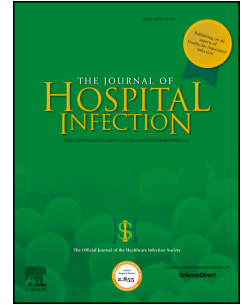


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Future priorities of acute hospitals for surgical site infection surveillance in England

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Running title: hospital priorities for SSI surveillance

Background: Since the launch of the national surgical site infection (SSI) surveillance service in 1997, successive expansions of the programme provided hospitals with increasing flexibility in procedures to target through surveillance. Ensuring the programme continues to meet hospitals' needs remains essential.

Aim: As a means to inform the future direction of the service, a survey of all acute NHS Trusts was undertaken to assess and understand priorities for surveillance.

Methods: A web-based survey was circulated to acute NHS Trust infection control teams in England asking them to identify and rank i) reasons for undertaking current SSI surveillance ii) priority surgical categories for future SSI surveillance and iii) reasons for prioritising these categories.

Findings: Of the 161 Trusts surveyed, 84 (52%) responded. Assessment of quality of care was identified as the most common driver for SSI surveillance activity. Considerable heterogeneity in priority areas was observed, with 24 different surgical categories selected as top priority. Of the procedures undertaken by 15 or more Trusts, Caesarean section (2.7), hip replacement (2.8) and coronary artery bypass graft (2.9) were highest ranked. All 17 categories in the current surveillance programme were selected as a top priority by one or more Trusts.

Conclusion: Whilst the majority of hospitals' priorities for SSI surveillance are included in the current programme, the top ranked priority, Caesarean section, is not included. Given the diversity of priority areas, maintaining a comprehensive spectrum of categories in the national programme is essential to assist hospitals in addressing local priorities.

Key words: Surgical Wound Infection; Surveys and Questionnaires; Population surveillance; England

Introduction

Surveillance of surgical site infection (SSI) can be an effective means to drive down rates of infection.[1;2] Studies have shown that well-organised surveillance with feedback of surgeon-specific, SSI rates to surgeons were associated with significant reductions in post-operative infection.[3-6]

Public Health England (PHE) provides a framework to assist hospitals in England to undertake surveillance of infections which occur as a result of major surgery. The aim of SSI Surveillance Service (SSISS) is to enhance the quality of patient care by encouraging hospitals to use data obtained from surveillance to compare local rates of SSI over time and against a national benchmark rate, and to use this information to review and guide clinical practice. The surveillance programme, which comprised 13 surgical categories when launched in 1997, expanded over time to encompass an additional 4 categories, primarily in response to demand by hospitals. In 2004, surveillance of infections in orthopaedic surgery was made mandatory for NHS hospital Trusts by the Secretary of State, and a recent Competitions and Markets Authority order compels private hospitals to collect and publish comparable data.[7;8] Beyond these requirements, hospitals preselect surgical categories from the SSISS programme to target for surveillance according to their own priorities from a range of surgical specialties spanning general, vascular, gynaecology, cardiothoracic, gastroenterology, neurosurgery and orthopaedics.

As an active surveillance programme, SSI surveillance is a resource-intensive process. As such, targeting certain procedures for surveillance may preclude surveillance in other areas if resources are limited. Both local and national strategic considerations are important to this selection process. Successive subgroups of the government Advisory Committee on Antimicrobial Prescribing, Resistance and Healthcare Associated Infections (APRHAI) have made recommendations for the focus of SSI surveillance in England.[9;10] The latest of these suggested a switch from orthopaedic

SSI surveillance to surgical categories with a higher risk of infection, especially colorectal surgery in recognition of the high infection risk and opportunity to drive down Gram-negative bacterial infections.[10;11]

To inform the future direction of the SSISS programme, and in particular the impact on participation in orthopaedic surgery surveillance should the mandate for participation be lifted as recommended by the last APRHAI subgroup, a survey was disseminated to all acute NHS hospital Trusts in England. The survey engaged stakeholders to identify their current drivers for undertaking SSI surveillance and gauge the procedures they would prioritise for future surveillance in the absence of the current mandate. In conjunction with wider public health considerations, the survey could inform national policy on hospitals' surveillance participation requirements and assess resources required locally and centrally in light of any proposed changes.

Methods

Survey population

All NHS (state funded) acute hospital Trusts in England performing adult and paediatric surgery.

Questionnaire design

An electronic questionnaire was designed using commercially available online software (SelectSurvey.Net). An introductory email explaining the aims and objectives of the survey was sent to all acute NHS hospital Trusts in England, including specialist centres, regardless of whether they had participated in the PHE SSI Surveillance Service. The email contained a uniform resource locator (URL) link to the survey and was sent to the Directors of Infection Prevention and Control (DIPC) of each Trust. This made clear that participation was completely voluntary and included instructions emphasising submission of one unified response per Trust reflecting the views of the entire infection control team. Respondents were assured that responses would be handled confidentially and published anonymously.

The survey questionnaire (see Supplementary materials) consisted of five questions, of which the first two had to be completed - the name of participating hospital Trust and the profession of the healthcare worker completing the survey. The survey questions asked Trusts to select and rank:

1. Five foremost reasons for currently undertaking SSI surveillance in the hospital.
2. Five surgical categories the hospital would prioritise for surveillance over the forthcoming three years in the absence of any government mandate.
3. Five key reasons for selecting the categories in question 2.

Surgical categories included in the list for questions 2 and 3 included all 17 in the current SSISS programme along with a further 17 based on additional categories included in the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) programme.[12]

The survey was available for completion for 4 weeks in July 2013; two reminders were sent to non-responders. Hard copies of the survey were also circulated to the Trusts who requested them, facilitating discussions between the IPC and surgical teams.

Statistical analysis

Responses from Trusts were collated as a single dataset from the online database. Descriptive statistical analyses were undertaken on aggregate data. Weighted average ranks were calculated to summarise priorities across hospital Trusts with weights based on the rank score selected. These were calculated as follows:

$$\bar{R}_i = \frac{\sum_{i=1}^6 i R_i}{N}$$

where R_i denotes number ranking i (with R_6 denoting number unranked), \bar{R}_i the average rank and N the number responding.

Results

The online questionnaire was distributed to a total of 161 hospital Trusts performing adult and paediatric surgery. Of these, 84 (52%) Trusts provided responses to the survey. Three Trusts supplied two responses and in two instances these were from the same individual. The latest (and most complete) response was used for analysis in two instances and a unified response created for one Trust from two part-completed responses supplied by the same individual.

Survey completion rates were slightly higher from general acute (54%, 62/115) than teaching Trusts (48%, 22/46; $\chi^2_{(1df)} = 0.49$, $p=0.485$) and from specialist paediatric, orthopaedic, cardiothoracic, burns and cancer trusts (56%, 10/18) than non-specialist Trusts (52%, 74/143; $\chi^2_{(1df)} = 0.09$, $p=0.761$) although in neither comparison were these differences statistically significant. Infection Control Nurses provided the majority of survey responses (61%; 51), followed by Infection Control Doctors (31%; 26) and other staff (8%;7).

The most frequent reason for performing SSI surveillance (Table I) was to assess the quality of care given to patients (81%), followed by compliance with government policy for mandatory orthopaedic surveillance (77%). Other reasons included understanding the prevention opportunities (74%), impact of SSI on the patients and hospital resources (69%) and early detection of outbreaks (63%).

Of the 34 surgical procedures included in the survey, the categories selected by the Trusts as their priority for surveillance over the next 3 years, assuming no mandatory requirement, identified Caesarean section and ventricular shunt as having the highest average rank amongst Trusts conducting these procedures (2.7; Tables II, III). Whilst Caesarean sections were performed by a large number of responders (46), ventricular shunts were performed by just 6 Trusts. 'Other' unspecified procedures were also ranked highly (2.7) by 3 Trusts although no further details on the nature of these procedures were given. Of the 19 surgical procedures undertaken by 15 or more

respondents (Figure 1), after Caesarean section the next highest ranked were hip replacement (2.8), coronary artery bypass graft (CABG; 2.9) and pacemaker and knee replacement surgery, equally ranked at 3.1. All 17 categories in the current SSI surveillance programme were among these 19, with Caesarean section and pacemaker surgery the only two missing from SSI surveillance programme in this sub-analysis.

The highest level of current local surveillance activity across all 34 categories was for hip (92%) and knee (89%) replacement followed by CABG (76%) and Caesarean section (57%) (Tables II, III). Hip and knee replacement, CABG and Caesarean section were most frequently selected by Trusts as their top priority (50%, 40%, 47% and 46% respectively) for future surveillance. Beyond these four categories, an array of 20 different surgical categories were selected as top priority for future surveillance, including all 17 categories currently within the SSI surveillance programme.

The reasons why Trusts selected each of their top ranked priority categories are indicated in Figure 2. Across all 33 categories selected by Trusts answering this question (n=67), opportunities for prevention was the highest ranked (average rank 2.6) followed by significant impact of the infection on patients (2.7) and need to establish baseline SSI rates (2.9). Of categories chosen by 5 or more Trusts, the significant impact of SSI on patients was ranked highest for cardiac surgery (including CABG), cholecystectomy, hip and knee replacement and spinal surgery. For caesarean section, the need to establish a baseline SSI rate was ranked highest (2.3), marginally above opportunities for prevention (2.3).

Discussion

Results from this survey provide a useful insight into the priorities for SSI surveillance among hospital Trusts in England. Orthopaedic procedures, specifically hip and knee replacement, were the most frequently selected as number one priority for future surveillance due to the impact of the infections on patients and the perceived preventability of these infections. Although infection rates are very low (less than 1%) for these clean surgical procedures[13], the overall burden of infection is none-the-less substantial, as they are very common procedures, each undertaken on over 100,000 patients per year in the UK.[14] Among SSIs identified within the last national point prevalence survey of healthcare-associated infections, orthopaedics/trauma made up a third of all SSIs in hospital inpatients.[15] The true burden becomes apparent in observing the impact of infections on patients and hospitals, in particular the need for further revision surgery and its associated high cost, and the potential for long-term disability.[14;16] Hospitals' recognition of this impact is likely to be as important an impetus for surveillance activity as the mandatory requirement to undertake this. This also chimes with the increasing trend towards continuous surveillance observed in these categories.[11]

Of 34 surgical categories from which Trusts could select their priorities for future surveillance, the 17 included in the current national SSI surveillance programme were all identified as priorities by one or more respondents. However, there was considerable diversity in the overall pattern of priority areas suggesting differing local needs. This supports the inclusions of a wide range of categories of surveillance within the programme to meet local needs.[17] However, a category not currently offered by the SSISS, Caesarean section, received the highest ranked priority for SSI surveillance over the next 3 years. The reasons most commonly chosen in support of Caesarean section being given a high rank included 'need to establish a baseline' along with 'opportunities for prevention' and 'significant impact of infection'. The high risk of infection post Caesarean section has been previously noted through a pilot study in England, averaging at 1 in 10, with the potential to substantially

reduce this risk observed in other parts of the UK.[18;19] Whilst the majority of SSIs following Caesarean section are superficial, given the high volume of such procedures, the less common severe infections amount to a significant burden of infection. Opportunities for prevention are evident with precipitous falls in SSI rates following initiation of surveillance noted in a recent global assessment of the impact of surveillance.[2;20] In contrast, reductions in SSI following colorectal surgery were more modest, illustrating the challenge to reduce Gram-negative bacterial infections.[2;21] Further evidence to compare clinical and costs effectiveness of surveillance between categories, along with development of cross-speciality measures of burden, will assist hospitals in future prioritisation.

Many hospitals have been proactive in initiating local surveillance in categories they regard as a priority but not currently offered as part of the national surveillance programme, including Caesarean section and organ transplant. This demonstrates prioritisation of resource to improve patient care for categories not currently offered by the national surveillance programme and suggests expansion of the categories on offer may result in reasonable uptake to form robust benchmarks. Whilst specialist surgical procedures, in particular ventricular shunts, ranked highly amongst hospital Trusts performing these surgeries, benchmarking may prove difficult given the small number of hospitals performing these procedures. Potential uptake for highly ranked procedures, including pacemaker surgery, should however be explored further. At present in England only orthopaedic surveillance is mandatory.

The survey has limitations. Results may not represent the full national picture due to the low response rate although we note the mix of Trusts was broadly representative of acute Trusts as a whole in England. The responses reflect priorities at the time the survey was undertaken; periodic reassessment should be undertaken to ensure the programme remains current and meets hospitals' needs. Advances in surgical technique along with changes in population co-morbidities may present

new challenges in maintaining low infection rates in increasingly complex patients and procedures. As such, priorities for surveillance are likely change.

In conclusion, we identified considerable heterogeneity in Trusts' priorities for surveillance, indicating a need for the national surveillance programme to provide a comprehensive range of surgical categories to meet local needs. Whilst expansion to include Caesarean section needs to be considered, the resourcing for this needs to be explored given the potentially high uptake by hospitals. Broadening the scope of the programme to accommodate specialist procedures should also be considered where sufficient potential participation exists to support benchmarking. Developing future surveillance methodologies to reduce the burden of local data collection will be essential to facilitate hospitals' ability to implement increasingly comprehensive cross-specialty programmes of surveillance.

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Conflict of interest statement

None declared.

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Table I. Ranking of five foremost reasons for NHS hospital Trusts currently undertaking SSI surveillance

<i>Reason for currently undertaking surveillance (n=84)</i>	No. Trusts selecting ranking position							Average Rank
	<i>(1-5, 1=highest)</i>					Total	(%)	
	1	2	3	4	5			
Assess quality of care	37	14	5	6	6	68	(81.0)	2.7
Compliance with mandatory surveillance*	35	9	3	2	16	65	(77.4)	3.1
Opportunities for prevention	15	16	16	10	5	62	(73.8)	3.5
Significant impact of SSI	24	7	9	14	6	60	(71.4)	3.5
Early warning of outbreaks	8	17	18	8	3	54	(64.3)	3.8
Assess impact of interventions	6	8	11	16	8	49	(58.3)	4.4
Need to establish SSI rate	11	9	8	6	6	40	(47.6)	4.4
Current high rates of SSI	4	9	8	13	5	39	(46.4)	4.7
Significant resource burden	10	4	5	7	7	33	(39.3)	4.8
Past high rates of SSI	5	2	12	10	6	35	(41.7)	4.9
Commissioner request	6	5	2	4	12	29	(34.5)	5.1
High number of SSI (large no. patients)	2	1	4	8	9	24	(28.6)	5.4
Other reason	1	0	0	0	1	2	(2.4)	5.9

*Requirement of Department of Health

Table II: Ranking of surgical categories currently included in PHE SSISS programme as top five priorities for NHS hospital Trust over next 3 years assuming no mandatory requirement*

Surgical category [~]	No. performing surgery	No. undertaking surveillance (%)	Average rank	No. ranking category as top	No. ranking category as top 5 priority (%)
				priority (%)	
Hip replacement	64	59 (92%)	2.8	32 (50%)	47 (73%)
Coronary artery bypass surgery	17	13 (76%)	2.9	8 (47%)	12 (71%)
Knee replacement	63	56 (89%)	3.1	25 (40%)	46 (73%)
Repair of neck of femur	61	36 (59%)	3.7	16 (26%)	37 (61%)
Large bowel	61	23 (38%)	3.9	11 (18%)	38 (62%)
Vascular	39	11 (28%)	3.8	7 (18%)	26 (67%)
Cardiac	17	10 (59%)	3.9	4 (24%)	9 (53%)
Breast	60	15 (25%)	4.0	7 (12%)	39 (65%)
Spinal	31	9 (29%)	4.1	5 (16%)	17 (55%)
Cranial	15	5 (33%)	4.3	1 (7%)	7 (47%)
Reduction of long bone fracture	58	13 (22%)	4.8	5 (9%)	22 (38%)
Small bowel	59	13 (22%)	4.7	3 (5%)	24 (41%)
Abdominal hysterectomy	57	12 (21%)	4.7	4 (7%)	27 (47%)
Limb amputation	53	7 (13%)	4.8	2 (4%)	21 (40%)
Bile duct, liver, pancreatic	47	8 (17%)	4.8	4 (9%)	18 (38%)
Gastric	54	8 (15%)	4.9	4 (7%)	18 (33%)
Cholecystectomy	56	6 (11%)	5.0	1 (2%)	20 (36%)

*mandatory categories: hip, knee, reduction of long bone fracture, repair of neck of femur

[~] listed in order of average weighted priority rank (low average rank = high priority)

Table III. Ranking of surgical categories not currently included in PHE SSISS programme as top five priorities for NHS hospital Trust over next 3 years assuming no mandatory requirement*

Surgical category [~]	No. performing surgery	No. undertaking surveillance (%)	Average rank	No. ranking	No. ranking
				category as top priority (%)	category as top 5 priority (%)
Caesarean section	46	26 (57%)	2.7	21 (46%)	37 (80%)
Ventricular shunt	6	1 (17%)	2.7	1 (17%)	6 (100%)
Other (not specified)	3	2 (67%)	2.7	0	3 (100%)
Solid organ transplant	4	3 (75%)	2.8	1 (25%)	4 (100%)
Pacemaker	15	1 (7%)	3.1	4 (27%)	12 (80%)
Renal	9	1 (11%)	3.2	2 (22%)	7 (78%)
Oesophageal	5	2 (40%)	3.6	0	4 (80%)
Exploratory laparotomy	8	1 (13%)	3.8	0	5 (63%)
Appendectomy	13	0	3.9	0	9 (69%)
Hernia repair	4	0	4.0	1 (25%)	2 (50%)
Neck surgery	3	0	4.0	0	2 (67%)
Maxillofacial/ENT/oral	12	1 (8%)	4.1	1 (8%)	8 (67%)
Thoracic	8	3 (38%)	4.3	0	5 (63%)
Prostate	11	1 (9%)	4.4	0	5 (45%)
Ophthalmic	10	1 (10%)	4.5	0	5 (50%)
Shunt for dialysis	3	0	5.3	0	2 (67%)
Splenic	n/a	n/a	Not ranked	n/a	n/a

*mandatory categories: hip, knee, reduction of long bone fracture, repair of neck of femur

[~] listed in order of average weighted priority rank (low average rank = high priority)

Figure legends

Figure 1. Average weighted ranking* of surgical categories selected by NHS Trusts as priorities for surveillance over next 3 years

* categories where ≥ 15 currently performing surgery (low average rank = high priority)

Figure 2. Average weighted ranking of reasons NHS Trusts selected surgical category* as a priority for surveillance over next 3 years

* categories with ≥ 5 responses (low average rank = high priority)



Figure 1.

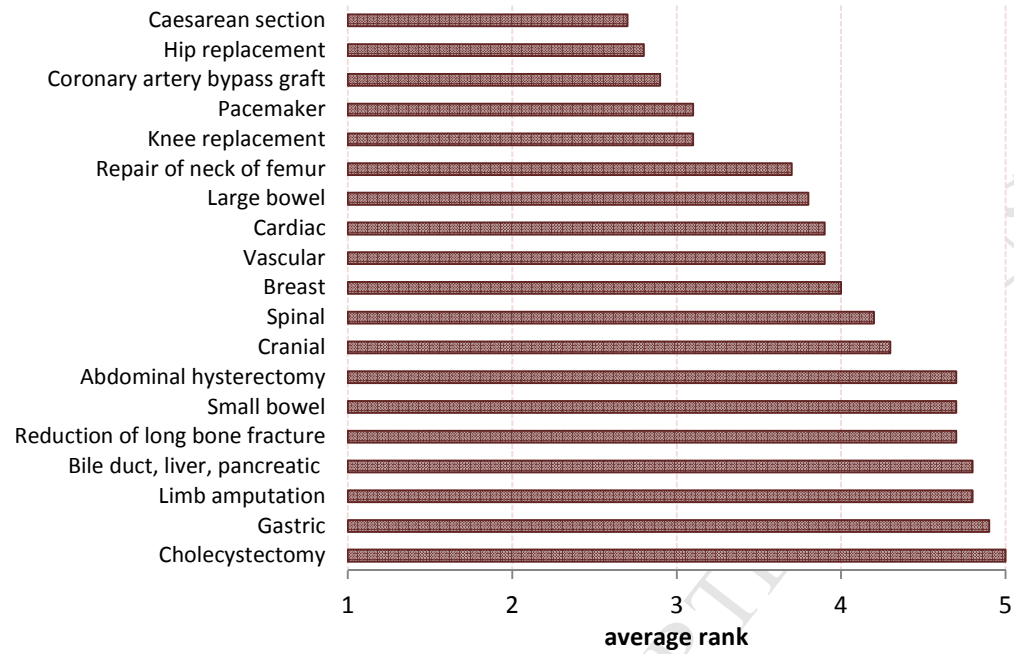
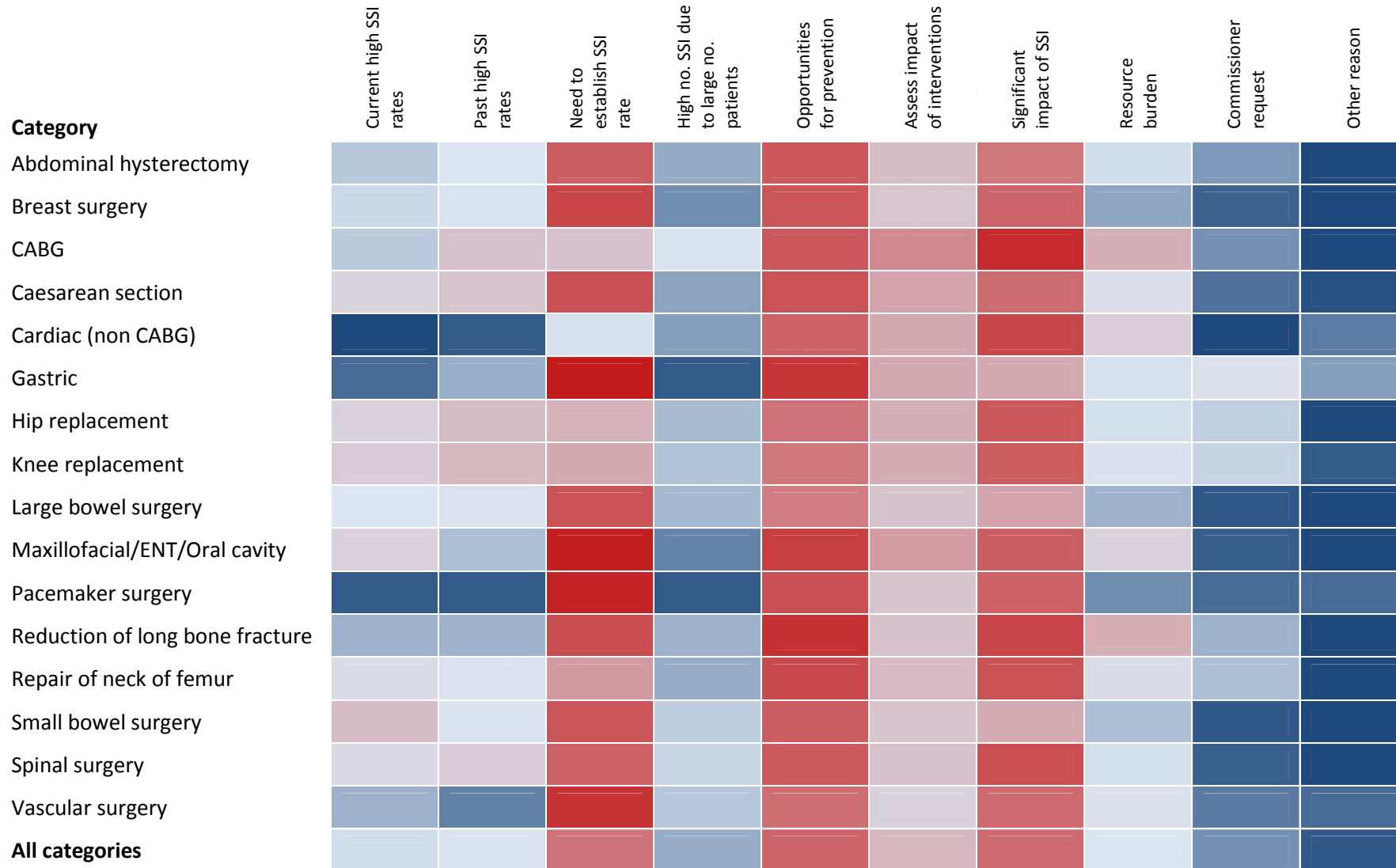


Figure 2.



Supplementary materials

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Theresa Lamagni

ACCEPTED MANUSCRIPT

Supp Figure 1 - Survey invitation

Dear Infection Prevention and Control Team member,

We are conducting a survey to inform the future development of the national surveillance of surgical site infection (SSI) programme by identifying NHS priorities for surveillance. The questionnaire is seeking to assess:

- factors influencing your current SSI surveillance;
- categories of surgery your Trust currently surveys locally;
- categories your Trust consider important in the next 3 years.

We request that this survey is completed by all acute NHS Trusts undertaking adult or paediatric surgery, regardless of their current level of participation in the national surveillance programme.

The survey can be accessed from <https://www.hpa-surveys.org.uk/TakeSurvey.aspx?EID=981B4n90B865B1793B39mB2LM2KB74J>

This survey should be discussed and completed by the Infection Prevention and Control Team (ICD/ Microbiology, IPCN, DIPC) jointly with surveillance staff, surgical colleagues, medical and nursing directors and submitted as a single Trust response by **21 July 2013**.

Survey responses will be collated and published on the PHE website and emailed directly to NHS Trusts. Whilst the survey asks Trusts to identify themselves, this is for the purposes of gauging the overall response rate and to cross-reference your local surveillance activity with participation in the national surveillance scheme.

Individual Trust's survey responses are entirely confidential and will not be disclosed to third parties or shared in any manner which could identify individuals or Trusts. Your participation in this survey is essential in order to inform future priorities. As such we would greatly appreciate your assistance and look forward to receiving your response.

Yours sincerely

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Supp Figure 1 - Survey questions

1. Your job title:
2. NHS Trust name:
3. Please rank your top 5 reasons (1 - 5, with 1 the most important) that best describe reasons for **CURRENTLY** undertaking SSI surveillance in your Trust:

	Please rank (1= top priority)
To demonstrate quality of care delivered to surgical patients	
Concerns around current high rates of SSI	
Past experience of high rates of SSI	
Need to establish rate of SSI (not previously/ recently measured)	
High total burden of a particular SSI due to a large number of patients undergoing that surgery	
To provide early warning of outbreaks or incremental increases in SSI	
Opportunities for prevention	
Assess the impact of interventions introduced e.g. screening, antibiotic prophylaxis	
Compliance with Department of Health mandatory surveillance requirement	
Significant impact of SSI to patients e.g. prolonged length of stay, adverse outcomes	
Significant resource burden e.g. excess length of stay, readmission penalties	
Requested by Commissioners or other external bodies	
Other - please state in the box below:	

4. Priority categories of SSI for surveillance for the **FUTURE**.

The table below lists categories of surgery (column A1) included in the current national surveillance scheme (see [here](#) for further details on procedures included).

In the table below, please:

- Indicate which categories of surgery are performed at your hospital (B).
- Indicate whether you have undertaken SSI surveillance in your Trust for each surgical category during the last 2 years, irrespective of whether submitted to the national programme (C).

- Please select from A2 any categories of surgery not included in A1 if you have undertaken surveillance in them during the last 2 years or consider them important for future surveillance in your Trust.
- Rank the top 5 categories from A1 and/or A2 you would prioritise for surveillance over the **next 3 years** according to your local needs and **assuming no mandatory requirement for reporting in a specific category (D)**.

A1 National Surveillance Surgical Categories

	B. Is this surgery performed at your hospital?	C. Have you undertaken SSI surveillance in past 2 years?	D. Rank future priority for next 3 years (1= top priority)
Abdominal hysterectomy			
Bile duct, liver and pancreas			
Breast surgery			
CABG			
Cardiac (non-CABG)			
Cholecystectomy			
Cranial Surgery			
Gastric			
Hip replacement			
Knee replacement			
Large bowel surgery			
Limb amputation			
Reduction of long bone fracture			
Repair neck of femur			
Small Bowel surgery			
Spinal surgery			
Vascular surgery			

A2 Additional Surgical Categories

	B. Is this surgery performed at your hospital?	C. Have you undertaken SSI surveillance in past 2 years?	D. Rank future priority for next 3 years (1= top priority)
--Please select --			
--Please select --			
--Please select --			

--Please select --			
--Please select --			

[Drop down selection Q4 A2]
Appendicectomy
Caesarean section
Exploratory laparotomy
Herniorrhaphy
Maxillofacial/ENT/Oral cavity
Neck surgery (e.g. thyroid, tracheal)
Oesophageal surgery
Ophthalmic
Other (please state)
Pacemaker surgery
Prostate surgery
Renal surgery/urology
Shunt for dialysis
Solid organ transplant
Splenic surgery
Thoracic surgery
Ventricular shunt

Please add details for 'other' selected in A2:

--

5. For each category selected in the table in Q4 please indicate and rank (from 1 to 5) the factors which influenced the selection of your top five priority categories for future surveillance in your Trust (1 = top priority)

Category from Q4	Current high rates of SSI	Past high rates of SSI	Need to establish SSI rate	High numbers of SSI due to a large number of patients	Opportunities for prevention	Assess impact of interventions introduced	Significant impact of SSI to patients	Significant resource burden	Requested by Commissioners/ external bodies	Other please state below:
--Please select--										
--Please select--										
--Please select--										
--Please select--										
--Please select--										