

Perceptions and Digitalisation of Outbreak Management in UK Health Services: A Cross-Sectional Survey

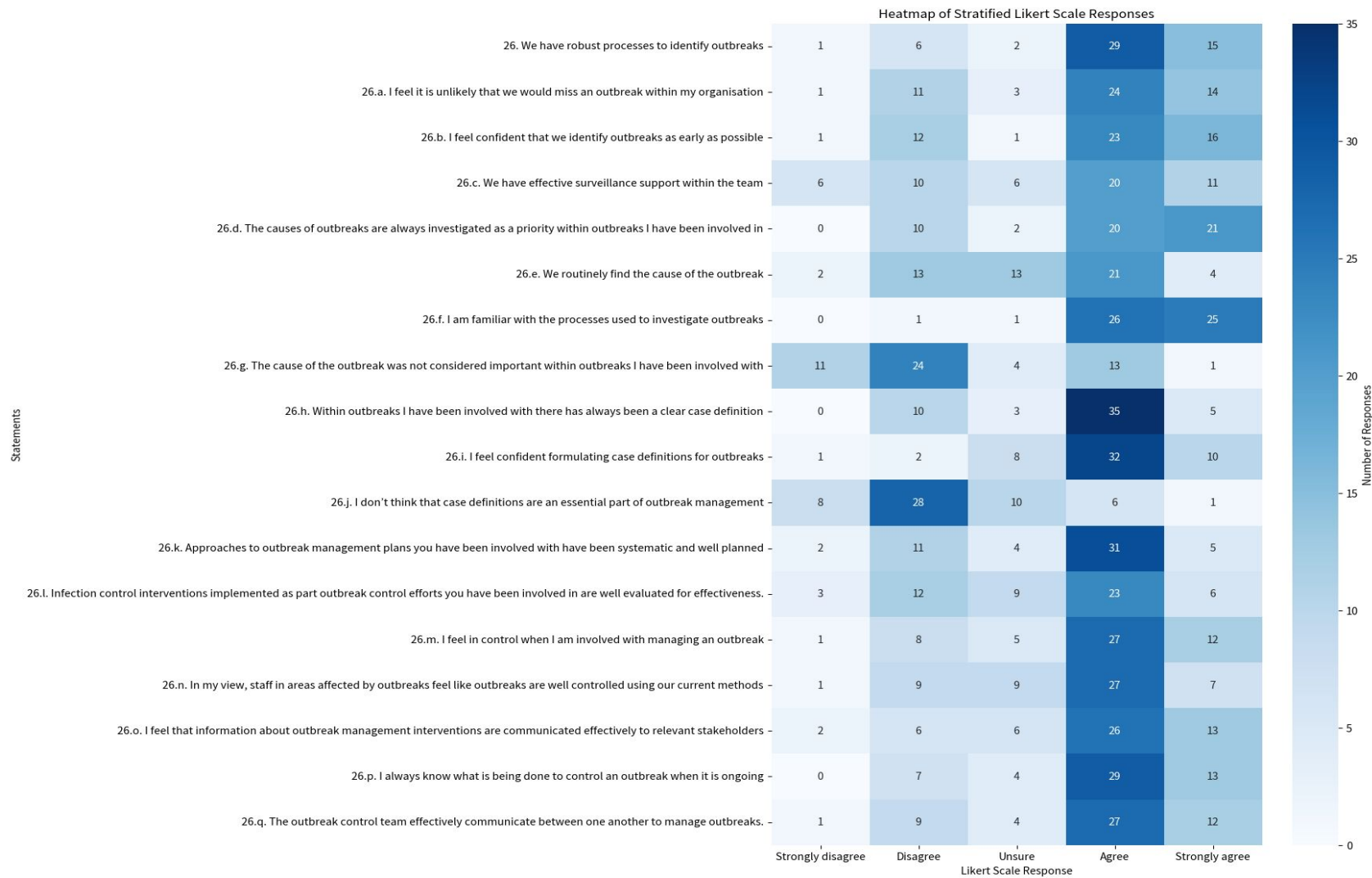
Journal:	<i>Journal of Infection Prevention</i>
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Keyword:	Outbreak management, processes, Perceptions, preparedness, resilience
Abstract:	<p>Background: Global challenges arise from infectious disease which represent significant challenges to the provision of healthcare, requiring efficient management procedures to limit transmission. Evaluating current outbreak management processes within UK healthcare services is essential for identifying strengths, weaknesses, and potential improvements.</p> <p>Objectives: This study aimed to assess infection prevention and control (IPC) practitioners' access to outbreak management (OM) data. Secondary objectives involved determining IPC practitioners' perceptions of outbreak management processes and the state of digitalisation of OM in the UK.</p> <p>Methods: National cross-sectional survey data were collected to evaluate current outbreak management approaches. To supplement this, information requests were sent to the ten largest teaching and research NHS hospital trusts in England.</p> <p>Findings: The survey received 55 responses with 53 considered for analysis. Out of ten NHS trusts, 9 provided completed FOI responses, while one was unable to provide data.</p> <p>Discussion: The study offers unique insights into prevailing outbreak management practices within UK health services. Although positive perceptions surround key outbreak management stages, concerns arise, including varying confidence levels in surveillance processes' robustness, efficacy of management interventions, and communication effectiveness.</p> <p>Conclusions: The study highlights challenges with OM processes in the UK, including issues like poor surveillance and delayed outbreak detection. Positive practitioner perceptions contrast with concerns over data collection, follow-up, and limited digitalisation, relying on basic tools like Excel and Word, hindering retrospective learning.</p>

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Supplementary information 1. Survey respondent characteristics

Demographic	Number / proportion of sample
<i>Age</i>	
18-24	0 (0.0%)
25-34	5 (9.4%)
35-44	8 (15.1%)
45-54	20 (37.7%)
55-54	20 (37.7%)
65+	0 (0.0%)
Prefer not to say	0 (0.0%)
<i>Years of experience in IPC</i>	
1-5	10 (18.9%)
5-10	13 (24.5%)
10+	30 (56.6%)
<i>Formal qualifications in IPC</i>	
None	11 (20.8%)
RCN IPC course	4 (7.5%)
Diploma	7 (13.2%)
Bachelor's degree	4 (7.5%)
Post-graduate certificate	2 (3.8%)
Level 6 study	2 (3.8%)
Masters level study	8 (15.1%)
Masters degree	9 (17.0%)
Other non-university course	6 (11.3%)
<i>Gender</i>	
Male	5 (9.4%)
Female	47 (88.7%)
Other	0 (0.0%)
Prefer not to say	1 (1.9%)
<i>Profession</i>	
Nurse	46 (86.7%)
Clinical scientist	2 (3.8%)
Doctor	2 (3.8%)
Other	3 (5.7%)
<i>Healthcare setting</i>	
Acute	16 (30.1%)
Non-acute	27 (50.9%)
Both acute and non-acute	10 (18.7%)
<i>Geographical Region</i>	
North East	2 (3.8%)
North West	17 (32.1%)
Yorkshire and the Humber	7 (13.2%)
East Midlands	2 (3.8%)
West Midlands	3 (5.7%)
East of England	3 (5.7%)
London	3 (5.7%)
South East	3 (5.7%)
South West	5 (9.4%)
Wales	4 (7.5%)
Scotland	3 (5.7%)
Northern Ireland	1 (1.9%)

Supplementary information 2: Heat map of Likert scale responses



Supplementary information 3: Outbreak interventions reported within FOI responses**Outbreak interventions**

Isolation of positive and symptomatic cases

PCR* testing of symptomatic cases

Cohorting of positive cases

Contact tracing

Visitor cessation

Duty of candour

Daily monitoring by IPC experts

Outbreak meetings

Electronic audit of respiratory assessments

Overview monitoring of outbreaks and submission to national databases

Audit of PPE* compliance

Decontamination of the environment

Restriction of staff movement / staff off work

CDT* audit for each case

Antibiotic audit

Enhanced cleaning using Chlorine releasing agent

Terminal cleans (including curtain change) of bed areas vacated

Screening of symptomatic staff

Outbreak escalated / communicated to patient flow and on-call teams

SitRep of outbreak through chief nurse DIPC* / COVID-19 Management group to NHSE/I*

Ward based hand hygiene and PPE audits daily

Environmental cleaning spot checks weekly

All staff are wearing FFP3* masks

Enhanced cleaning is in place

Ward closed

No sharing of catering between wards

Virucidal alcohol hand gel

Ward deep clean

Staff education

Support from IPC team

Root cause analysis

Source identified

Daily review of all symptomatic patients

Decontamination of reusable equipment and ward environment

COVID-19 safety checklist

Increased IPC and senior team presence

Individual post infection reviews and PII*

Reviewed IV* and device management practices

Ward communications to relatives

Promotion of ventilation

Correct placement of patient

Enhanced cleaning

Enhanced hand hygiene

Increasing full infection and control precautions across affected area

Notes:

1-Two NHS trusts were unable to provide data on the interventions implemented during the last outbreak they experienced.

2-The compilation of this list is solely derived from the data provided through FOI requests and does not indicate the authors' validation of the listed interventions.

*Acronyms have been reported as they were within FOI responses

Supplementary information 4. CROSS checklist

Checklist for Reporting Of Survey Studies (CROSS)

Section/topic	Item	Item description	Reported on page #
Title and abstract			1
Title and abstract	1a	State the word "survey" along with a commonly used term in title or abstract to introduce the study's design.	1
	1b	Provide an informative summary in the abstract, covering background, objectives, methods, findings/results, interpretation/discussion, and conclusions.	1
Introduction			
Background	2	Provide a background about the rationale of study, what has been previously done, and why this survey is needed.	2
Purpose/aim	3	Identify specific purposes, aims, goals, or objectives of the study.	3
Methods			
Study design	4	Specify the study design in the methods section with a commonly used term (e.g., cross-sectional or longitudinal).	3
	5a	Describe the questionnaire (e.g., number of sections, number of questions, number and names of instruments used).	3
Data collection methods	5b	Describe all questionnaire instruments that were used in the survey to measure particular concepts. Report target population, reported validity and reliability information, scoring/classification procedure, and reference links (if any).	3-5
	5c	Provide information on pretesting of the questionnaire, if performed (in the article or in an online supplement). Report the method of pretesting, number of times questionnaire was pre-tested, number and demographics of participants used for pretesting, and the level of similarity of demographics between pre-testing participants and sample population.	4
	5d	Questionnaire if possible, should be fully provided (in the article, or as appendices or as an online supplement).	Included as supplement
Sample characteristics	6a	Describe the study population (i.e., background, locations, eligibility criteria for participant inclusion in survey, exclusion criteria).	4 / supplement
	6b	Describe the sampling techniques used (e.g., single stage or multistage sampling, simple random sampling, stratified sampling, cluster sampling, convenience sampling). Specify the locations of sample participants whenever clustered sampling was applied.	4-5
	6c	Provide information on sample size, along with details of sample size calculation.	4-5 / supplement
	6d	Describe how representative the sample is of the study population (or target population if possible), particularly for population-based surveys.	4 / 13
Survey administration	7a	Provide information on modes of questionnaire administration, including the type and number of contacts, the location where the survey was conducted (e.g., outpatient room or by use of online tools, such as SurveyMonkey).	5
	7b	Provide information of survey's time frame, such as periods of recruitment, exposure, and follow-up days.	5

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2			
3			5
4		Provide information on the entry process:	
5		→For non-web-based surveys, provide approaches to minimize	
6	7c	human error in data entry.	N/A survey
7		→For web-based surveys, provide approaches to prevent “multiple	could only be
8		participation” of participants.	completed
9			once
10			NA
11	Study preparation	8 Describe any preparation process before conducting the survey	
12		(e.g., interviewers’ training process, advertising the survey).	
13		Provide information on ethical approval for the survey if obtained,	5
14	Ethical considerations	9a including informed consent, institutional review board [IRB]	
15		approval, Helsinki declaration, and good clinical practice [GCP]	
16		declaration (as appropriate).	
17		Provide information about survey anonymity and confidentiality	5
18	9b	and describe what mechanisms were used to protect unauthorized	
19		access.	
20		10a Describe statistical methods and analytical approach. Report the	5
21		statistical software that was used for data analysis.	
22		10b Report any modification of variables used in the analysis, along with	NA
23		reference (if available).	
24		10c Report details about how missing data was handled. Include rate of	NA
25		missing items, missing data mechanism (i.e., missing completely at	
26		random [MCAR], missing at random [MAR] or missing not at	
27		random [MNAR]) and methods used to deal with missing data (e.g.,	
28		multiple imputation).	
29	Statistical analysis	10d State how non-response error was addressed.	NA
30			
31		10e For longitudinal surveys, state how loss to follow-up was	NA
32		addressed.	
33		10f Indicate whether any methods such as weighting of items or	NA
34		propensity scores have been used to adjust for non-	
35		representativeness of the sample.	
36			NA
37		10g Describe any sensitivity analysis conducted.	NA
38			
39	<hr/>		
40	Results		
41	<hr/>		
42	11a	Report numbers of individuals at each stage of the study. Consider	6
43		using a flow diagram, if possible.	
44	11b	Provide reasons for non-participation at each stage, if possible.	NA
45	Respondent characteristics	11c Report response rate, present the definition of response rate or the	NA
46		formula used to calculate response rate.	
47		11d Provide information to define how unique visitors are determined.	NA
48		Report number of unique visitors along with relevant proportions	
49		(e.g., view proportion, participation proportion, completion	
50		proportion).	
51	Descriptive results	12 Provide characteristics of study participants, as well as information	In
52		on potential confounders and assessed outcomes.	supplementary
53			information
54	Main findings	13a Give unadjusted estimates and, if applicable, confounder-adjusted	NA
55		estimates along with 95% confidence intervals and p-values.	
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		For multivariable analysis, provide information on the model building process, model fit statistics, and model assumptions (as appropriate).	NA
	13b		
		Provide details about any sensitivity analysis performed. If there are considerable amount of missing data, report sensitivity analyses comparing the results of complete cases with that of the imputed dataset (if possible).	NA
	13c		

Discussion

Limitations	14	Discuss the limitations of the study, considering sources of potential biases and imprecisions, such as non-representativeness of sample, study design, important uncontrolled confounders.	13
Interpretations	15	Give a cautious overall interpretation of results, based on potential biases and imprecisions and suggest areas for future research.	13-14
Generalizability	16	Discuss the external validity of the results.	14

Other sections

Role of funding source	17	State whether any funding organization has had any roles in the survey's design, implementation, and analysis.	16
Conflict of interest	18	Declare any potential conflict of interest.	16
Acknowledgements	19	Provide names of organizations/persons that are acknowledged along with their contribution to the research.	16

Supplementary information 5. Survey tool administered digitally via JISC survey tool**Consent form**

1. I confirm that I have read the information sheet [V2 11/01/2023] for this study on the previous page.
2. I have had the opportunity to consider the information, ask questions and have had any questions answered satisfactorily.
3. I understand that my participation is voluntary and that I am free to withdraw at any time before submitting the results without giving any reason.
4. I understand that the information collected about me will be used to support other research in the future and may be shared anonymously with other researchers.
5. I understand if I give my contact details they will be stored securely by the research team for 5 years for the purpose of sharing progress and inviting participation in follow up activity related to this project.
6. I agree to take part in the above study.

Demographic details

7. What is your age?
8. How many years of experience in infection control do you have?
9. Please specify any formal qualifications you have in infection control. If you have none, please write 'none'.
10. What is your gender?
11. Please specify your profession.
- 11.a. If you selected Other, please specify:
Please specify your role.
12. Have you ever been involved in managing an outbreak?
13. Do you currently use a tool or framework to assist with the production of outbreak management plans/to document decisions? (e.g. software. Excel, paper-based tool).
If the answer is no please write 'no' if yes, please specify.
14. Do you work in an acute or non-acute setting?
15. Which region do you work in?

Non-Likert scale questions

The following questions relate to the availability of outbreak management data within your IPC service.

Please assess honestly whether you could access the following data related to the most recent confirmed outbreak you were involved with:

16. Was a clearly documented outbreak management plan produced describing all outbreak control measures implemented during the outbreak?
17. Do you have dedicated surveillance support within your team?
18. If asked to, could you state which IPC interventions were implemented during this outbreak?

- 1
2
3 19. If asked to, could you state how these interventions were evaluated?
4 20. Can you state the number of IPC audits conducted during the outbreak. (e.g., hand
5 hygiene, personal protective equipment, environmental)?
6 21. Were all these audits followed up with an action plan?
7 22. Is there evidence of these plans being followed up?
8 23. Was there an action log created to keep track of actions, staff assigned and action
9 status?
10 24. Is there a summary document for example, a document containing all details of the
11 outbreak management effort including epidemiological data and interventions
12 implemented, produced at the end of the outbreak?
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Likert Scale statements

(related to identification of outbreaks)*

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19 26. We have robust processes to identify outbreaks.
20 26.a. I feel it is unlikely that we would miss an outbreak within my organisation.
21 26.b. I feel confident that we identify outbreaks as early as possible.
22 26.c. We have effective surveillance support within the team.

(related to investigation of outbreaks)*

- 23
24
25 26.d. The causes of outbreaks are always investigated as a priority within outbreaks I have
26 been involved in.
27 26.e. We routinely find the cause of the outbreak.
28 26.f. I am familiar with the processes used to investigate outbreaks.
29 26.g. The cause of the outbreak was not considered important within outbreaks I have been
30 involved with.

(related to development of case definition)*

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32
33 26.h. Within outbreaks I have been involved with there has always been a clear case
34 definition.
35 26.i. I feel confident formulating case definitions for outbreaks.
36 26.j. I don't think that case definitions are an essential part of outbreak management.

(related to control of outbreaks)*

- 37
38
39 26.k. Approaches to outbreak management plans you have been involved with have been
40 systematic and well planned.
41 26.l. Infection control interventions implemented as part outbreak control efforts you have
42 been involved in are well evaluated for effectiveness.
43 26.m. I feel in control when I am involved with managing an outbreak.
44 26.n. In my view, staff in areas affected by outbreaks feel like outbreaks are well controlled
45 using our current methods.

(related to communication surrounding outbreak management)*

- 46
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48 26.o. I feel that information about outbreak management interventions are communicated
49 effectively to relevant stakeholders.
50 26.p. I always know what is being done to control an outbreak when it is ongoing.
51 26.q. The outbreak control team effectively communicate between one another to manage
52 outbreaks.
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54

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56 27. Please use this space to add any additional information about your experiences of
57 outbreak management which you feel may be relevant. (free text)
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3 ***text in brackets was not visible to respondents but illustrates how attitude scales**
4 **were constructed for each outbreak management phase.**
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For Peer Review

Supplementary information 6. FOI request

I am writing to make a request under the Freedom of Information Act 2000 for information about how your Trust has managed outbreaks of communicable disease.

Specifically, I would like to request the following information:

1. The total number of communicable disease outbreaks (by organism / resistance mechanism) that have occurred within the Trust over the past two years.
2. For the most recent, concluded outbreak, I would like to know the number of staff and patients who were involved.
3. For the most recent, concluded outbreak, please provide the details of the interventions that were put in place to manage the outbreak, including (but not limited to) any infection control measures, isolation procedures, and contact tracing activities.
4. For the most recent, concluded outbreak, please state how the interventions were assessed for effectiveness, including any data or analysis that was used to evaluate their success.
5. Please state any digital tools you use as part of your outbreak management processes. This might include, for example, Word, Excel, ICNet.

I have provided an example data collection table below. Please indicate explicitly, as stated in the table, if data cannot be obtained within the 18 hours because of how it is collected or if the data is not collected.

Data collection table

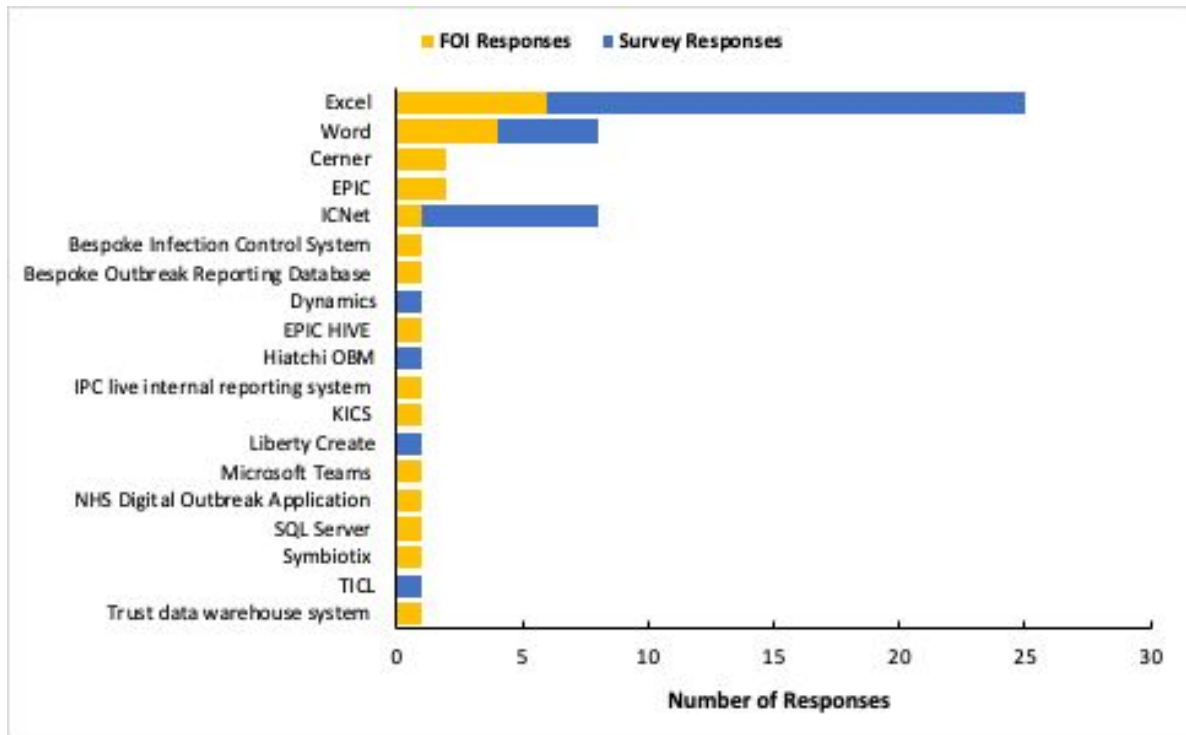
Number of communicable disease outbreaks (by organism / resistance mechanism that have occurred within the Trust over the last two years)		For the most recent outbreak,	For the most recent outbreak	For the most recent outbreak	Digital tools used as part of outbreak management processes
		The number of staff and patients who were involved	Details of the interventions which were put in place	The effectiveness of each intervention	
Organism	Number of outbreaks	Number of staff: Number of patients:	List of interventions: 1- 2- 3-	Evaluation method for intervention: 1- 2- 3-	Digital tool: 1- 2- 3-
This data is not collected in a way which can be accessed within 18 hours		This data is not collected in a way which can be accessed within 18 hours	This data is not collected in a way which can be accessed within 18 hours	This data is not collected in a way which can be accessed within 18 hours	We do not use digital tools as part of our outbreak control processes
This data is not collected		This data is not collected	This data is not collected	This data is not collected	N/A

Please provide the information in an electronic format if possible, and within the 20 working day deadline set out by the Freedom of Information Act. If you need any clarification or further information to assist you in providing this information, please let me know as soon as possible.

Thank you for your attention to this matter.

Yours faithfully,

Figure 1. The number of NHS trusts / survey respondents identifying which digital tools are used within their OM processes.



Review

Table 1. FOI response data

NHS Trust	Able to report number of outbreaks w/wo covid in last 2 years	Able to report number of patients/ staff involved in most recent outbreak	Able to list interventions implemented during last outbreak	Were interventions evaluated?	Able to report how were interventions evaluated	Number of digital tools used within OM process
1	Yes	Yes	Yes	Not evaluated	NA	Unclear, two bespoke systems used
2	Yes	Yes	Yes	Evaluation not aggregated by intervention. Less cases noted as evidence of efficacy.	Unclear	3
3	Yes	Yes	Yes	Not clear	Audits and 'monitoring'	5
4	Yes	Yes	Yes	Not evaluated	NA	2
5	Only provided data on COVID outbreaks	Yes	Yes	No data collected	NA	3
6	Yes	Yes	Yes	Not clear	Undefined audits	3
7	No	Not recorded in a retrievable form	Not recorded in a retrievable form	Not recorded in a retrievable form	Not recorded in a retrievable form	1
8	Yes	Yes	Yes	Not evaluated	NA	1
9	Yes	Yes	Yes	Not clear	Audits	4
10	Unable to provide data	Unable to provide data	Unable to provide data	Unable to provide data	Unable to provide data	Unable to provide data

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3 **Title:** Perceptions and Digitalisation of Outbreak Management in UK Health Services: A Cross-
4 Sectional Survey
5
6

7 **Abstract**
8
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10 **Background:**

11 **Global challenges arise from infectious disease which represent significant challenges to the**
12 **provision of healthcare, requiring efficient management procedures to limit transmission.** Evaluating
13 current outbreak management processes within UK healthcare services is essential for identifying
14 strengths, weaknesses, and potential improvements.
15
16

17 **Objectives:**

18 This study aimed to assess infection prevention and control (IPC) practitioners' access to outbreak
19 management (OM) data. Secondary objectives involved determining IPC practitioners' perceptions
20 of outbreak management processes and the state of digitalisation of OM in the UK.
21

22 **Methods:**

23 National cross-sectional survey data were collected to evaluate current outbreak management
24 approaches. To supplement this, information requests were sent to the ten largest teaching and
25 research NHS hospital trusts in England.
26

27 **Findings:**

28 The survey received 55 responses with 53 considered for analysis. Out of ten NHS trusts, 9 provided
29 completed FOI responses, while one was unable to provide data.
30

31 **Discussion:**

32 The study offers unique insights into prevailing outbreak management practices within UK health
33 services. Although positive perceptions surround key outbreak management stages, concerns arise,
34 including varying confidence levels in surveillance processes' robustness, efficacy of management
35 interventions, and communication effectiveness.
36

37 **Conclusions:**

38 **The study highlights challenges with OM processes in the UK, including issues like poor surveillance**
39 **and delayed outbreak detection. Positive practitioner perceptions contrast with concerns over data**
40 **collection, follow-up, and limited digitalisation, relying on basic tools like Excel and Word, hindering**
41 **retrospective learning.**
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43
44

45 **Key words:** Outbreak management, processes, perceptions, preparedness, resilience
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48 **Word count:** 4062
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Introduction

Background

Outbreaks of infectious diseases pose significant challenges to healthcare systems worldwide, requiring effective and timely response strategies to mitigate impact on public health. Infection prevention and control (IPC) and public health practitioners in the UK play a crucial role in managing outbreaks and safeguarding the population from the spread of communicable diseases. To ensure the effectiveness of existing outbreak management (OM) processes, it is necessary to assess the current state of processes within the UK healthcare system. IPC practitioners play a pivotal role, working to prevent the transmission of infections and maintain nationally mandated standards of patient safety (Health and Social Care Act 2012). Limited research has been conducted to comprehensively evaluate the availability of key outbreak management data and the efficacy of current approaches within the UK. The author is not aware of any studies or reviews of the processes used to manage outbreaks of communicable diseases in the UK. Existing evidence points towards inconsistencies within this area of practice (Centre for Workforce Intelligence 2015, Hale et al 2015). Notably, a cross-government exercise to test the UK's response to a serious influenza pandemic that took place in October 2016 involving more than 950 people concluded that:

'the UK's preparedness and response, in terms of its plans, policies and capability, is currently not sufficient to cope with the extreme demands of a severe pandemic that will have a nation-wide impact across all sectors' (Exercise Cynus Report 2017, page 6)

The lack of regulation and information about the current size, nature, and practices of the infection control workforce in the UK (CWI 2015) may explain the paucity of data indicating how highly specialised processes such as outbreak management are conducted and could therefore be improved upon. Understanding the access to and understanding of key outbreak management processes among IPC practitioners is essential for identifying potential barriers to effective outbreak response. Resource availability, including outbreak protocols, surveillance requirements, and outbreak investigation reports, is vital for informed decision-making, prompt action, and coordination of resources. Assessing practitioners' perceptions of the efficacy of current local approaches to OM is crucial for improvement and optimisation of outbreak response strategies. Experienced IPC practitioners possess valuable knowledge and insight into the strengths and weaknesses of existing practices. Their perspectives can help identify areas of improvement, guide policy decisions, and inform future strategies to enhance outbreak management processes.

Purpose

The research question for this study was:

- How do UK IPC services currently manage outbreaks of communicable disease?

Objectives:

1. Determine the perceptions of UK-based IPC practitioners on the efficacy of current approaches to OM in their respective organisations.
2. Determine the accessibility of key data to support OM efforts.
3. Determine the current state of digitalisation of OM processes in UK health services.

By conducting a widely distributed cross-sectional survey of UK-based IPC practitioners and incorporating data obtained from Freedom of Information (FOI) requests, this study aimed to fill the existing knowledge gap by exploring both the access to key outbreak management data and the perceptions of IPC practitioners regarding the effectiveness of current approaches. This comprehensive approach provides an insight into the current state of outbreak management in the UK health services.

Methods

Study design

The study utilised two data collection methods. **These included a cross-sectional survey and freedom of information requests to leading NHS trusts.** The survey tool utilised 27 questions including demographic information and general questions exploring the availability of key surveillance functions within the respondent's services. This was followed by Likert scale questions exploring perceptions of each aspect of outbreak management processes. The outbreak management process comprises key stages (Sistrom and Hale 2006, Torok et al 2016) which were used as the focus of attitude scales. Firstly, the 'Identification' stage, involving identification of infection rates deviating from what is expected, identified through surveillance or clinical observations. Secondly, the 'Surveillance' stage includes collecting samples and interviewing potentially affected patients to understand the nature of the outbreak. In the 'Case Definition' stage, healthcare professionals collaborate to create a precise description of affected patients based on specific criteria. 'Control Measures' involve implementing interventions to halt the outbreak's transmission. Lastly, effective 'Communication' describes the dissemination of outbreak information to stakeholders, patients, and staff, ensuring swift and accurate updates. A free-text question was also included to allow respondents to provide additional details.

In addition to the survey, FOI requests were sent to the Shelford Group, the 10 largest and leading NHS trusts. The structure of this request was based on the research objectives and sought to determine what data NHS organisations held, to understand how they managed and reviewed their performance of outbreak management. The use of FOI requests is recommended to access data which is not otherwise disclosed (Fowler et al 2013). Guidance provided by the University College London (2012) on FOI for academic researchers informed the methodology. In cases where data was

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2
3 initially withheld, FOI officers were informed of the purpose of the request to encourage a response.
4 The request was made using explicit questions including example responses where relevant, a data
5 collection table was also provided to facilitate the request. The time limit (18 hours) within which
6 FOI requests must be fulfilled provided insights into not only what data was available, but also how
7 rapidly these data could be provided. The data requested included:
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- 10 ● The number of communicable disease outbreaks (by organism / resistance mechanism) that
11 have occurred within the trust over the last two years.
- 12 ● For the most recent outbreaks:
 - 13 ○ the number of staff and patients involved.
 - 14 ○ interventions which were put in place.
 - 15 ○ how the effectiveness of each intervention was evaluated.
- 16 ● The digital tools used as part of the outbreak management process.

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21 As per the UCL (2012) guidance this study did not rely solely on FOI data and instead this was used to
22 triangulate cross-sectional survey data to achieve a more complete picture of outbreak management
23 processes in the UK. Importantly, this research aimed not to single out specific NHS trusts regarding
24 their outbreak management procedures, but rather to provide insights into current practices that
25 can inform and support investment into research and development of outbreak management
26 practices. Consequently, individual trusts are not identified within the analysis. Freedom of
27 Information (FOI) requests used to collect data are considered public records, reinforcing the
28 transparency and openness of the study.
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33 **Data collection methods**

34 The survey tool was piloted with responses from five IPC specialists who responded to the survey
35 then provided feedback on the content and wording of the survey. This pilot identified only minor
36 issues with the demographic elements and as such the pilot data were included in the final analysis
37 as no significant changes were made to the survey tool. The demographics of the pilot sample
38 included a majority (n=3) who had over 10 years of experience in IPC with the remainder having
39 between 5-10 years of experience in IPC (n=2). The age of the respondents ranged from 35-64. The
40 majority were female (n=3) with the remainder being male (n=1) or preferring not to say (n=1).
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45 **Sample characteristics**

46 The target population for the survey included infection control practitioners of any professional
47 background who had experience of managing outbreaks of communicable disease. There is currently
48 no data available on the number of IPC practitioners working within the NHS according to the most
49 recent Center for Workforce Intelligence [report](#) (2015). The report also notes the membership of the
50 Infection Prevention Society, which was over 2000 as of 2023. However, this membership will
51 include individuals not involved in the operational management of outbreaks including researchers,
52 commercial representatives and link workers with no direct responsibility for managing outbreaks.
53 Due to the limited sample sizes and unclear overall size of the study population, performing a power
54 calculation to determine the statistical significance of the survey responses was not possible. The
55 survey was therefore closed after a predetermined period of eight months.
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Survey / FOI request

The survey was conducted digitally using the JISC online survey tool. FOI requests were sent via the relevant pathways as required by each NHS organisation.

Administration

The survey data collection period was eight months from January to August 2023. The survey was distributed via established UK-based professional networks for practitioners working in the field of infection control. These included the Infection Prevention Society, the Hospital Infection Society and the Queen's Nursing Institute Infection Prevention and Control Champions Network and UK-based higher education courses related to infection control (identified via IPS UK IPC courses list published online). A QR code link to the survey was also shared by the author during talks provided during the survey period. In addition, a social media advert was shared by the research team on social media, Twitter and LinkedIn, inviting individuals meeting the inclusion criteria to contact the author to receive a survey link. The survey link was not published directly in any public forums to ensure that only responses from practising professionals were considered.

Ethical considerations

This research was given a favourable ethical opinion by the University of Salford Ethics Committee. The survey was conducted anonymously, and no personal identifiable data was collected within the tool.

Statistical analysis

Data was analysed using descriptive statistics and content analysis (Vaismoradi et al., 2013). Likert scale responses were analysed using Cronbach's alpha coefficient (Tavakol, & Dennick 2011). Statements grouped into scales representing the five aforementioned stages of outbreak management e.g. 'identification of outbreaks', 'surveillance'. The Cronbach's alpha coefficient provides insight into the consistency of responses (Eisinga et al 2013) related to each stage of the outbreak management process which is useful for indicating which aspect(s) of the OM process IPC practitioners have negative / positive perceptions of based on their current practice. The coefficient was calculated using SPSS version 29.01.1 (171). A Cronbach's alpha coefficient of 1 indicates high internal reliability of a scale, and a coefficient of 0 indicates no internal reliability. Due to the pragmatic realities of research in small, hard-to-reach populations of unknown size such as the UK IPC practitioner population, additional tests for reliability such as criterion or construct validity were not conducted.

As the target population size is unknown and the survey was distributed via multiple channels, it is unknown how many people received access to the link. As such calculation of a non-response rate is not feasible.

Results

Respondent characteristics

The full details of respondent demographics can be seen in Supplementary Information 1. Respondents were predominantly between 35-54 years old (n=28, 75.5%), with 37.7% (n=20) in both the 45-54 and 55-64 age groups. The majority (n=30, 56.6%) had over 10 years of IPC experience, while 24.5% had 5-10 years and 18.9% (n=10) had 1-5 years. Formal qualifications included master's degrees (n=9, 17.0%) and study at master's level (n=8, 15.1%). Participants without IPC qualifications account for 20.8% (n=11). Female respondents made up 88.7% (n=47), males 9.4% (n=5), and 1.9% (n=1) chose not to disclose their gender. Nurses dominate the sample (n=46, 86.7%). Respondents from acute settings comprised 30.1% (n=16), non-acute 50.9% (n=27), and 18.7% (n=10) work in both settings. Geographically, the North West (n=17, 32.1%), Yorkshire and the Humber (n=7, 13.2%), and the South West (n=5, 9.4%) are well-represented although all regions of the UK were represented. Two responses were removed from the analysis due to either not being UK-based or not working as a specialist in infection control, and not having been involved in the OM process.

Descriptive results

The survey contained both Likert and non-Likert scale questions related to the five broad outbreak management domains. Full responses to all Likert scale questions can be seen in Supplementary Information 2.

Identification of outbreaks

Non-Likert scale questions

The majority of respondents (n=27, 50.9%) indicated that they had no dedicated surveillance support within their teams.

Likert scale questions

There were four statements in the attitude scale for identification of outbreaks. The scale showed good internal consistency with a Cronbach's Alpha coefficient of 0.84. Majorities agreed that they have robust processes to identify outbreaks (n=44, 83.0%). Twelve respondents (22.6%) indicated that they thought it likely that their organisation would fail to detect an outbreak, this correlated with confidence in timely detection of outbreaks for which 13 respondents (24.5%) felt their organisations do not identify outbreaks as early as possible. This may be explained by variance in perceptions of the robustness of surveillance support for which 16 respondents (30.2%) felt it was ineffective in their organisations.

Outbreak investigation

Non-Likert scale questions

Most respondents (n=35, 66.0%) indicated that they were aware of the number of IPC audits conducted during the last outbreak they managed. From this, (n= 33, 62.3%) reported a subsequent creation of an action plan and 47.2% (n=25) reported that these action plans were followed up.

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5 *Likert scale questions*

6 There were four statements in the attitude scale for outbreak investigation. The scale showed fair
7 internal consistency with a Cronbach's Alpha coefficient of 0.67. The majority of respondents (n=41,
8 77.4%) agreed that the causes of outbreaks are always investigated. There were mixed responses to
9 a statement regarding the causes of outbreaks with less than half (n=25, 47.2%) indicating that they
10 routinely determine the causes of outbreaks. Almost all respondents (n=51, 96.2%) indicated that
11 they were familiar with the processes used to investigate outbreaks. Most respondents (n=35,
12 66.0%) agreed that the cause of outbreaks was considered important within outbreaks that they had
13 been involved with.
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17 **Case definition**

18 There were no non-Likert scale questions for this domain.
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21 *Likert scale questions*

22 There were three statements in the attitude scale for case definition. This scale showed a notably
23 poor Cronbach's Alpha coefficient of 0.29. Most respondents (n=40, 75.5%) indicated that there is
24 always a clear case definition for outbreaks they have been involved with. The majority (n=42,
25 79.2%) indicated they felt confident formulating case definitions and agreed that case definitions are
26 an essential part of outbreak management (n=36, 67.9%).
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30 **Control measures**

31 *Non-Likert scale questions*

32 Most respondents (n=52, 98.1%) indicated that they could state which IPC interventions were
33 implemented during the last outbreak they managed. However, only 52.8% (n=28) indicated that
34 they could say how the efficacy of these interventions had been evaluated.
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38 *Likert scale questions*

39 There were four statements in the attitude scale for control measures. The scale showed good
40 internal consistency with a Cronbach's Alpha coefficient of 0.86. The majority agreed that
41 approaches to outbreak management planning had been systematic and well planned (n=36, 67.9%).
42 Just over half of respondents (n=29, 54.7%) indicated that IPC interventions implemented as part of
43 outbreak control efforts were well evaluated for effectiveness. However, most respondents (n=39,
44 73.6%) indicated that they felt in control when managing outbreaks and 64.2% (n= 34) felt that staff
45 in areas affected by outbreaks felt like the outbreaks are well controlled.
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50 **Communication**

51 *Non-Likert scale questions*

52 The majority (n=42, 79.2%) indicated that a clearly documented outbreak management plan
53 detailing control measures was produced during the most recent outbreak they were involved with.
54 The majority of respondents indicated that an action log is kept tracking actions, staff assigned to
55 complete the action and the action status (n=33, 62.3%). 58.5 % (n = 31) of respondents indicated
56 that a summary document was created containing all details of the outbreak management effort at
57 the end of the outbreak.
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Likert scale questions

There were three statements in the attitude scale for communication. The scale showed good internal consistency with a Cronbach's Alpha coefficient of 0.82. Most respondents (n=39, 73.6%) felt that information about outbreak management interventions are communicated effectively to relevant stakeholders. Most (n=42, 79.2%) indicated that they felt knowledgeable about control efforts during ongoing outbreaks. Fewer (n=39, 73.6%) felt that members of the outbreak control team effectively communicate between one another to manage outbreaks.

The last question of the survey offered respondents the opportunity to provide any additional information about their experiences of outbreak management. In total 47.2% of respondents (n=25) provided a free text response. These responses were insufficient for robust qualitative analysis however, they indicated issues related to currently employed approaches to outbreak management in the UK.

One respondent indicated that there is a lack of clarity around processes to support the outbreak management response:

'There is no set process established currently that enables effective outbreak management, the processes and guidelines required are unclear and appear to be reactive rather than proactive. Outbreak management presently seems driven more by organisational pressures than patient safety.'

Some respondents suggested that there is apathy towards investment in developing the specialty of IPC which they felt hinders improvement of outbreak management processes.

'The IPC team is vastly understaffed to enable effective education and support and daily interventions at the site of the infection. There has been no investment in surveillance software for infections despite repeated requests...without the adequate levels of IPC staff to implement training to be a preventative service we then become passive observers of outbreaks.'

Freedom of Information Requests

In total, completed FOI responses were received for nine out of the ten NHS trust contacted. One trust responded but did not provide the data, citing exemption under section 12 of the Freedom of Information Act and stating that it would be prohibitively expensive to retrieve the requested data, and not possible within 18 hours. Details of the responses can be seen in Table 1.

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3 **Table 1.** FOI response data
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11 Data were collected from both the FOI requests and the survey to identify any digital tools currently
12 in use as part of the outbreak management process. Survey respondents were also asked to identify
13 any frameworks or tools they used to manage outbreaks. Figure 1 illustrates the digital tools
14 reported by both survey respondents and within FOI responses.
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20 **Figure 1.** The number of NHS trusts / survey respondents identifying which digital tools are used
21 within their OM processes.
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28 A total of nine (18.5%) survey respondents indicated that they currently use no tools or frameworks
29 to assist with the production of outbreak management plans and to document decisions, with five
30 survey respondents (9.4%) respondents indicating they used paper-based tools.
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Discussion

This is the first study to examine outbreak management processes within UK health services. To the authors knowledge, this is also the first cross-sectional survey undertaken of the UK IPC workforce related to OM. There are currently no nationally recognised measures for assessing outbreak management efficacy. The field of outbreak management, from an operational perspective, is still relatively understudied, and little is known about the attitudes of and understanding held by practitioners in this domain. This study utilised data from both a survey and FOI requests. There were variations noted between responses to these differing data collection approaches.

Within survey responses, respondents held mixed perceptions of current outbreak management (OM) approaches. They generally viewed performance in the five key OM stages positively, for example respondents typically reported that felt they have robust processes to identify outbreaks (n=44, 83.0%), most (n=41, 77.4%) agreed that the causes of outbreaks are always investigated, that approaches to outbreak management planning had been systematic and well planned (n=36, 67.9%) and most respondents (n=39, 73.6%) indicated that they felt in control when managing outbreaks. A specific attitude scale regarding case definitions showed poor internal reliability. Reversed directionality in a scale statement (see 26.j in Supplementary Information 2) may have led to misinterpretation. Other findings highlighted uncertainty in interventions' follow-up and audit effectiveness. Within free-text responses respondents cited factors like unclear OM processes, surveillance limitations, and apathy towards IPC as a specialty.

Within FOI requests, a notable theme was confusion surrounding the interpretation of 'intervention' and 'evaluation'. Responding organisations exhibited uncertainty in distinguishing between these concepts, making retrospective reviews challenging in OM. The use of epidemiological data to determine OM efficacy was limited, with only one trust reporting such practices. Although it is feasible, that OM teams may review epidemiological data, the FOI responses contradict the generally positive perceptions of data availability and outbreak control as reported in the survey. Although evaluation of outbreak interventions may be considered expensive and impractical (Pegorie et al 2014), it may be facilitated if efforts are made to proactively collect additional quantitative or qualitative data to help determine if interventions were effective.

Regarding data to support OM, most respondents claimed awareness of interventions, diverging from FOI results which showed poorly documented and even inaccessible data relating to interventions. The FOI data revealed a diversity of interpretations of the term 'intervention', in some cases these were ambiguously defined, e.g. 'enhanced hand hygiene' 'monitoring by IPC experts' and 'situation reporting' or even concept such as 'duty of candour'. Interventions varied, with emphasis on cleaning, communication, and screening/isolation. IPC staff presence was reported as valuable. Few trusts explicitly evaluated intervention efficacy, often detailing audits, or use of published guidance as a measure of effectiveness. Thereby assuming the audited intervention, itself is effective or that the guidance is appropriate in all situations within which it was applied. Full details of the reported OM interventions can be seen in Supplementary Information 3. In relation to basic data on the number of outbreaks it was noted that four trusts were unable to provide the number of outbreaks they had experienced over the two years prior, indicating that documentation of outbreak occurrence and related intelligence is poor.

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5 In relation to digitalisation of the OM process, the data from both the survey and FOI requests
6 indicated that currently Microsoft Excel and Word are the most used digital tools. **The use of which**
7 **pose challenges as the unintended use of these applications introduces the potential for**
8 **compromised data integrity, inaccuracy, and limits the utility of the recorded information. These**
9 **non-standardised tools may lead to data fragmentation and hinder effective collaboration between**
10 **healthcare organisations (Peng et al 2020).** To improve outbreak response quality, efforts are
11 needed to establish a standardised approach to OM and a minimum data set requirement to enable
12 retrospective review of outbreaks.
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16 Healthcare authorities should consider adopting standardised digital platforms designed for real-
17 time data sharing and interoperability, enabling swift and informed decision-making during
18 outbreaks. By utilising standardised systems, health services could enhance preparedness and
19 response capabilities, ultimately improving the effectiveness of outbreak management efforts. This
20 issue was also identified in a recent study on electronic data collection in low and middle-income
21 countries (Keating et al 2021).
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25 Finally, within FOI responses it was noted that there were discrepancies in defining the term
26 'outbreak' across trusts, with one trust notably using 'outbreak,' 'cluster,' and 'sporadic cases'
27 interchangeably. This lack of clarity may affect accurate outbreak reporting and hinder efforts to
28 understand the true nature and scale of outbreaks.
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32 Future research should focus on establishing a minimum data set required for effective outbreak
33 management efforts, in addition to development of new digital tooling which can be integrated
34 across organisations to facilitate learning from outbreaks. Further qualitative study is also needed to
35 better understand the processes employed currently by teams responsible for OM to provide
36 greater depth to our understanding of what influences perceptions of practice in this area among
37 IPC practitioners.
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41 **Limitations**

42 The survey's limited sample size might not fully capture nationwide practices, yet assessing
43 significance is complex due to the absence of comprehensive data about the UK IPC workforce.
44 Studies looking to understand the IPC workforce in the UK have typically used small samples, for
45 example an early study which utilised interviews with only four IPC leads in UK NHS trusts to
46 understand IPC practices (Barrett et al 2008). A more recent survey seeking to establish how IPC
47 services best operate yielded only 70 responses (Burnett et al 2022), in this case the survey was
48 distributed via the Infection Prevention Society, however, the inclusion criteria for this study were
49 wider in that the respondents did not require experience in outbreak management.
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54 FOI requests were only sent to the Shelford Group of NHS Trusts due to practicalities, but other
55 smaller providers may have valuable contributions however this was beyond the scope of this study.
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Conclusion

Overall, the findings of this study indicate that there are currently challenges associated with approaches to OM within the UK healthcare system. Whilst the perceptions of IPC practitioners appear broadly to be positive towards the process, issues were identified. These include poor surveillance processes potentially leading to delayed outbreak detection and limiting the ability to evaluate intervention efficacy using epidemiological data. A lack of robust data collection and follow up of interventions and audits was reported. Limited digitalisation of the process was identified, with a dependence on non-standardised Microsoft Excel and Word-based tools, limiting the accessibility of robust data and therefore precluding the possibility for meaningful retrospective learning from outbreaks.

References

Barrett, C., Hilder, D., & Prieto, J. (2008). Infection control team workforce project. *British Journal of Infection Control*, 9(4), 23-27.

Burnett, E., Cooper, T., Wares, K., et al. (2023). Designing an optimal infection prevention service: Part 1. *Journal of Infection Prevention*, 24(1), 3-10. <https://doi.org/10.1177/17571774221127695>

Centre for workforce intelligence (2015). Review of the IPC nurse workforce in the UK. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/507608/CfWI_Review_of_IPC_nurse_workforce.pdf

Department of Health and Social Care (2017). Exercise Cygnus. Retrieved from <https://www.gov.uk/government/publications/uk-pandemic-preparedness/annex-a-about-exercise-cygnus>

Eisinga, Grotenhuis, H. F. te, & Pelzer, B. . (2013). The reliability of a two-item scale: Pearson, Cronbach or Spearman-Brown? *International Journal of Public Health*, 58(4), 637–642. <https://doi.org/10.1007/s00038-012-0416-3>

Fowler, A. J., Agha, R. A., Camm, C. F., & et al. (2013). The UK Freedom of Information Act (2000) in healthcare research: A systematic review. *BMJ Open*, 3, e002967. <https://doi.org/10.1136/bmjopen-2013-002967>

Hale , R., Powell, T., Drey, N., Gould, D. (2015). Working practices and success of infection prevention and control teams: a scoping study. *Journal of Hospital Infection* 89, 2, 77-81.

Health and Social Care Act (2012). c. 7. Available at: <http://www.legislation.gov.uk/ukpga/2012/7/contents/enacted> (Accessed: 11th August 2023).

Keating, P., Murray, J., Schenkel, K., et al. (2021). Electronic data collection, management and analysis tools used for outbreak response in low- and middle-income countries: A systematic review and stakeholder survey. *BMC Public Health*, 21(1), 1741. <https://doi.org/10.1186/s12889-021-11790-w>

Sistrom MG, Hale PJ (2006) Outbreak investigations: community participation and role of community and public health nurses. *Public Health Nursing*. 23 (3), 256-263. doi: 10.1111/j.1525-1446.2006.230308.x

Pegorie, M., Shankar, K., Welfare, W. S., Wilson, R. W., Khuroya, C., Munslow, G., Fiefield, D., Bothra, V., & McCann, R. (2014). Measles outbreak in Greater Manchester, England, October 2012 to September 2013: epidemiology and control. *Euro surveillance : bulletin Europeen sur les maladies*

1
2
3 transmissibles = European communicable disease bulletin, 19(49), 20982.

4 <https://doi.org/10.2807/1560-7917.es2014.19.49.20982>

5
6
7 Peng, C., Goswami, P., & Bai, G. (2020). A literature review of current technologies on health data
8 integration for patient-centered health management. *Health Informatics Journal*, 26(3), 1926-1951.
9 <https://doi.org/10.1177/1460458219892387>

10
11
12
13 Tavakol, & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical*
14 *Education*, 2, 53–55. <https://doi.org/10.5116/ijme.4dfb.8dfd>

15
16
17 Török E, Moran E, Cooke FJ (2016) Infection control: surveillance of alert organisms. In Török E,
18 Moran E, Cooke FJ (Eds) *Oxford Handbook of Infectious Diseases and Microbiology*. Second edition.
19 Oxford University Press, Oxford, 130-202.

20
21
22 Vaismoradi, M., Turunen, H. and Bondas, T. (2013), Qualitative descriptive study. *Nursing & Health*
23 *Sciences*, 15, 398-405. <https://doi.org/10.1111/nhs.12048>

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30
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33
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36 this research. We also thank the 53 busy infection control practitioners who took the time to
37 provide us with this insight into OM processes in the UK.

40 **Supplementary information:**

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43 1-Survey demographic data

44 2-Likert scale responses

45 3-Outbreak interventions reported within FOI

46 4-CROSS checklist <https://link.springer.com/article/10.1007/s11606-021-06737-1>

47 5-Survey tool

48 6-FOI request

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