 over a 4 week period.

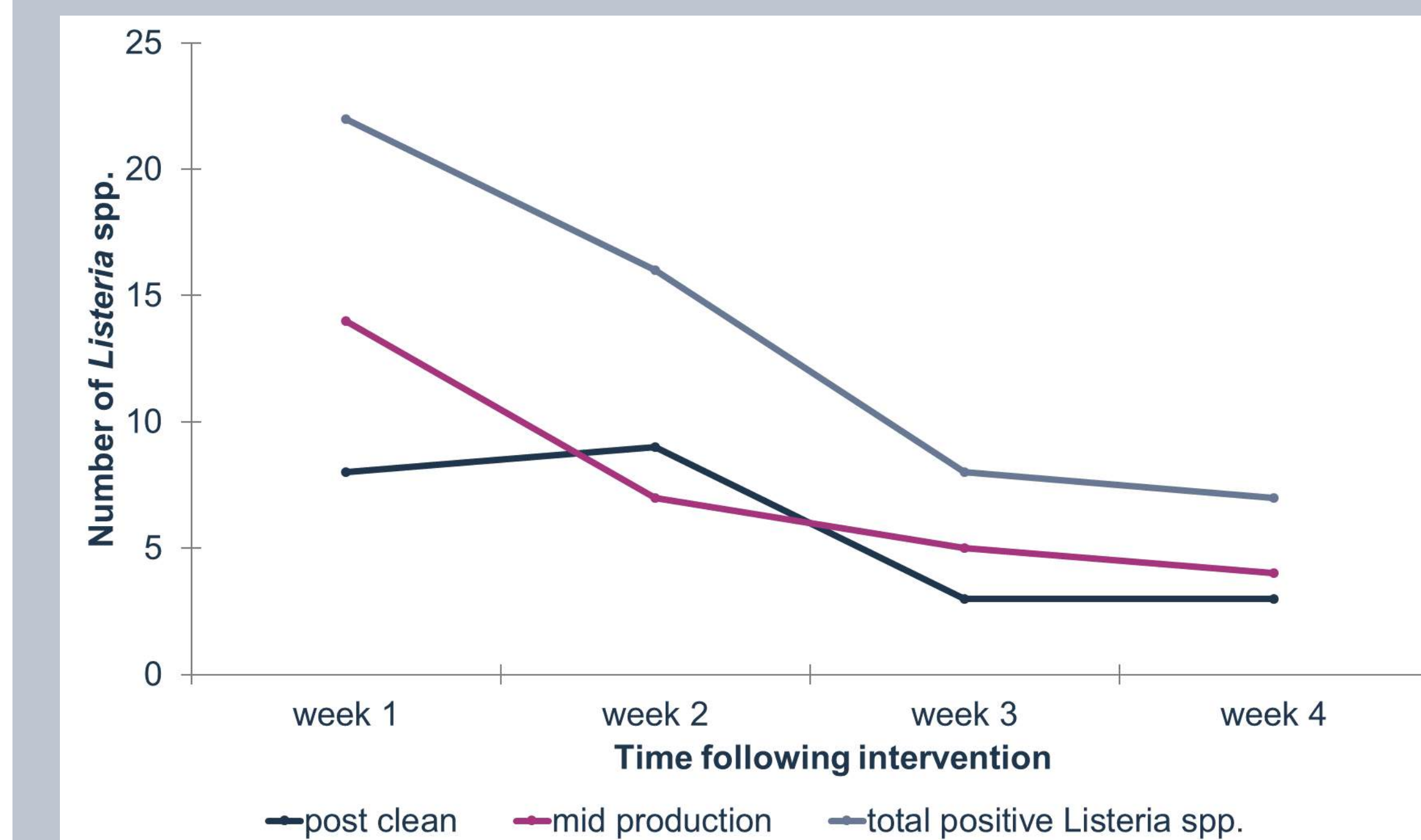


Figure 1. Number of *Listeria* spp. positive environmental swabs in area 4 following intervention ($n=537$).

Figure 1. highlights the total number of positive *Listeria* spp. results post-clean and mid-production swab results over a four week period following the intervention in area 4. During this time all interventions in Table 3 were implemented by the LAT. All swabs were taken by a trained qualified individual to minimise sampling variation.

The 'zonal' Environmental Monitoring plan in area 4, identified niches of *Listeria* spp. present in the area:

- **Zone 1:** direct food contact surfaces.
- **Zone 2:** areas directly adjacent to zone 1, e.g. non-food contact surfaces in the processing area. It is the area around the exposed product in which a pathway to product contamination could exist, via staff or equipment.
- **Zone 3:** the area surrounding zone 2, e.g. drains and doorways.

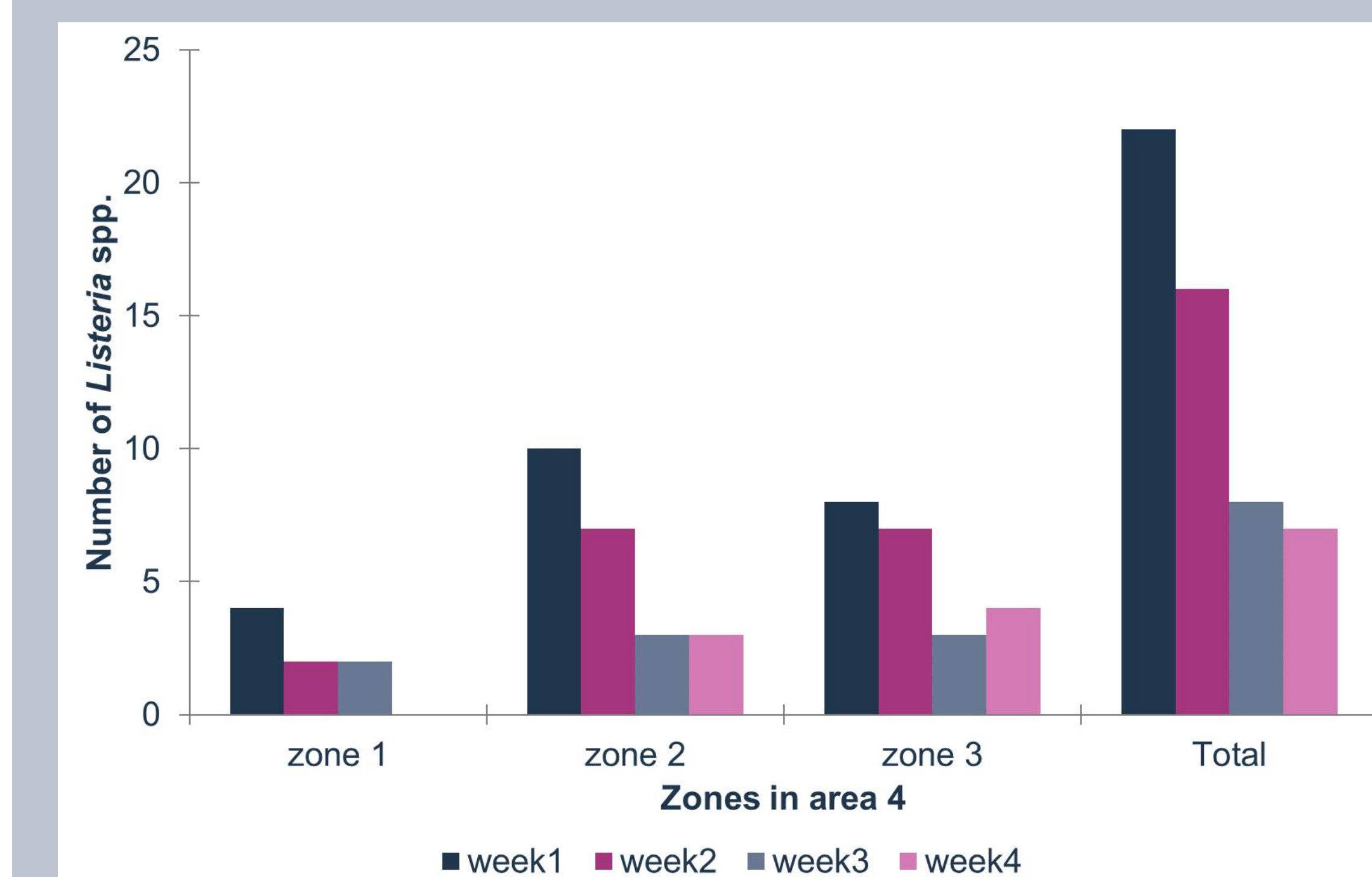


Figure 2. *Listeria* spp. positive swab results by zone following intervention ($n=537$).

As indicated in Figure 2, a reduction of *Listeria* spp. results in Zone 2 and Zone 3 was identified following implementation of the interventions, suggesting origin of the pathogen to be environmental.

Significance of study

This research has followed a focused approach to address the increased incidence of *Listeria* spp. in the environment and therefore product manufactured from Area 4 over a 4 week period of time.

The study demonstrated effective interventions in the following areas:

- **Knowledge and skills:** team members in the area benefitted from additional training in manufacturing / hygiene practices and Listeria awareness.
- **Supervision:** Increased presence, GMP audits and two way communication in the area improved the housekeeping standards.
- **Facilities:** Investment and maintenance of fabrication and equipment was completed which reduced risk of pathogen harbourage locations.
- **Verification and validation of interventions:** Implementation of a 'zonal approach' to environmental swabbing provided logical approach to monitoring and effectiveness of interventions.
- **Senior Management Commitment:** dedication to the approach of 'seek and destroy' and improving the food safety culture of the business.

Implementation of the rapid response Listeria Action Team intervention resulted in a 60% reduction of *Listeria* spp. in the RTE food processing environment.

References

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