

Draft:

Long term probabilistic forecasts of activity mitigation in English hospitals: a national elicitation exercise providing an outside view based on judgements of experts in support of the New Hospital Programme.

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Abstract

Objectives: To elicit an outside perspective of probabilistic forecasts based on judgements of experts on the extent to which various types of hospital activity might be mitigated over 20 years, in support of the New Hospital Programme (NHP) in the English National Health Service (NHS).

Design: A prospective online elicitation exercise, over two rounds, to forecast the reduction (0% no reduction to 100% total reduction) in 77 types of hospital activity across England via five types of mitigation:- outpatient attendance avoidance (n=8); inpatient admission avoidance (n=31); A&E attendance avoidance (n=12); outpatient delivery mode (n=4); length of stay reduction (n=22) and eight types of activity groups.

Setting: Clinical and non-clinical staff working in the English NHS.

Participants: 17 clinical and non-clinical staff who provided expert forecasts.

Outcome: Aggregated forecasts representing the percentage reduction (0% to 100%) in hospital activity based on “surprisingly low” (10th percentile – P10) to “surprisingly high” (90th percentile – P90) forecasts from individual experts.

Results: After exclusions we had 657 probabilistic forecasts from 17 experts, where the median number of forecasts per expert was 42 (range: 2 to 77). The most pessimistic forecast was for inpatient avoidance of frail elderly admissions (mean=5.71%, P10=0.43%, P90=16.40%). The most optimistic forecast was for inpatient admission avoidance for vascular surgery (mean=48.27%, P10=19.82%, P90=78.57%). The overall (n=77) aggregate means ranged from a low of 5.71% to high of 48.27% with an average width of 50.08%. The aggregate means varied by type of mitigation:- outpatient attendance avoidance (from 16.42% to 34.12%, n=8); inpatient admission avoidance ranged (from 5.71% to 48.27%, n=31); A&E attendance avoidance (from 18.71% to 32.91%, n=12); outpatient delivery mode (16.42% to 34.13%, n=4); length of stay reduction (from 15.41% to 45.91%, n=22). The aggregate means also varied across the types of hospital activity:- hospital activity amenable to psychiatric liaison and community psychiatry (from 13.33% to 18.33%, n=4); hospital activity amenable to public health interventions (from 14.09% to 23.41%, n=6); hospital activity amenable to medicines management (from 12.74% to 29.45%, n=5); hospital activity amenable to primary care and community interventions (from 5.71% to 27.91%, n=14); planned paediatric activity (from 16.42% to 27.86%, n=6); emergency department and acute medicine activity (from 8.71% to 35.26%, n=16); planned medical activity (from 18.69% to 34.13%, n=3); planned surgical activity (from 20.19% to 48.27%, n=23). Experts highlighted mainly four types of mitigation mechanisms - prevention, displacement, quality improvement and revised treatment thresholds.

Conclusion: A national elicitation exercise has provided long term aggregate forecasts that make explicit the wide variation and uncertainty associated with future mitigation activities from an outside perspective designed to overcome the limitations of point estimates, the flaw-of-averages, and the over optimism associated with inside views. These forecasts may now be incorporated into the planning process for new hospitals in the English NHS.

Introduction

Hospitals are an integral part of healthcare systems across the world. In the English National Health Service (NHS) there are about 515 hospitals¹. This hospital estate has some deteriorating buildings² which prompted the government to announce the New Hospital Programme (NHP) which seeks to build 40 new hospitals across the NHS in England. A further seven hospitals, compromised by the use of reinforced aerated autoclaved concrete, have also been added to the NHP³.

Building a new hospital is a major investment decision usually involving large sums of public funds. It is important that we think carefully about the design decisions. A hospital that is too small will be overwhelmed because it will not cope with demand. A hospital that is too big will be underutilised. Either way, too big or too small, does not represent good value for money.

The design process for a new hospital requires estimation of future levels of activity. This is a complex problem as hospital activity is influenced by a wide range of external and internal factors such as background changes in the demographics of the population, changes to how hospital care will be delivered in the future (say with virtual clinics and wards) and the extent to which some types of hospital activity may be mitigated through prevention, displacement, quality improvement or revised treatment thresholds.

To support the NHP design process the Strategy Unit (SU) analytics team has developed a sophisticated demand and capacity model (known as the NHP Model) which considers multiple factors that impact on demand projections across a 20-year time horizon. The NHP modelling approach necessarily involves scores of input parameters some of which must be set using judgments or probabilistic forecasts from (human) Subject Matter Experts (SMEs).

The process by which we ascertain expert judgements is known as elicitation and is informed by the literature on cognitive biases, project planning and decision analysis, which is summarised by Hemming et al⁴. "Expert judgement can be remarkably useful when data are absent or incomplete. However, experts can also make mistakes. This is often due to a range of cognitive biases such as anchoring, availability, and representativeness, groupthink, overconfidence, and difficulties associated with communicating knowledge in numbers and probabilities. Inappropriate and ill-informed methods for elicitation can amplify these biases. Well designed, structured elicitation protocols can enhance the quality of expert judgments. These protocols treat each step of the elicitation as a process of formal data acquisition, and incorporate research from mathematics, psychology and decision theory to help reduce the influence of biases and to enhance the transparency, accuracy, and defensibility of the resulting judgements."⁴

There are of necessity many NHP model parameters that are uncertain and can only be determined by asking SMEs to provide a probabilistic forecast. The forecasts from SMEs represent an outside view⁵ in the form of 80% subjective degrees of belief or probabilistic intervals which equate to the 10th and 90th percentiles (commonly known as the P10-P90 or 80% interval)^{4,5}. This paper describes an elicitation exercise undertaken to obtain forecasts about mitigation of hospital activity across England over a 20-year time horizon.

Methods

Ethical Approval

Ethical approval was granted by the Chair of the Humanities, Social and Health Sciences Research Ethics Panel at the University of Bradford (EC27944) in August 2023.

Participants

We envisaged that SMEs taking part in this study (which had two rounds of data collection described later) would have some of the following characteristics.

- Clinical or non-clinical expertise in the subgroup domain
- Expertise by experience of working in that domain.
- Typically, be NHS based staff or academia/research or government .
- Consent to participate on a voluntary basis.
- Agree to follow the elicitation protocol.
- Have an appetite for making probabilistic forecasts.

Participants were invited to take part in the exercise via emails which were sent by the NHP lead for Engagement (C McKeown) to about 700 people working in the NHS. Participation was voluntary, confidential and required consent with the option to withdraw at any time. From an initial expression of interest of 136 people, 87 consented to taking part and 29 completed round 1 of the exercise. (see acknowledgements) and 18 completed round 2 of the exercise. Given the tight timelines involved in this potentially demanding exercise alongside workload pressures in the NHS, it was anticipated that most SMEs would not have adequate time to complete the exercise. The main reason for drop out was lost to follow-up or lack of time. Several (only 1 of the 18 in round 2) SMEs indicated that they were employed by a NHS hospital Trust which was part of the NHP. This was not deemed to be a conflict of interest that ruled out participation in the study especially as this elicitation exercise was at the aggregate England level and not focused on any specific hospital. Our primary analysis is based on round 2 data from 18 SMEs.

NHP Activity Model Overview

The NHP Activity Model has five major input categories, (see Figure 1) to predict activity over 20 years. Two of the input categories ("Baseline activity based on 2019" and "Existing demand-supply imbalances") are determined using existing datasets. The remaining three categories relate to factors (see dotted boxes in Figure 1) which require future projections.

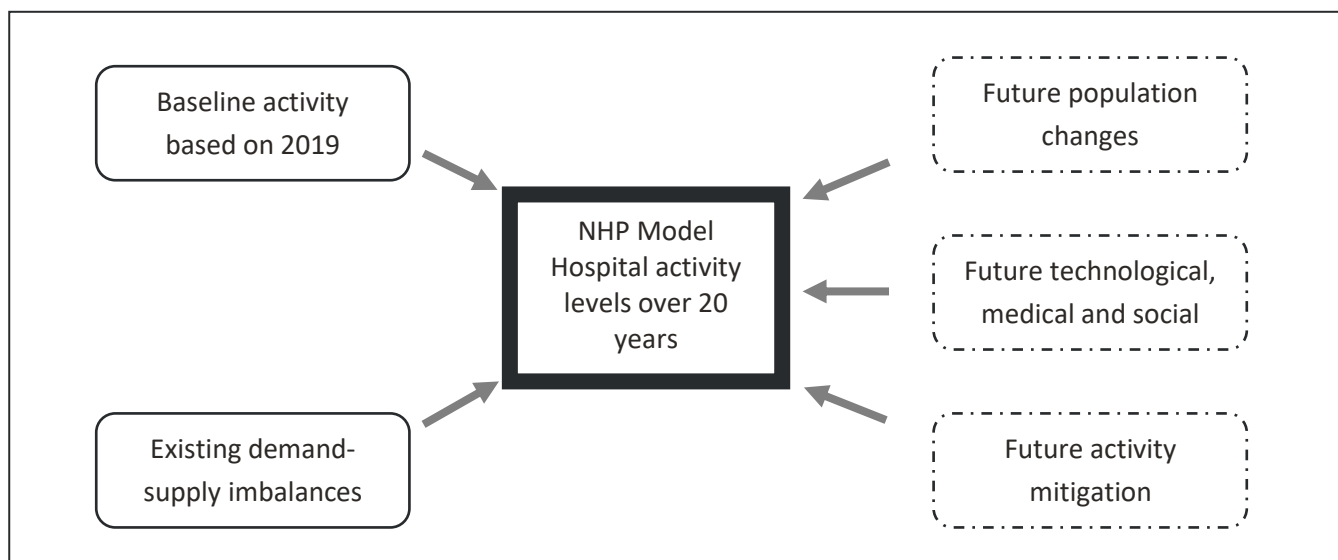


Figure 1 Overview of NHP activity model

Future activity mitigation

The focus of this elicitation exercise was on "Future activity mitigation" which consists of 77 parameters (see Appendix 1 – List of Parameters) as summarised in the table below which shows groups of hospital activity and by five types of mitigation. The number in each cell of the table is the count of the number of parameters that need to be judged.

Table 1.1 **Groups and types of hospital activity mitigation. Number in each cell is the count of the parameters requiring a probabilistic forecast. (n= number of SME who provided a valid forecast).**

Hospital activity group	Type of mitigation	N
Emergency department and acute medicine activity	A&E attendance avoidance	12
	Length of stay reduction	4
Hospital activity amenable to medicines managements	Inpatient admission avoidance	5
Hospital activity amenable to primary care and community	Inpatient admission avoidance	10
	Length of stay reduction	4
Hospital activity amenable to psychiatric liaison and community psychiatry	Inpatient admission avoidance	3
	Length of stay reduction	1
Hospital activity amenable to public health interventions	Inpatient admission avoidance	6
Planned medical activity (adult)	Outpatient attendance avoidance	2
	Outpatient delivery mode	1
Planned surgical activity (adult)	Inpatient admission avoidance	7
	Length of stay reduction	13
	Outpatient attendance avoidance	2
	Outpatient delivery mode	1
Planned paediatric activity	Outpatient attendance avoidance	4
	Outpatient delivery mode	2
Total		77

The specific types of activity amenable to mitigation (n=77) included in the NHP model were identified over a prolonged period within the Strategy Unit drawing on experience and knowledge of strategies and interventions that have commonly been implemented in healthcare. The interventions included were those that were intended to reduce primarily through avoidance, prevention, displacement, quality improvement or revised treatment thresholds, the volume of a given type of activity delivered within acute hospital settings. Illustrative examples are as follows:-

Mechanism	Type of hospital demand	Mechanism description	Example interventions
Prevent hospital care	Clinically preventable	Out of hospital interventions that aim to prevent ill health occurring or worsening to the point hospital care is needed.	Public health interventions (including health literacy), chronic disease management, acute management and self-management.
Redirect hospital care	Clinically divertible	Interventions that divert care to most appropriate out of hospital service.	Triage, advice and guidance, shared-decision making, co-location of services in A&E.
Substitute / Relocate hospital care to out of hospital settings	Clinically necessary	Interventions that provide traditional hospital-based care in out of hospital setting.	Upskilling of staff e.g medical assistant, care delivered in an alternative location such as consultant clinics in the community, hospital at home (early support discharge and admission avoidance) or virtual consultations
Efficient hospital care	Clinically necessary	Quality improvement interventions to improve efficiencies in hospital care such as patient flow. Might also include advances in medicine or technology.	Improving patient flow/ lean methodology (eg one stop clinics), nurse-led care, virtual follow-up clinics.
Revise treatment thresholds hospital care	Clinically necessary or unnecessary	Restricting access to hospital care.	Some types of treatments (eg tonsillectomies) may be reduced (say through more stringent patient selection criteria).

Algorithms were developed to identify specific cohorts of patients from Hospital Episode Statistics (HES) datasets that were the focus of such interventions drawing on published evidence and other relevant documents where available. For each type of activity, a historic trend graph was provided at the England level (not for any specific hospital), with age-sex standardisation where appropriate, with

2019 as the baseline year in a specifically designed online app for this National Elicitation Exercise (NEE)⁶, as shown in the screen shot below.

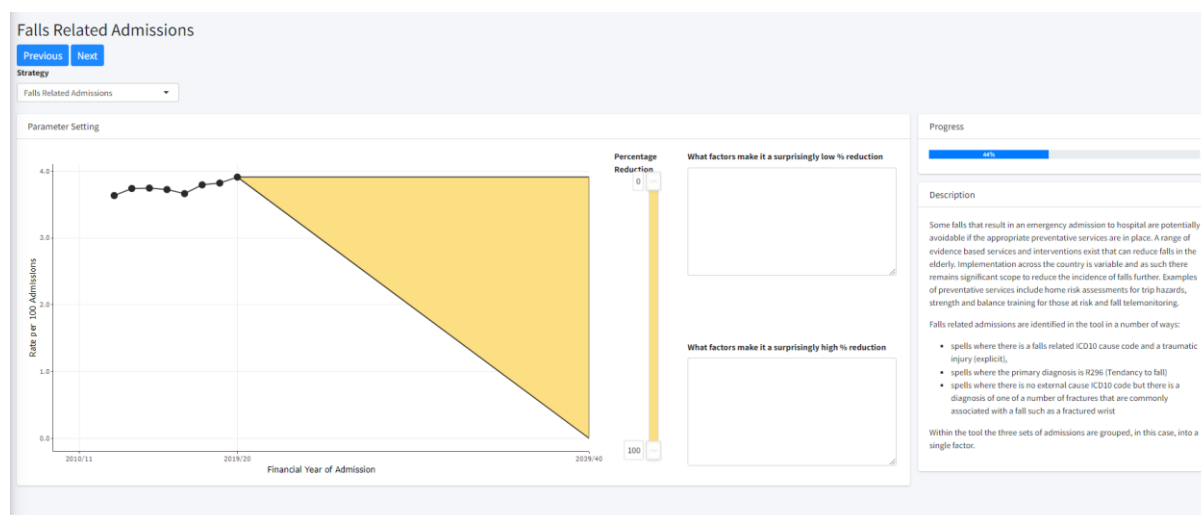


Figure 2 Screen shot of app showing the historic trend for falls related admissions (age-sex standardised) for England with additional supporting information and two free text data entry boxes. https://connect.strategyunitwm.nhs.uk/nhp_dev/national_elicitation/

Elicitation protocol

We based our elicitation protocol on the Stanford Research Institute protocol which has five broad steps: motivate, structure, condition, encode and verify, as described in the Handbook of Decision Analysis⁷ and the IDEA (Investigate, Discuss, Estimate, Aggregate) protocol as described by Hemming et al⁴ adapted to better suit our needs. The elicitation protocol is designed to mitigate well known cognitive biases that usually lead to overconfidence in the judgments of experts. The timelines and scale of the NHP led us to undertake an online elicitation exercise with supporting materials that did not involve interviews with SMEs.

To support SMEs in their task, we developed three short online training videos (<https://vimeo.com/showcase/nhpnee>), viz:

- Part 1 (~3 mins) provided an overview of the NHP model and explained why we needed the support of experts to make forecasts based on Figure 1
- Part 2 (~9 mins) provided SMEs with training on probabilistic forecasting.
- Part 3 (~4 mins) showed SME how to use the online data collection tool based on Figure 2 (described below).

SMEs who consented, were assigned a unique code, were sent the links to the videos and given three weeks to complete round 1 of the elicitation exercise and then a further two weeks to complete round 2.

SMEs were required to use a slider to provide an 80% subjective degree of belief or confidence interval which ranges from the 10th percentile to the 90th percentile (denoted p10 to P90). The slider was designed to go from 0% (no reduction) to 100% (total reduction). The concept of the 80% confidence interval was explained by using the qualitative terms “surprisingly low” and “surprisingly high” to denote the P10 and P90 respectively in the second online video. The time horizon for all judgments was 20 years from the baseline year of 2019. This ensures that the elicitation frame pre-dates the start of the covid-19 pandemic (31-Dec-2019). The online tool enabled SMEs to see the potential impact of their P10 and P90 intervals on the parameter of interest from previous activity (as shown over time) using a linear trajectory. The above steps were repeated for each parameter. SMEs could contact the study lead (MAM) at any time via email.

In round 1, SMEs were given up to two weeks (extended by a further week because of time constraints) to complete their assignment for their selected areas of expertise. In round 2, SMEs were given up to two weeks to compare their forecasts with those of their peers and make any changes before the final closing date. The instructions on the home page of the app are shown in appendix 2.

Data processing and analysis

All SMEs were deidentified and assigned a unique code which could not be linked back to the SME. Since the default P10 and P90 value in the app were 0% to 100% respectively, we excluded all such values from the data set. We also excluded point estimates, which is where the P10 and P90 were equal. For each SME's forecast, we assumed that this was described by a truncated Normal distribution with a minimum value of 0% (no activity avoided) and maximum value 100% (all activity avoided). We derived the mean and standard deviation of these distributions for each SME using their P10 and P90 values. These individual distributions were aggregated for each of the 77 hospital activities by bootstrapping. If n experts provided forecasts for a specific activity, then $(100,000/n)$ values were sampled at random from each expert's truncated Normal distribution. The resulting 100,000 values described the aggregated expert view distribution with each expert's view carrying equal weight. These aggregated expert view distributions are presented as mean and range plots (P10 to P90) in the results. The individual and aggregate forecasts under each group of hospital activity are presented in tabular and graphical format in the order indicated in Table 1.1 (shown earlier), with an aggregate summary of the rationales supplied by SMEs. Aggregate forecast intervals are summarised by means and ranges. The means reflect the optimism or pessimism of forecasters. The greater the mean the greater the optimism, the lower the mean the more pessimism. The wider the ranges the greater the uncertainty.

Results

Our primary analysis is based on round 2 data, where 18 SMEs provided a total of 736 probabilistic forecasts based on their selected areas of interest. About 10% (=79/736) of forecasts were excluded because they had a zero range (where the P10=P90=0%, n=5) or the range was 100% (where P10=0, P90=100%, n=74). After exclusions we had 657 probabilistic forecasts from 17 SMEs, where the median number of forecasts per SME was 42 (min 2, lower quartile 16, upper quartile 61, max 77).

Overview of aggregate forecasts

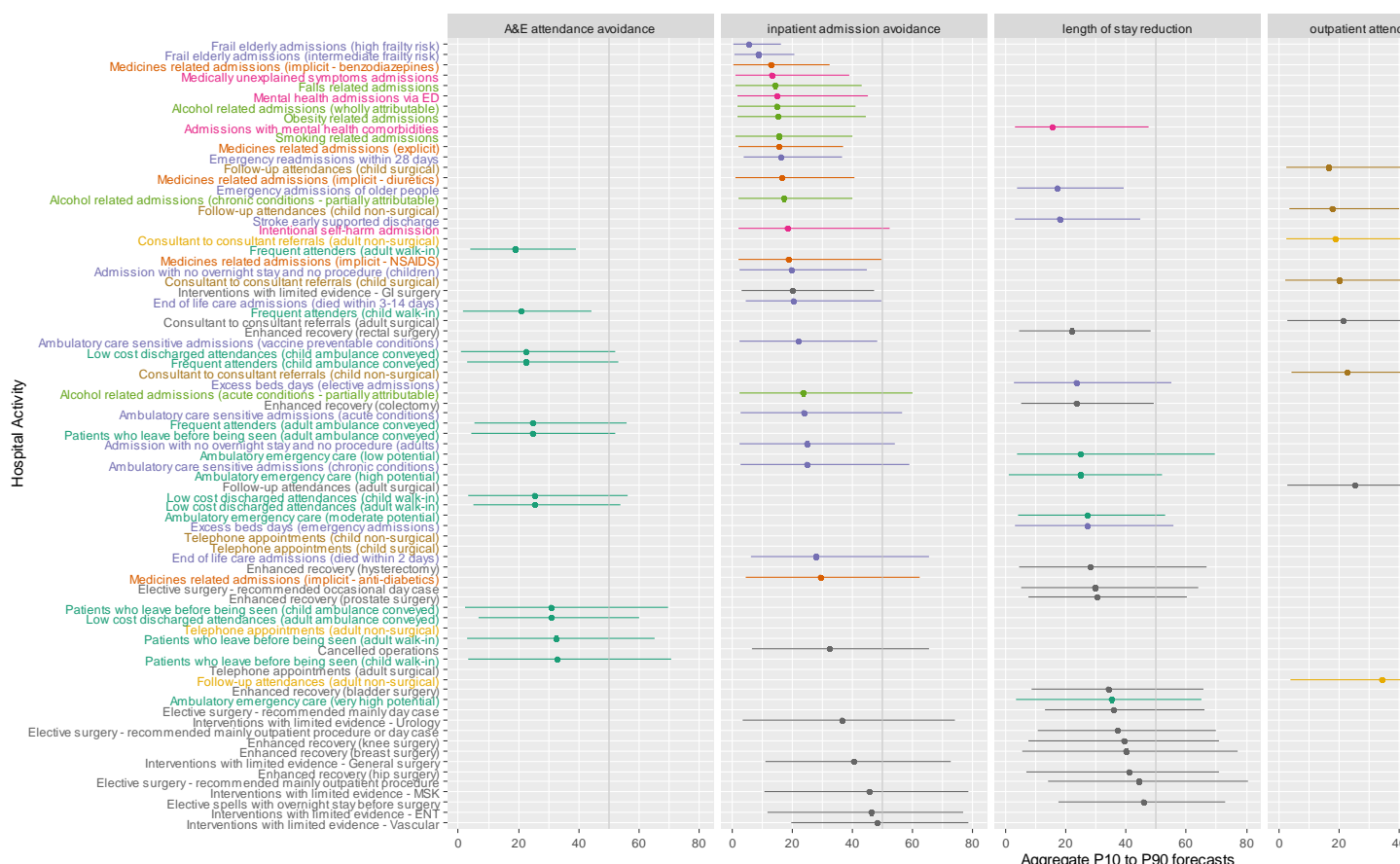


Figure 3 (overleaf) shows an overview of the aggregate forecast for each of the 77 types of hospital activity across five types of mitigation. SMEs highlighted mainly four types of mitigation mechanisms - prevention, displacement, quality improvement and revised treatment thresholds.

Aggregated “surprisingly low” P10 values (n=77) ranged from 0.43% to 19.82% (mean=4.77%), ninety percent of which were below 10.27%. Aggregated “surprisingly high” P90 values (n=77) ranged from 16.4% to 80.61% (mean=54.85%), ninety percent of which were above 39.61%. The average width of the forecast intervals was 50.08%.

The most pessimistic forecast was for inpatient avoidance of frail elderly admissions (5.71%, P10=0.43%, P90=16.40%). The most optimistic forecast was for inpatient admission avoidance for vascular surgery (48.27%, P10=19.82%, P90=78.57%).

The overall (n=77) aggregate means ranged from a low of 5.71% to high of 48.27%. The aggregate means varied by type of mitigation:- outpatient attendance avoidance (from 16.42% to 34.12%, n=8); inpatient admission avoidance ranged (from 5.71% to 48.27%, n=31); A&E attendance avoidance (from 18.71% to 32.91%, n=12); outpatient delivery mode (16.42% to 34.13%, n=4); length of stay reduction (from 15.41% to 45.91%, n=22). The aggregate means also varied across the types of hospital activity:- hospital activity amenable to psychiatric liaison and community psychiatry (from 13.33% to 18.33%, n=4); hospital activity amenable to public health interventions (from 14.09% to 23.41%, n=6); hospital activity amenable to medicines management (from 12.74% to 29.45%, n=5); hospital activity amenable to primary care and community interventions (from 5.71% to 27.91%, n=14); planned paediatric activity (from 16.42% to 27.86%, n=6); emergency department and acute medicine activity 1 (from 8.71% to 35.26%, n=16); planned medical activity (from 18.69% to 34.13%, n=3); planned surgical activity (from 20.19% to 48.27%, n=23).

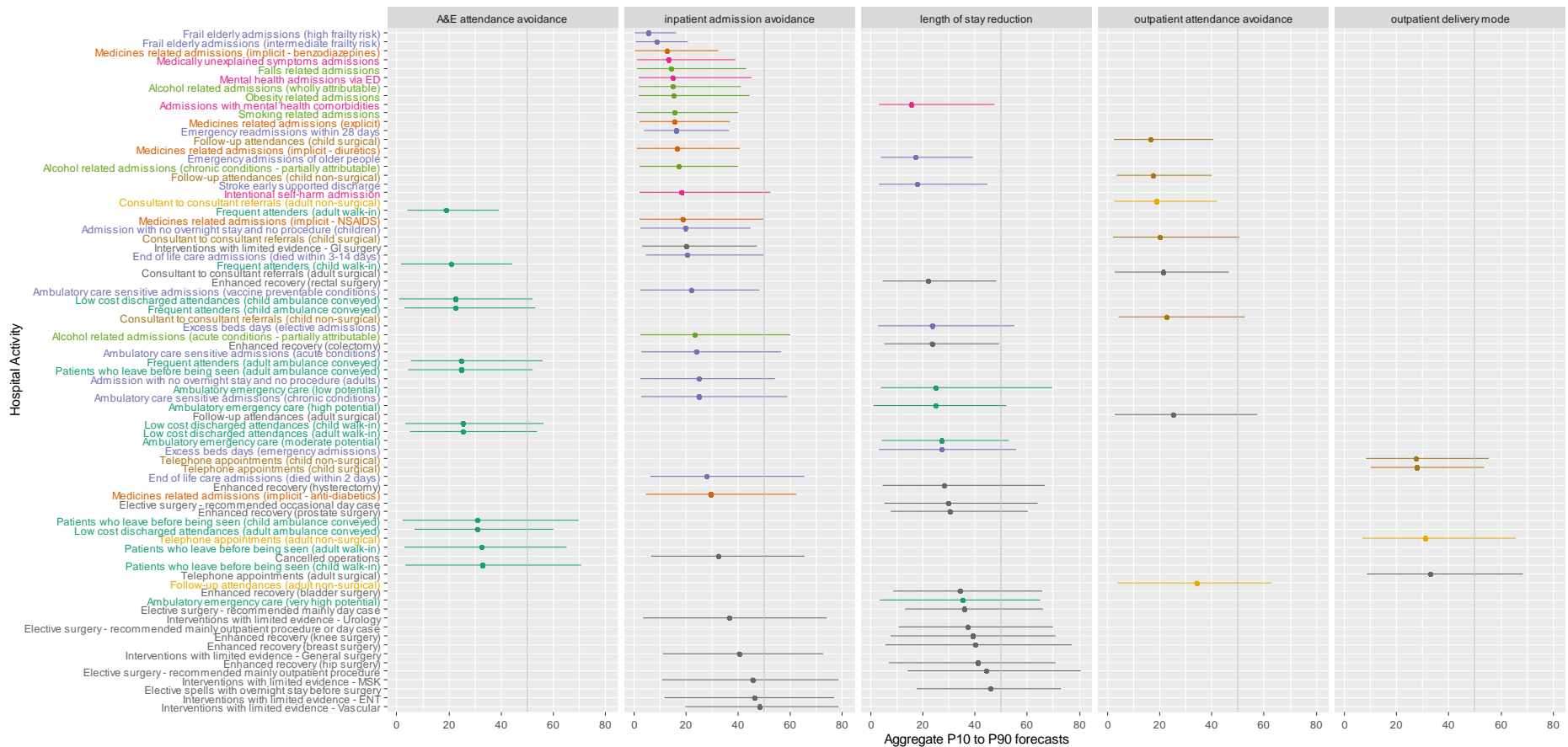
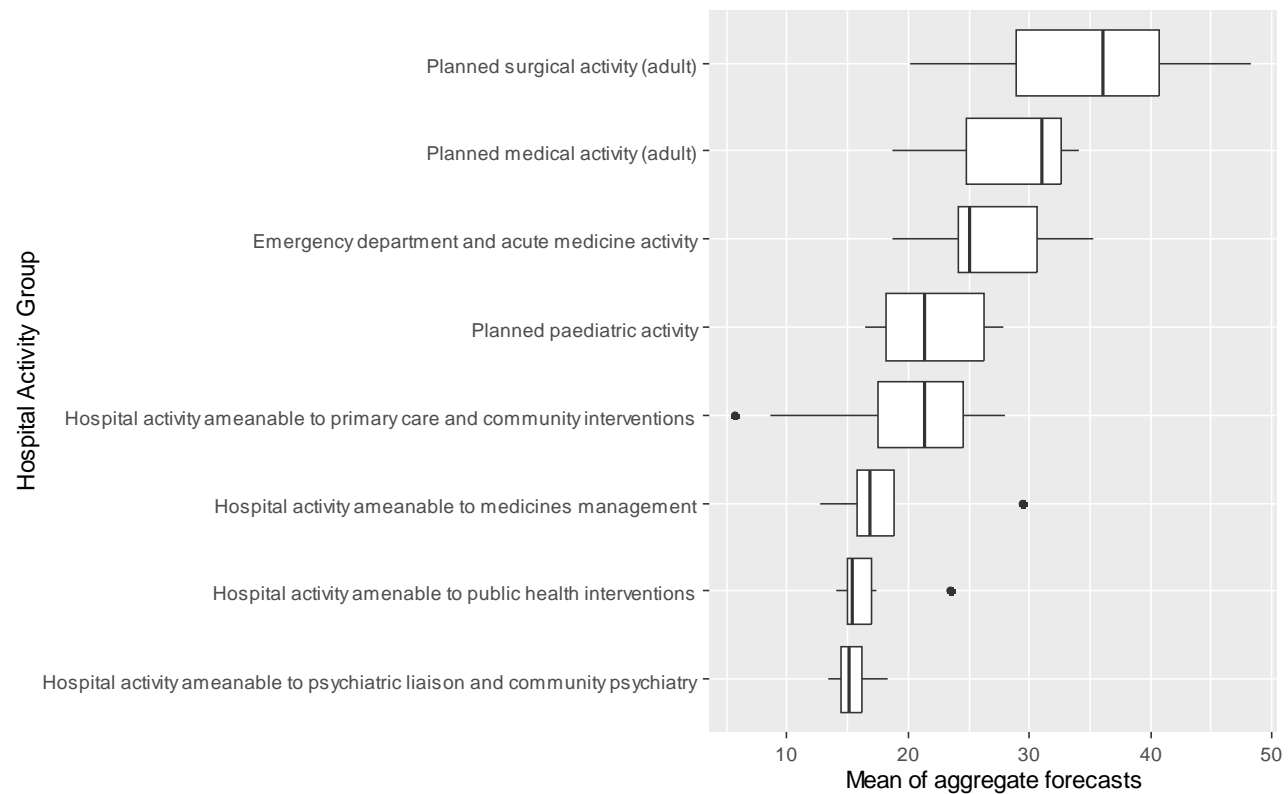


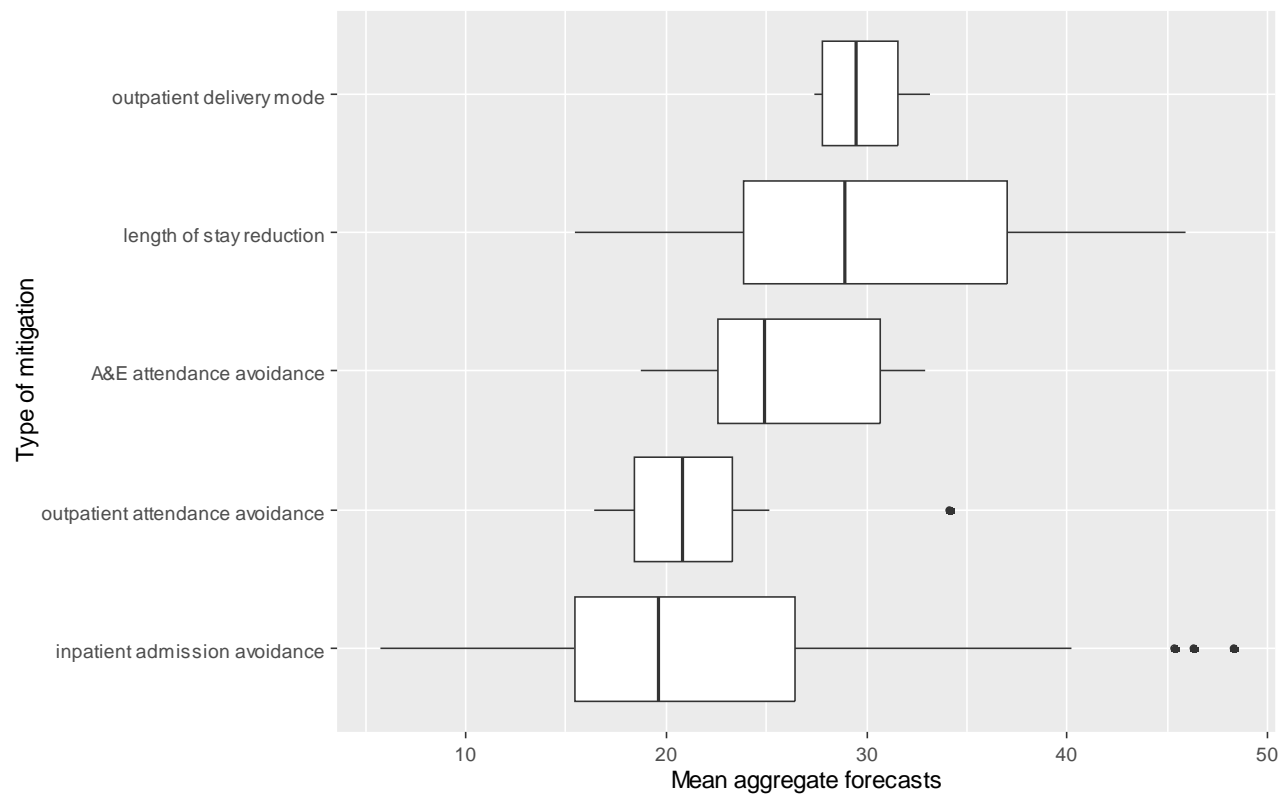
Figure 3 Overview of aggregate probabilistic forecasts, ranging from the 10th percentile to the 90th percentile, for 77 types of hospital activity in eight groups (y-axis) across five types of activity mitigation (top row header). The dot in each interval is the mean. Vertical grey line is a 50% reference indicator.

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The boxplots below show how the mean aggregate forecasts varied by type of groups of hospital activity. The most optimistic forecasts were for mitigation of planned surgical and medical activity. The most pessimistic forecasts for were hospital activity amenable to psychiatric liaison and community psychiatry and public health interventions.



The boxplots below show how the mean aggregate forecasts varied by type of type of mitigation. The most optimistic forecasts were for outpatient delivery mode and length of stay reductions (albeit with wide variation). The most pessimistic were for inpatient admission avoidance (albeit with wide variation) and outpatient attendance avoidance.



The table below summarises the mean aggregate forecasts by activity group and type of mitigation.

Hospital activity group	Type of mitigation	Min to Max of Means (n)
Emergency department and acute medicine activity	A&E attendance avoidance	18.71% to 32.91% (n=12)
	Length of stay reduction	24.87% to 35.26% (n=4)
Hospital activity amenable to medicines managements	Inpatient admission avoidance	12.74% to 29.45% (n=5)
Hospital activity amenable to primary care and community	Inpatient admission avoidance	5.71% to 27.91% (n=10)
	Length of stay reduction	17.40% to 27.30% (n=4)
Hospital activity amenable to psychiatric liaison and community psychiatry	Inpatient admission avoidance	13.33% to 18.33% (n=3)
	Length of stay reduction	15.41% (n=1)
Hospital activity amenable to public health interventions	Inpatient admission avoidance	14.09% to 23.41% (n=6)
Planned medical activity (adult)	Outpatient attendance avoidance	18.69% to 34.13% (n=2)
	Outpatient delivery mode	15.41% (n=1)
Planned surgical activity (adult)	Inpatient admission avoidance	20.19% to 48.27% (n=7)
	Length of stay reduction	22.12% to 45.91% (n=13)
	Outpatient attendance avoidance	21.51% to 25.10% (n=2)
	Outpatient delivery mode	33.19% (n=1)
Planned paediatric activity	Outpatient attendance avoidance	16.42% to 22.69% (n=4)
	Outpatient delivery mode	27.41% to 27.86% (n=2)
Total		5.71% to 48.27% (n=77)

In the next section the results for each cell in the above table are presented individually.

Individual and aggregate forecasts by specific subgroups

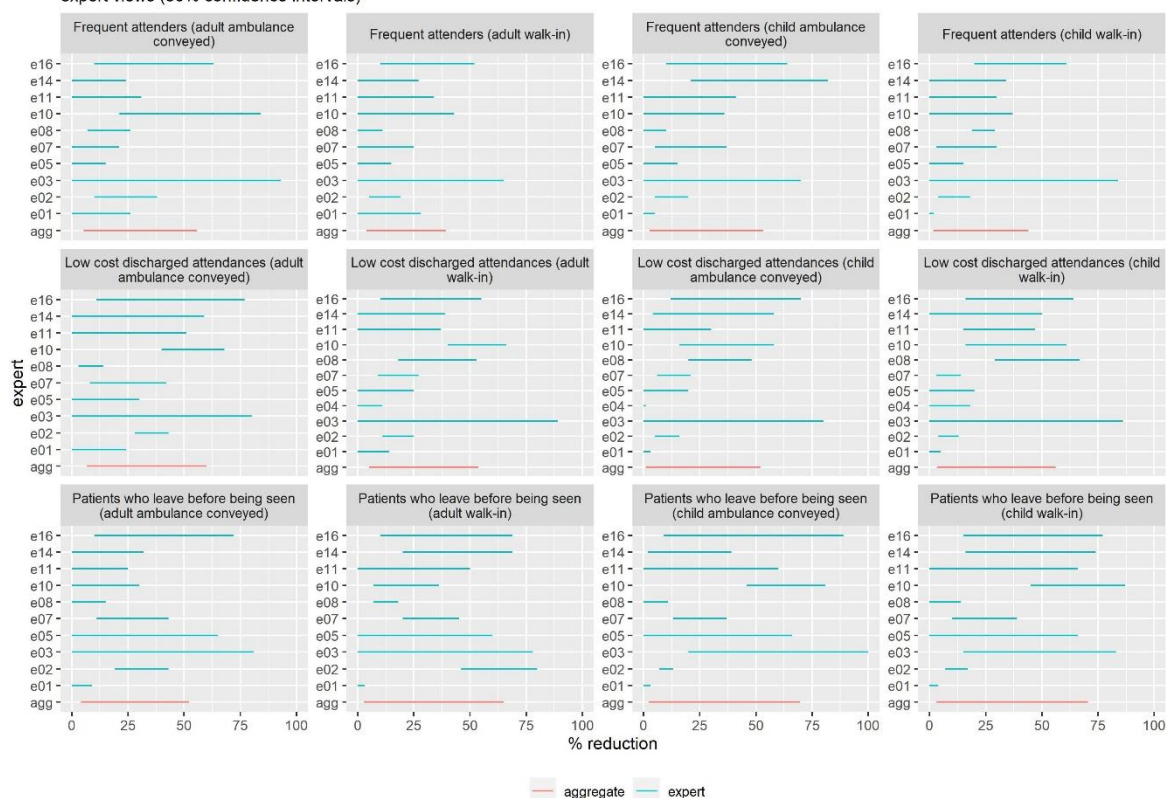
The individual and aggregate forecasts under each group of hospital activity are presented in tabular and graphical format overleaf in the order indicated in table 1.1.

Forecasts for emergency department and acute medicine activity that might be mitigated by avoiding attendance to A&E.

The table below lists the types of activity that might be mitigated, and the accompanying figure (overleaf) shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Frequent attenders (adult ambulance conveyed)	5.20	55.83	10
Frequent attenders (adult walk-in)	3.95	39.12	10
Frequent attenders (child ambulance conveyed)	2.77	53.18	10
Frequent attenders (child walk-in)	1.69	44.01	10
Low cost discharged attendances (adult ambulance conveyed)	6.75	59.89	10
Low cost discharged attendances (adult walk-in)	5.07	53.76	11
Low cost discharged attendances (child ambulance conveyed)	0.88	52.00	11
Low cost discharged attendances (child walk-in)	3.35	56.18	11
Patients who leave before being seen (adult ambulance conveyed)	4.19	51.98	10

Emergency department and acute medicine activity : A&E attendance avoidance expert views (80% confidence intervals)



Rationale for P10 values

Rationales given for low mitigation forecasts tended to focus on the absence of preventative interventions. SMEs cited a deterioration in the access to primary care and poor mental health services, as well as a general lack of investment in out of hospital services. In addition, SMEs described poor education regarding the appropriate usage of A&E services and a paucity of alternative options for service users as other limiting factors. Other factors which could be considered inefficiencies in the current care delivered included poor system joint working, long waiting lists (operative & outpatient) and delays to therapeutic interventions.

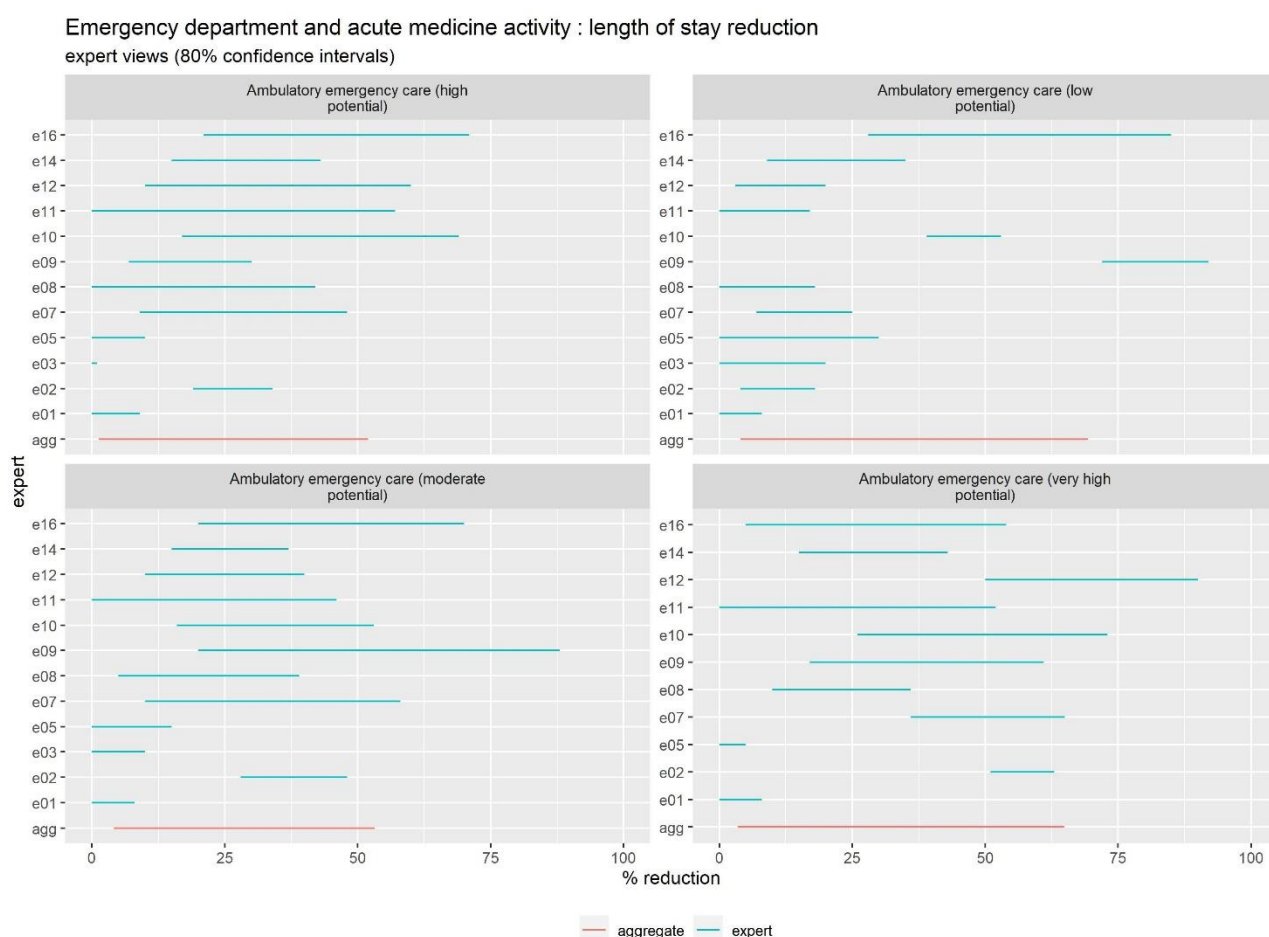
Rationale for P90 values

Most of the rationales provided by SMEs were related to prevention and public health initiatives as a mechanism of mitigation. SMEs described significant investment in primary care, successful patient education campaigns, improved vaccination uptake, improved NHS dental service and an expansion in community and mental health services. Some SMEs also referred to alternative locations for care where traditional hospital-based care is effectively relocated. For instance, the effective roll out of urgent care or walk-in facilities, investment in winter infection hubs, legislative changes to allow expanded care roles for allied health professionals, greater levels of telemedicine take up to enable consultation without attendance. Factors related to improved diversion of care (eg improved triage) and increased efficiency were also cited.

Forecasts for emergency department and acute medicine activity that might be mitigated by reductions in length of stay.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Ambulatory emergency care (high potential)	1.31	51.95	12
Ambulatory emergency care (low potential)	3.95	69.35	12
Ambulatory emergency care (moderate potential)	4.15	53.13	12
Ambulatory emergency care (very high potential)	3.41	64.90	11
Ambulatory emergency care (high potential)	1.31	51.95	12



Rationale for P10 values

Rationales for low mitigation forecasts centred on insufficient prevention, redirection and efficiency mechanisms. Inefficiencies were highlighted, due in particular to a lack of staffing in hospital A&E, poor use of technology and a lack of investment in waiting list reduction. Examples of low preventive

factors were the lack of public education on the appropriate use of emergency care services, as well as the poor levels of community and primary care provision. Some SMEs also noted that it is 'current policy' or 'preferable' to increase ambulatory emergency care as a way of reducing pressure on ED and avoiding inpatient admission.

Rationale for P90 values

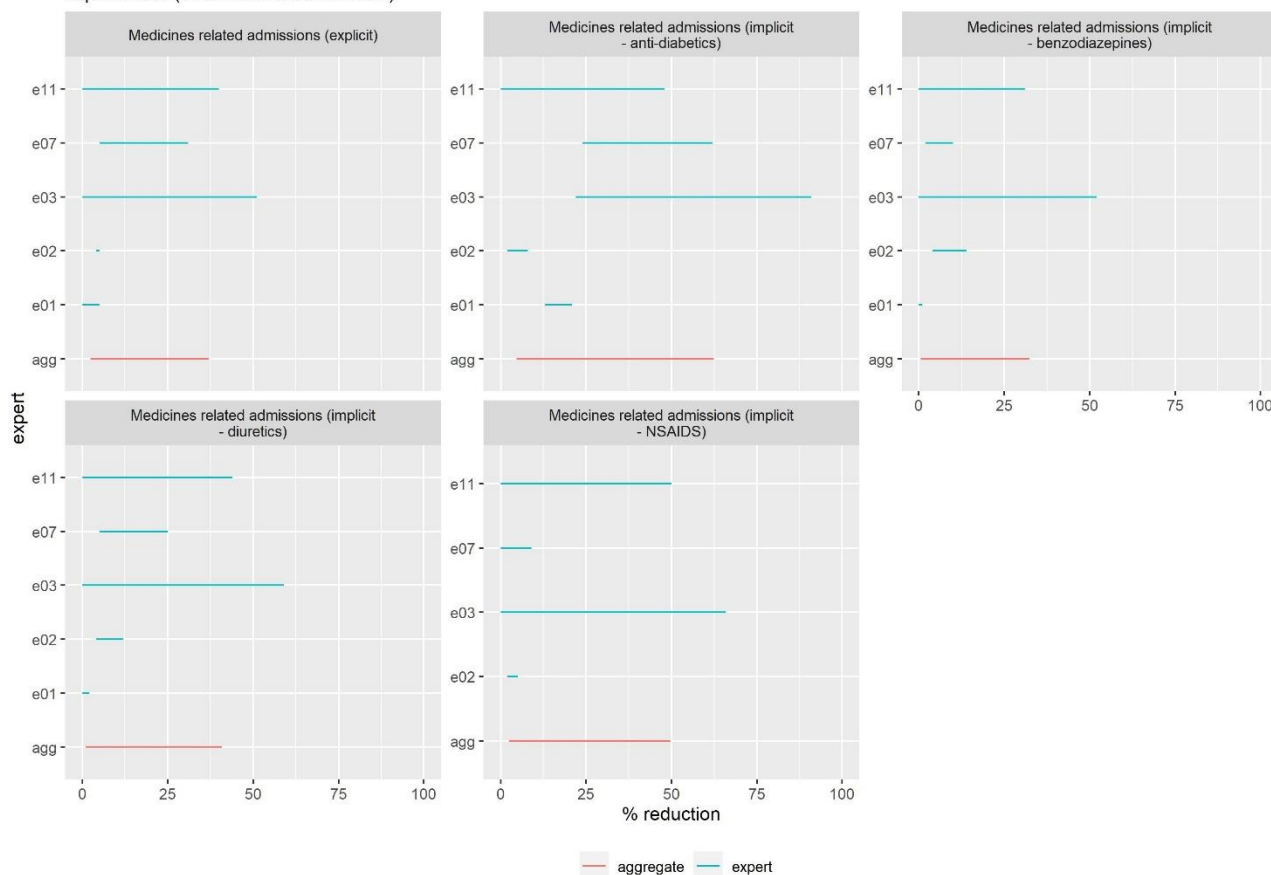
Some of the comments for high mitigation forecasts focussed on a potential increase in efficiency such as the use of technology. There were also examples of preventive and relocation mechanisms such as significant expansion in community services, digital innovations that support patients to manage their own care more effectively, virtual monitoring, increased role of community pharmacy, and increased utilisation of community diagnostic centres to appropriately divert ambulatory patients. Other comments such as 'robust divert communications to other services' were examples of redirection mechanisms of activity mitigation.

Forecasts for hospital activity amenable to medicines management that might be mitigated by avoiding inpatient admission.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Medicines related admissions (explicit)	2.36	36.95	5
Medicines related admissions (implicit - anti-diabetics)	4.63	62.42	5
Medicines related admissions (implicit - benzodiazepines)	0.53	32.47	5
Medicines related admissions (implicit - diuretics)	1.04	40.78	5
Medicines related admissions (implicit - NSAIDS)	2.37	49.69	4

Hospital activity amenable to medicines management : inpatient admission avoidance expert views (80% confidence intervals)



Rationale for P10 values

Most comments were either related to the absence of preventive mechanisms or inefficiencies. Poor staff and patient education relating to medicines, limited access to primary care and mental health services as well as increasing polypharmacy for patients with multiple co-morbidities. Some SMEs emphasised a lack of information sharing with concerns of poor interoperability of electronic health records, and staff shortages limiting time spent on reviewing medication resulting in a lack of medicine reconciliation.

Rationale for P90 values

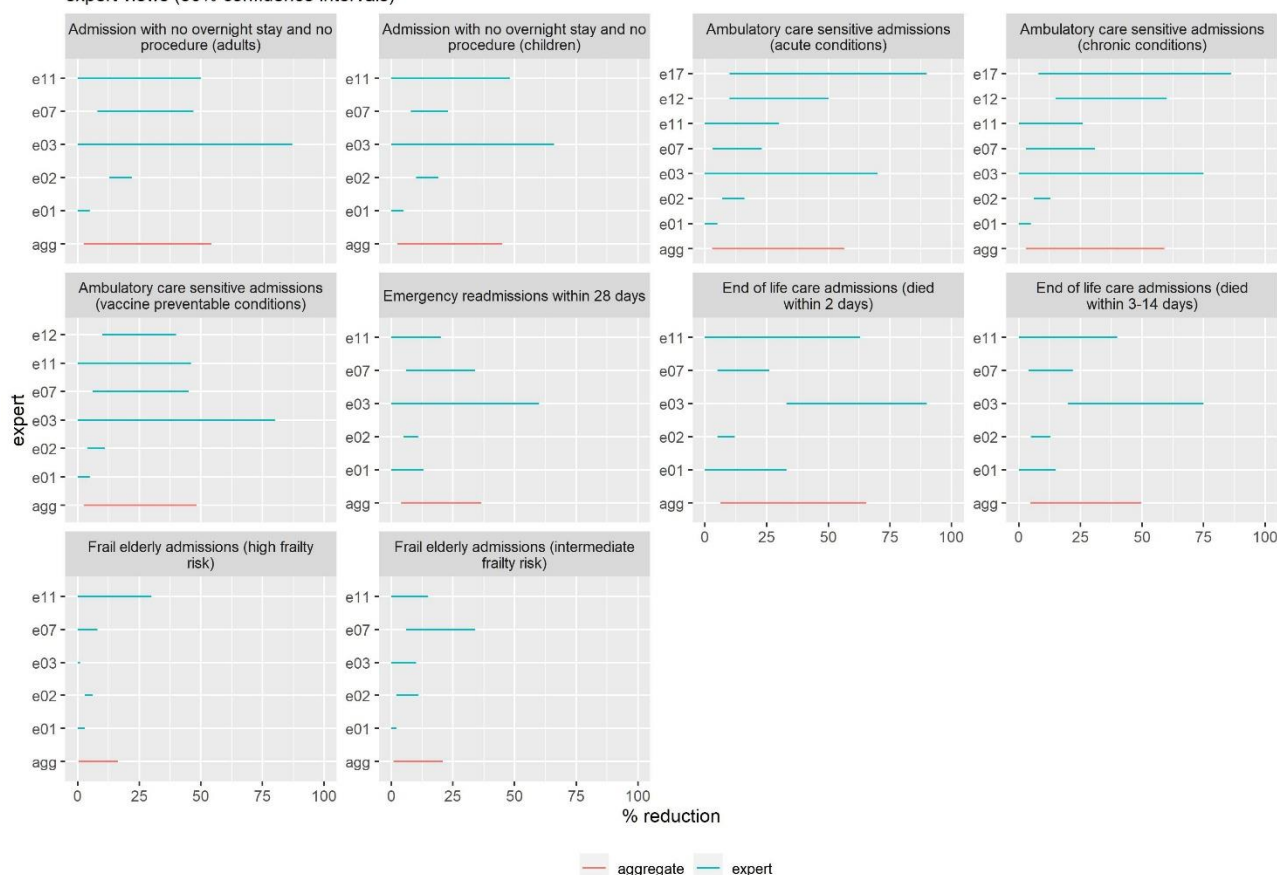
Rationales for high mitigation forecasts described increased prevention, increased efficiency and the relocation of related care. SMEs cited increased capacity in primary care for prospective medicines reviews, improved access to mental health services, reduction in waiting lists, and greater information sharing through improved access to electronic health records across clinical pathways. SMEs also described improved public education on the use of certain medicines, increased chronic condition support, and innovation in the use of digital solutions such as artificial intelligence for medicine reconciliation and remote monitoring of conditions. Some SMEs also listed factors which could be considered rationing mechanisms. For instance, one SME had commented, "Policy change and prioritisation of stopping benzos".

Forecasts for hospital activity amenable to primary care and community interventions that might be mitigated by avoiding inpatient admission.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Admission with no overnight and no procedure (adult)	2.47	54.15	5
Admission with no overnight stay with no procedure (children)	2.47	44.86	5
Ambulatory care sensitive admissions (acute conditions)	2.93	56.38	7
Ambulatory care sensitive admissions (acute conditions)	2.90	59.01	7
Ambulatory care sensitive admissions (vaccine preventable conditions)	2.66	48.33	6
Emergency readmissions within 28 days	4.05	36.57	5
End of life care admissions (died within 2 days)	6.29	65.45	5
End of life care admissions (died within 3-14 days)	4.71	49.65	5
Frail elderly admissions (high frailty risk)	0.43	16.40	5
Frail elderly admissions (intermediate frailty risk)	0.89	20.80	5

Hospital activity amenable to primary care and community interventions : inpatient admission avoidance expert views (80% confidence intervals)



Rationale for P10 values

Some of the common themes within the rationales described by SMEs related to a lack of preventive mechanisms. Examples were poor access to primary care, lack of education, and insufficient community and social care resource. Other comments were citing a lack of alternatives to substitute or relocate care to out of hospital settings, inefficiencies in current care practices and the challenges of redirecting care. For instance, SMEs highlighted insufficient investment in digital technology to support monitoring and remote consultations in the management of long-term conditions as well as the inadequate staffing of frailty multidisciplinary teams.

Rationale for P90 values

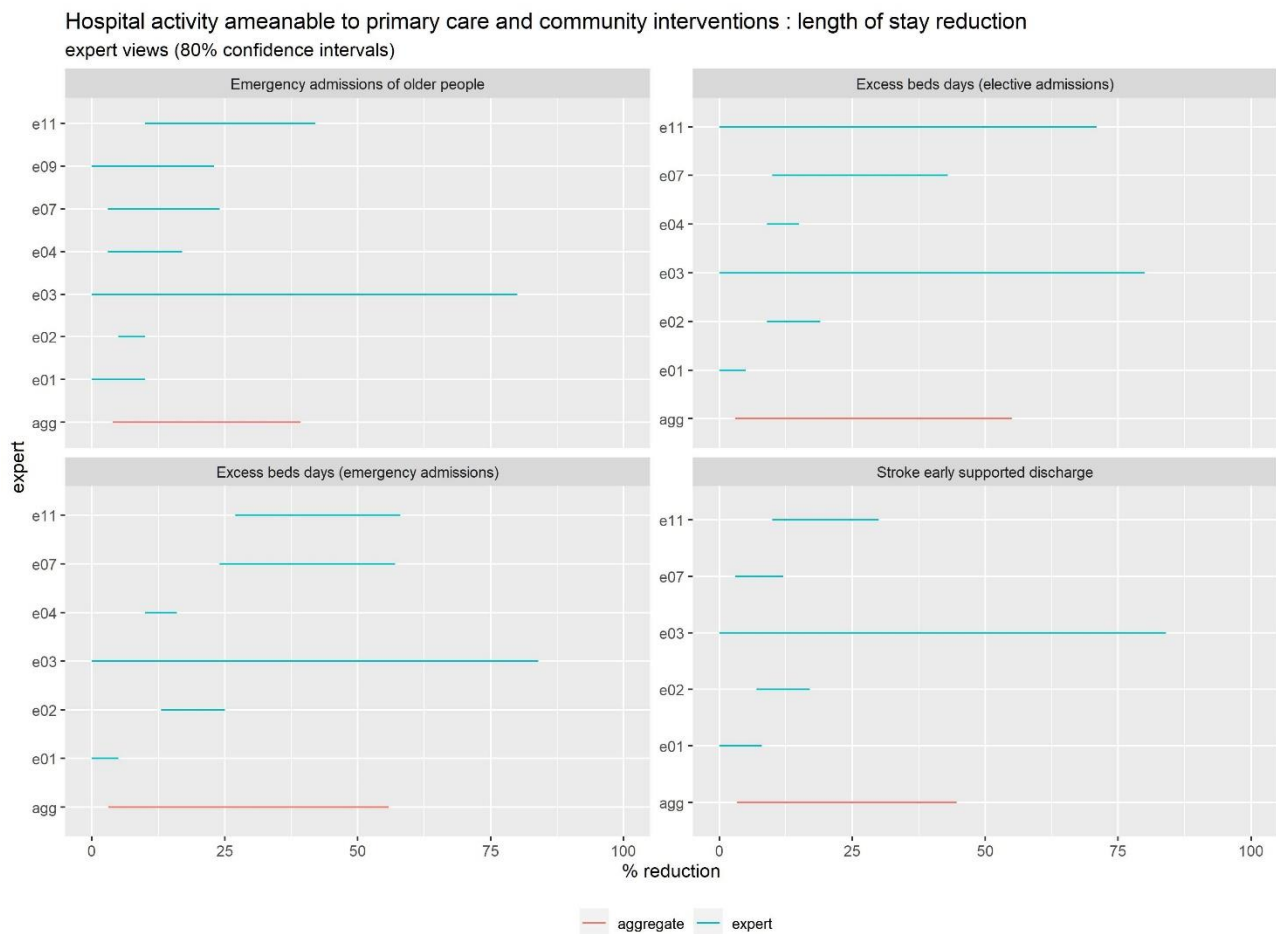
A broad range of factors were described by SMEs across these parameters. Some of the key themes related to preventive measures such as future government policy and public health management initiatives resulting in improvements to housing, heating, nutrition, and transport as well as measures to reduce obesity, loneliness, alcohol consumption and smoking. Other common factors for preventive mechanisms included improved access to primary and dental care, significant investment in community services and social care and improved chronic disease management. Relocation of care was also a mechanism here with SMEs citing effective remote monitoring and the use of virtual

wards. Improvements in the efficiency of care tended to relate to enhanced processes for medicine reconciliation, more effective advanced planning and information sharing, and better staffing of frailty clinics and palliative care provision.

Forecasts for hospital activity amenable to primary care and community interventions that might be mitigated by reduction in length of stay.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Emergency admissions of older people	3.96	39.27	7
Excess beds days (elective admissions)	2.98	55.01	6
Excess beds days (emergency admissions)	3.09	55.80	6
Stroke early supported discharge	3.34	44.62	5



Rationale for P10 values

Rationales for low mitigation mostly noted factors relating to a lack of preventive measures and inefficiencies in the delivery of care. SMEs listed factors such as a lack of social care and community funding, lack of investment in out of hospital services resulting in inadequate services to prevent admission as well as contributing to poor patient flow, and disjointed working between primary, community and acute care service provision. Some SME described a lack of rehabilitation facilities, or insufficient numbers of allied health professional in community settings which would otherwise substitute some of the in-hospital care.

Rationale for P90 values

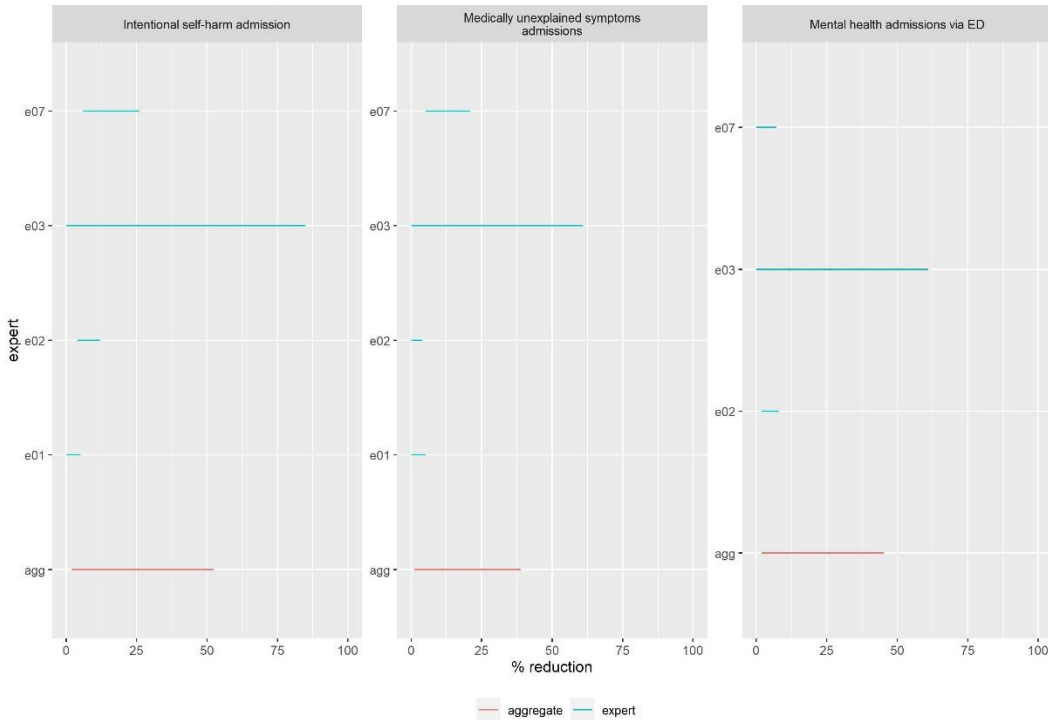
A wide range of factors were listed by SMEs. Many of these related to preventive measures, relocations of care and increased efficiency in the care provided. Some SMEs also cited factors that were redirections of care. Examples of some of the factors described were significant investment in social care and community services with more effective local system working to both prevent emergency admission and improve patient discharge. Earlier intervention and access to frailty assessment, enhanced MDT capacity, improved discharge liaison services and social care packages to prevent delayed discharge and the resulting deconditioning, and earlier informed decisions relating to palliative care were all cited. Additionally, the increased use of virtual wards and new build specialty DTOC (delayed transfer of care) centres were among some of the other factors provided.

Forecasts for hospital activity amenable to psychiatric liaison and community psychiatry that might be mitigated by avoiding inpatient admission.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Intentional self-harm admission	2.07	52.36	4
Medically unexplained symptoms admissions	1.17	38.82	4
Mental health admissions via ED	1.93	45.23	3

Hospital activity amenable to psychiatric liaison and community psychiatry : inpatient admission avoidance
expert views (80% confidence intervals)



Rationale for P10 values

Most SME comments described the absence of preventive mechanisms for activity mitigation. SMEs described a lack of community support and limited mental health provision. Additionally, some SMEs described an anticipated increase in the prevalence of mental illness, noting the impact of social media, health inequalities and deprivation.

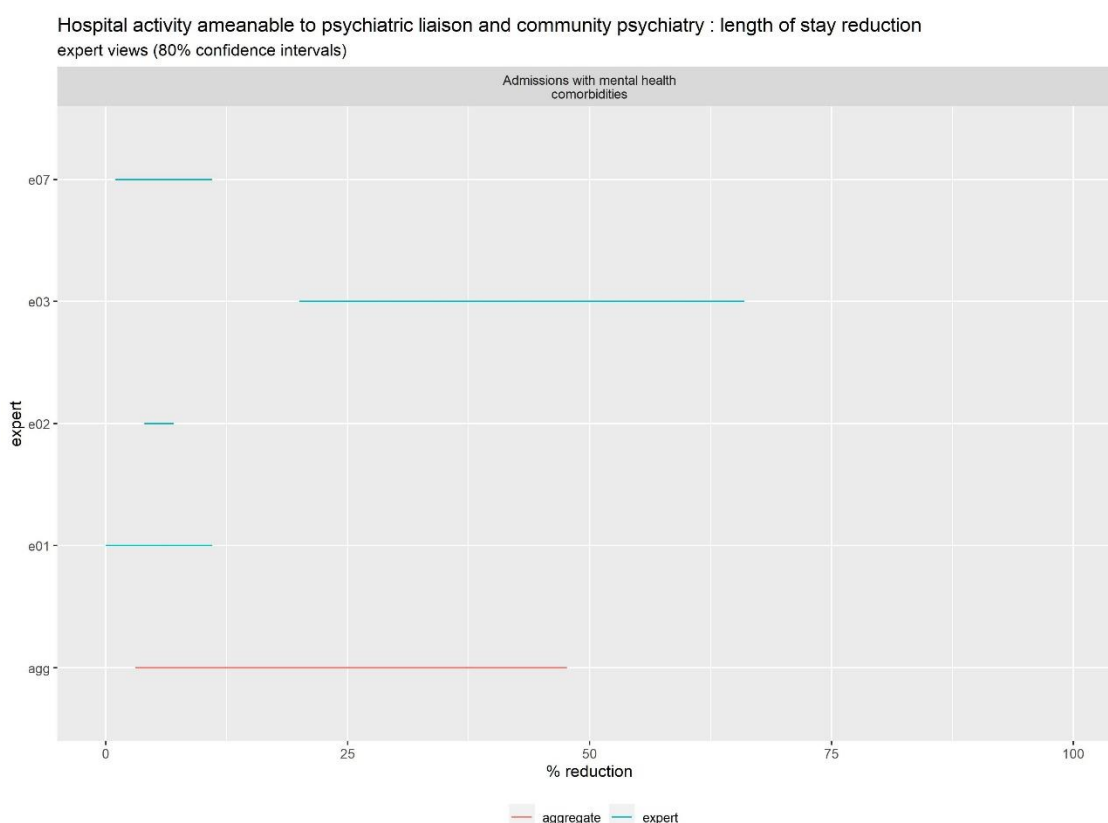
Rationale for P90 values

Factors supporting high activity mitigation forecasts were related to preventive measures or improvements in care. These included greater investment in mental health and public health services, more support in schools for promotion of mental health issues, earlier assessment and treatment, as well as better GP access. Pharmacy support was also noted which could be seen as a substitution for hospital-based care.

Forecasts for hospital activity amenable to psychiatric liaison and community psychiatry that might be mitigated by reductions in length of stay.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Admissions with mental health comorbidities	3.05	47.66	4



Rationale for P10 values

SMEs described limited preventive mechanism for activity mitigation. Comments focussed on the lack of mental health services, resource limitations and a lack of prioritisation as factors for low levels of activity mitigation.

Rationale for P90 values

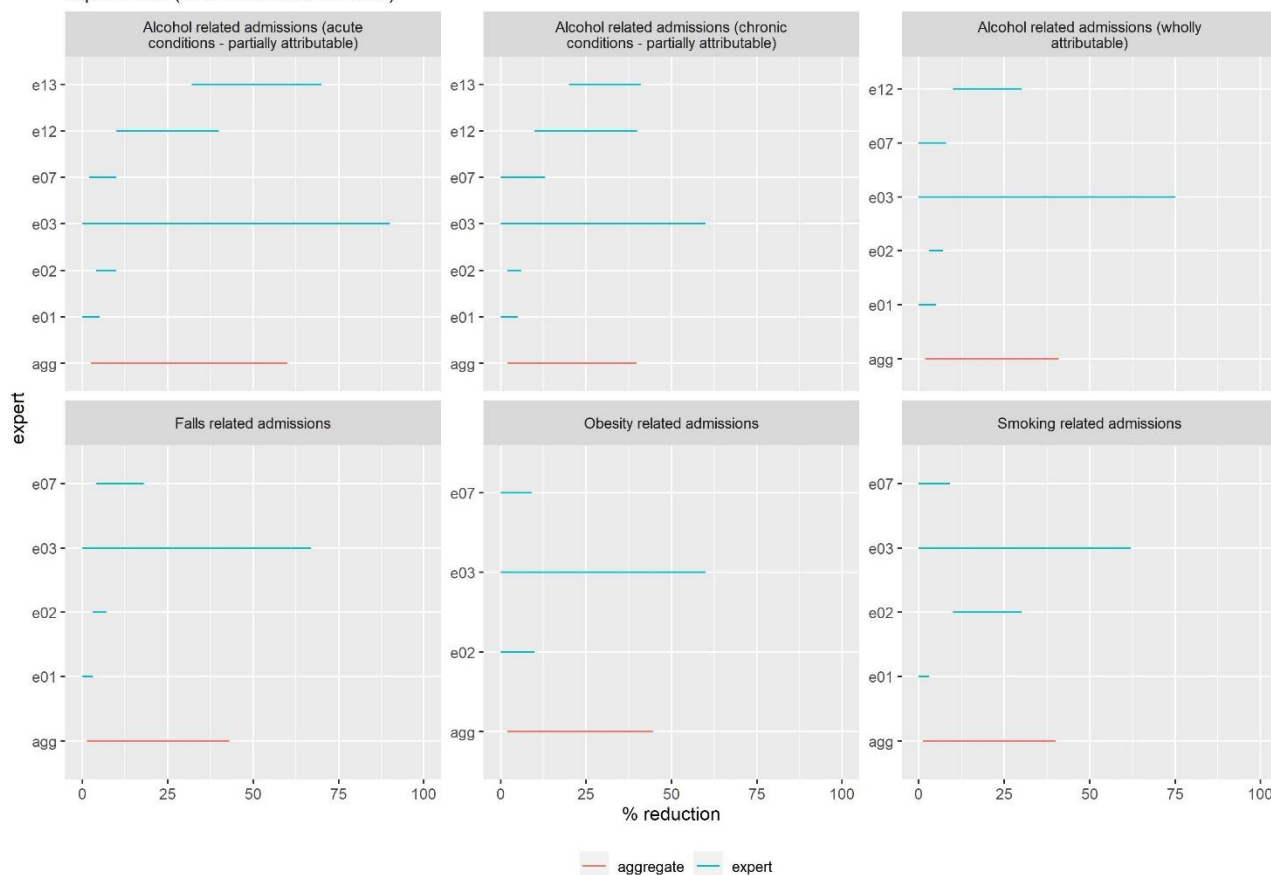
Rationales for high levels of activity mitigation focussed on prevention and relocation of care. Significant investment in mental health services and public health interventions were described. Some SMEs also noted possible increases in the number of clinical psychologists available to provide support to patients with chronic conditions and the increased use of virtual ward monitoring.

Forecasts for hospital activity amenable to public health interventions that might be mitigated by avoiding inpatient admission.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Alcohol related admissions (acute conditions - partially attributable)	2.48	60.08	6
Alcohol related admissions (chronic conditions - partially attributable)	2.10	39.84	6
Alcohol related admissions (wholly attributable)	1.85	40.96	5
Falls related admissions	1.29	43.07	4
Obesity related admissions	1.98	44.62	3
Smoking related admissions	1.13	40.02	4

Hospital activity amenable to public health interventions : inpatient admission avoidance expert views (80% confidence intervals)



Rationale for P10 values

In listing factors for low levels of activity mitigation, SMEs cited a lack of preventive mechanisms. Examples were limited mental health services, the impact of cost of living, homelessness, poverty, and ineffective interventions which fail to change population behaviour.

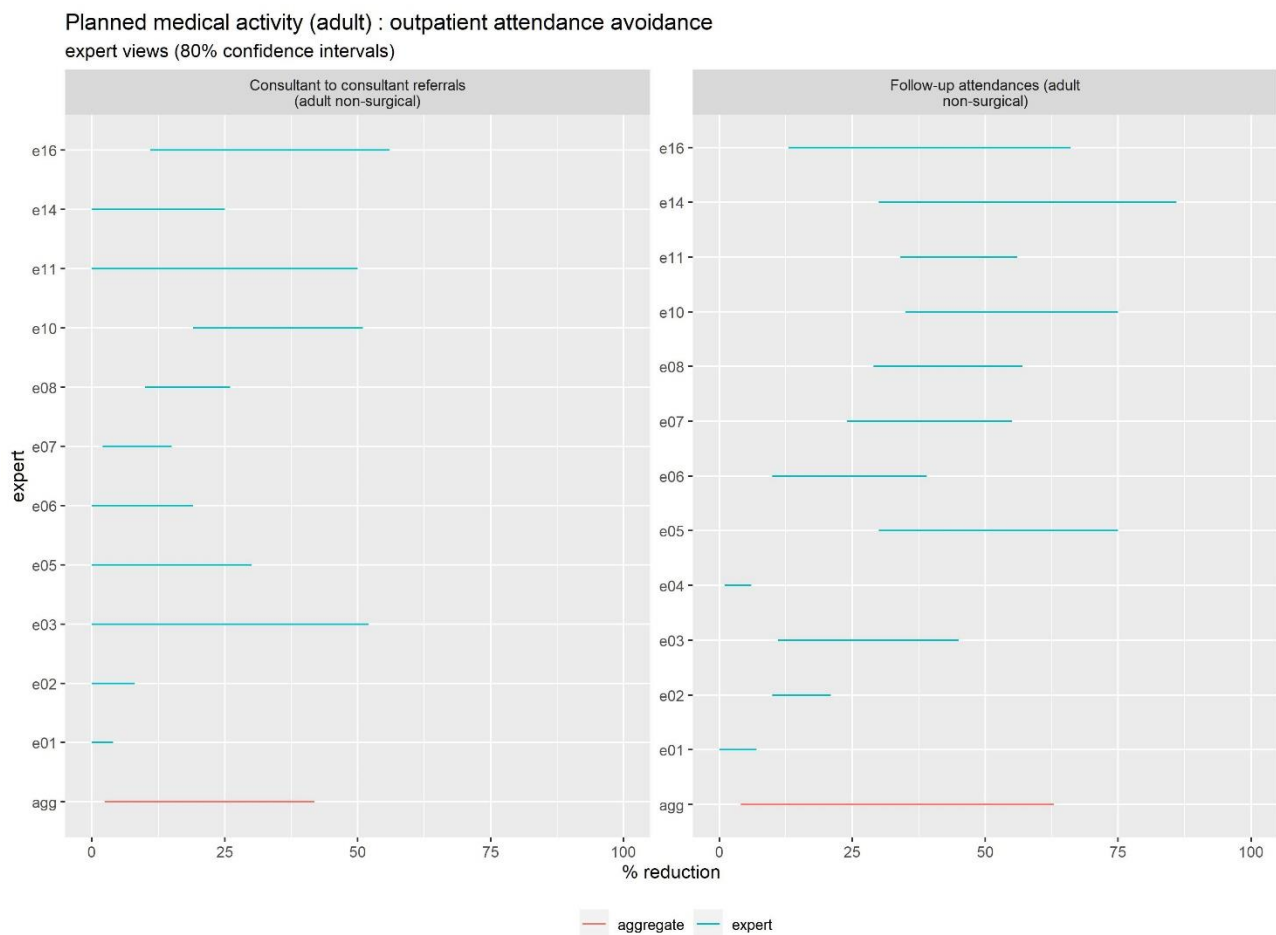
Rationale for P90 values

Rationales focussed on preventive measures. SMEs described public health interventions such as increased alcohol taxation, potential bans on some alcohol, effective investment in smoking cessation, better patient education, as well as improved mental health and well-being services.

Forecasts for planned medical activity for adults that might be mitigated by avoiding outpatient attendance.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Consultant to consultant referrals (adult non-surgical)	2.39	41.85	11
Follow-up attendances (adult non-surgical)	4.04	62.94	12



Rationale for P10 values

For consultant-to-consultant referrals, some SMEs described inefficiencies in the delivery of care. For instance, increasing sub-specialisation and delays in primary care were listed as factors.

For follow-up attendances, some SMEs described other inefficiencies and insufficient options to relocate care. A lack of IT investment, limited availability of virtual clinical environment, and a general lack of investment in out of hospital services resulting in no viable alternatives, particularly for those with long term conditions, were all cited.

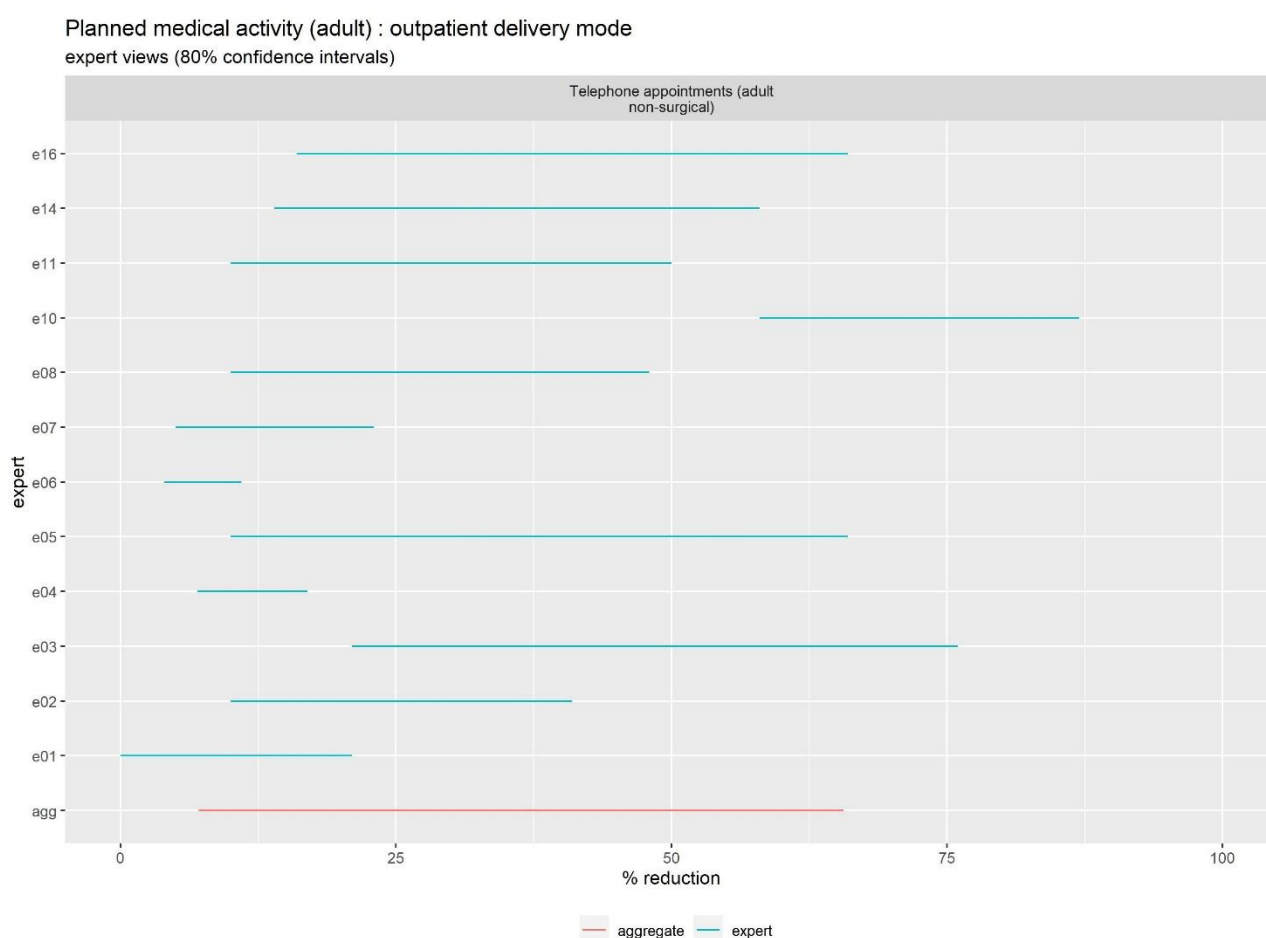
Rationale for P90 values

For consultant-to-consultant referrals, factors mostly related to the improved care and the availability of alternative options to relocate care. Comments included a more holistic approach to care, consultants becoming more general, more robust pathways, strong policies relating to referrals, clinical decision support software for diagnostic tests and greater availability of both diagnostic tests and treatment options in community settings. For follow-up attendances, SMEs again listed factors which increased efficiencies or provided other options to relocate care outside of hospital settings. Examples were investment in new models of care such as women's health hubs, investment in virtual clinics where appropriate, more effective remote monitoring, improved patient education and significant IT investment such as the use of AI for patients to access for queries.

Forecasts for planned medical activity for adults that might be mitigated by the mode of outpatient delivery.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Telephone appointments (adult non-surgical)	7.10	65.61	12



Rationale for P10 values

SMEs described factors which related to inefficiencies in care such as the poor uptake of digital technology, lack of clinical buy-in and delays in primary care.

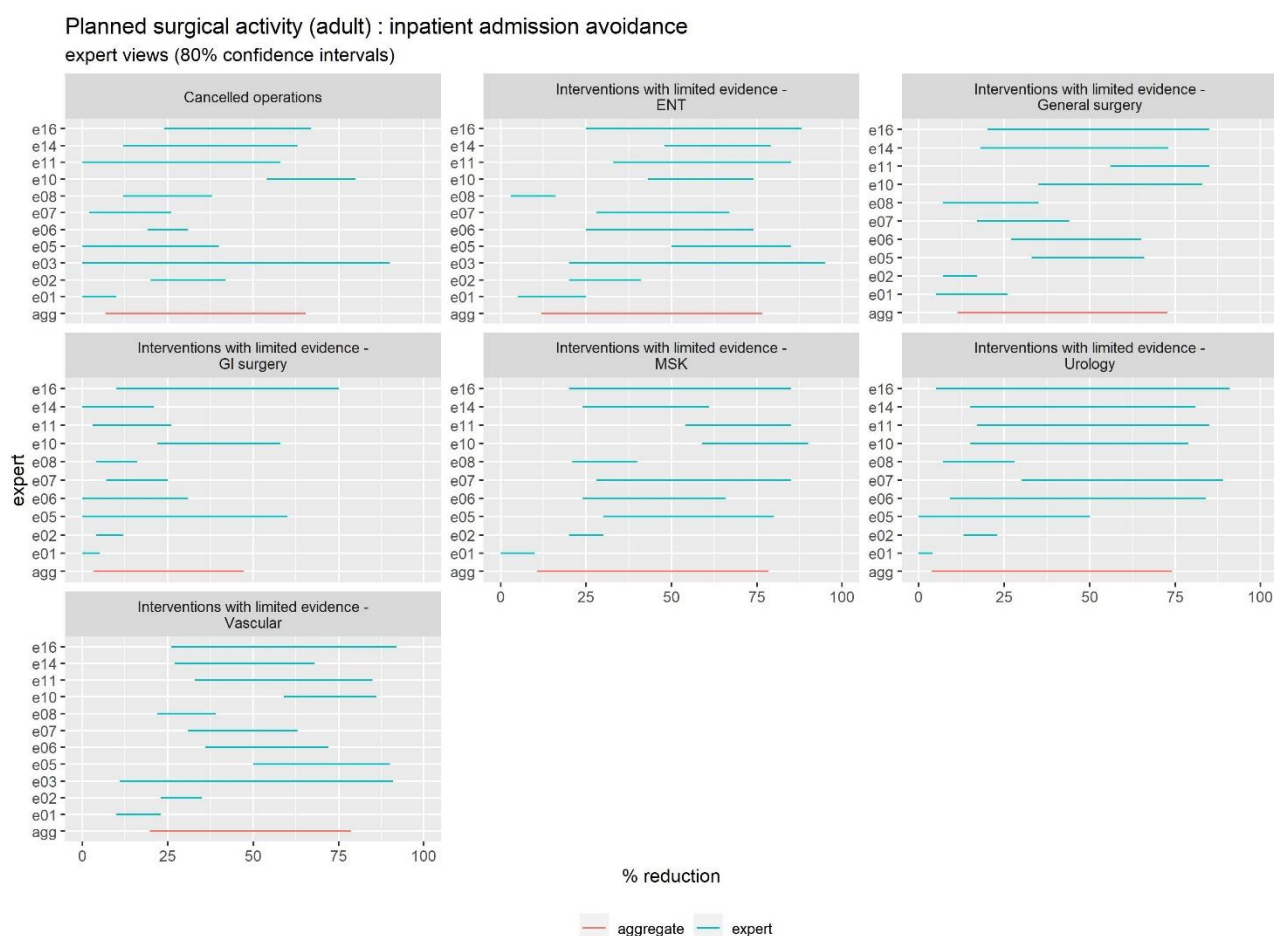
Rationale for P90 values

SMEs described efficiencies which facilitated a substitution of face-to-face consultations to tele or virtual consultations. Examples included increased use of digital technology and electronic patient records as factors for high mitigation.

Forecasts for planned surgical activity for adults which might be mitigated by avoiding inpatient admission.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Cancelled operations	6.77	65.33	11
Interventions with limited evidence - ENT	11.82	76.66	11
Interventions with limited evidence - General surgery	11.28	72.78	10
Interventions with limited evidence - GI surgery	3.22	47.22	10
Interventions with limited evidence – MSK	10.73	78.37	10
Interventions with limited evidence – Urology	3.71	74.16	10
Interventions with limited evidence - Vascular	19.82	78.57	11



Rationale for P10 values

For cancelled operations, a broad range of factors were listed by SMEs. They mostly focussed on inefficiencies and a lack of preventive measures. Some SME described staffing shortages, ineffective booking systems and admin procedures, poor communication with patients, ineffective preassessment, failure to increase day case rates and poor separation of elective and acute work. In addition, inadequate primary, social or community care support and patient transport issues were also cited as key factors.

Rationale for P90 values

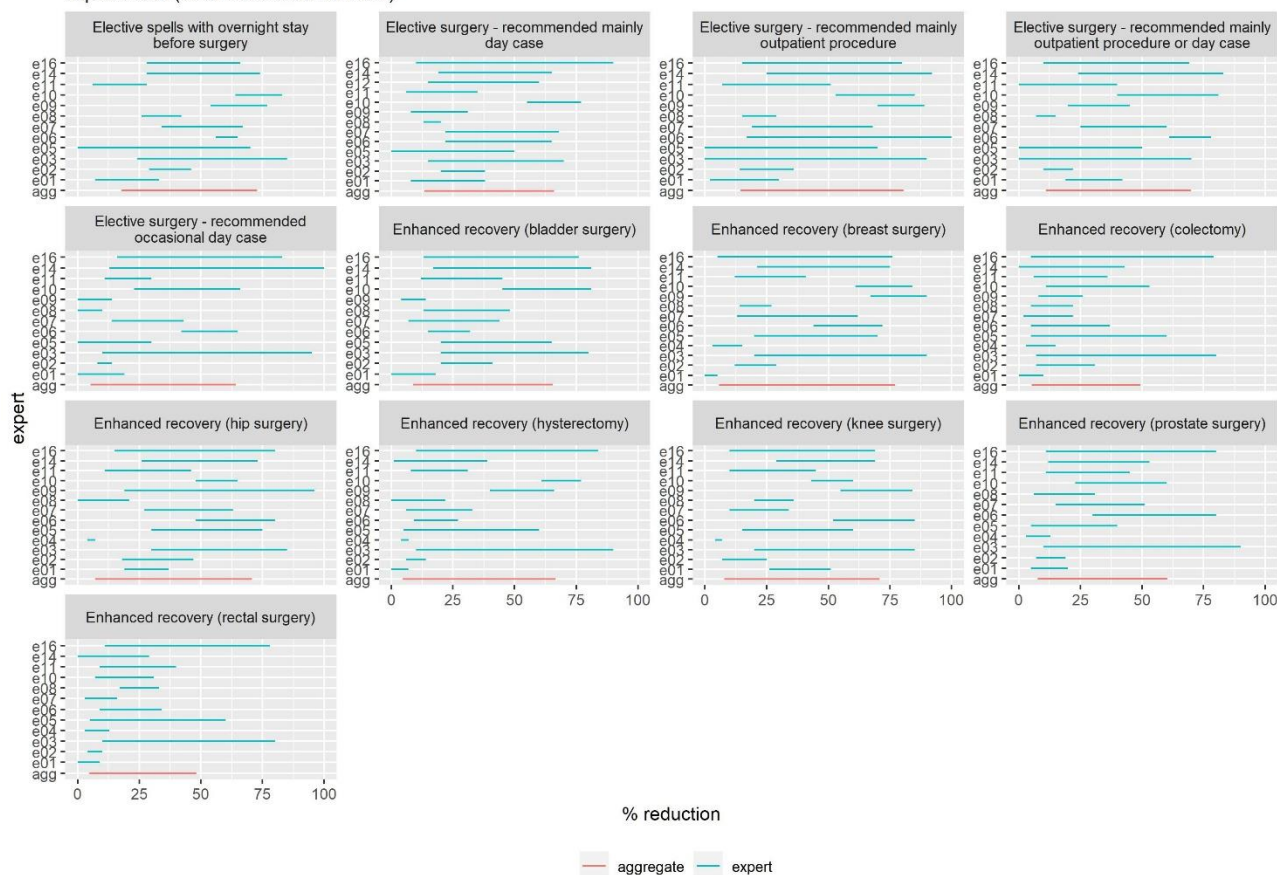
For cancelled operations, SMEs described preventive measures, the substitution of care and greater efficiencies. Factors listed included advances in electronic booking systems, better IT systems, improved patient communication, ring-fencing of elective beds or increases in off-site surgical centres, greater shift to day case procedures, improvements in pre-operative pathway management and better prehab. For interventions with limited evidence, SMEs largely cited factors that were preventive, increased efficiencies and rationing of the procedures. Examples of the factors provided were investments in public health campaigns, improvements in non-surgical treatment options and improved alternative pathways, better prevention strategies and patient access to self-management. Additionally, some SMEs described a future where NHS providers simply no longer offer these procedures.

Forecasts for planned surgical activity for adults which might be mitigated by reducing length of stay.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Elective spells with overnight stay before surgery	17.72	72.90	12
Elective surgery - recommended mainly day case	13.26	65.94	13
Elective surgery - recommended mainly outpatient procedure	14.34	80.61	12
Elective surgery - recommended mainly outpatient procedure or day case	10.91	69.94	12
Elective surgery - recommended occasional day case	5.20	64.16	12
Enhanced recovery (bladder surgery)	8.67	65.59	12
Enhanced recovery (breast surgery)	5.71	77.17	13
Enhanced recovery (colectomy)	5.27	49.40	13
Enhanced recovery (hip surgery)	7.07	70.73	13
Enhanced recovery (hysterectomy)	4.67	66.66	13
Enhanced recovery (knee surgery)	7.85	70.76	13
Enhanced recovery (prostate surgery)	7.78	60.32	12
Enhanced recovery (rectal surgery)	4.60	48.21	12

Planned surgical activity (adult) : length of stay reduction expert views (80% confidence intervals)



Rationale for P10 values

SMEs highlighted the lack of preventive measures, inefficiencies and limited availability of alternative options such as for 'optimisation' prior to surgery as well as the management of patients' recovery. Some SMEs described the impact of inadequate social care capacity in prohibiting the timely discharge of patients as well as travel and social barriers. Additionally, a lack of community services for patient recovery was cited with SMEs noting staff shortages of AHPs.

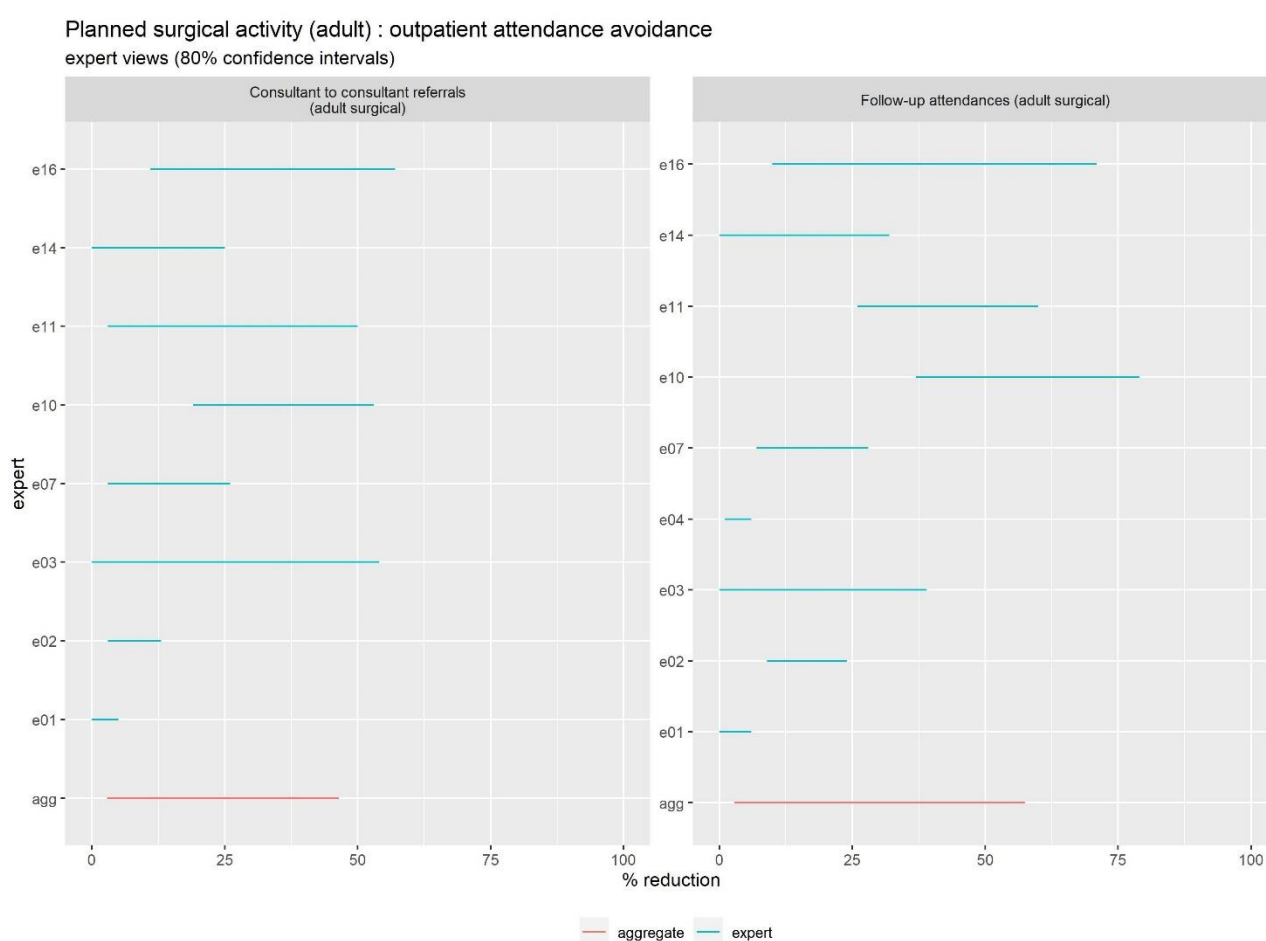
Rationale for P90 values

Factors listed by SMEs to explain high mitigation of activity mostly related to improvements in efficiency of the care delivered. However, preventive measures and the access to out of hospital alternatives were also commonly cited. Examples of the factors listed were screening programmes, better pre-operative assessment, future surgical advances resulting in less invasive procedures, better management of anaesthetics and increased remote monitoring. SMEs also described increased provision of elective surgical sites, greater joined-up working with community services, investments to enhance community support for patient prehab and recovery as well as greater funding for AHPs to help enable faster discharge.

Forecasts for planned surgical activity for adults which might be mitigated by avoiding outpatient attendance.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Consultant to consultant referrals (adult surgical)	2.89	46.44	8
Follow-up attendances (adult surgical)	2.85	57.43	9



Rationale for P10 values

For consultant-to-consultant referrals, SMEs tended to highlight inefficiencies. Some SMEs stated that increasing sub-specialisation and the specialisation of care at tertiary centres, is a limiting factor. Other low mitigation factors included delays in primary care, primary care resistance to making onward referrals and a failure to digitise. For follow-up attendances, some SMEs described

inefficiencies in the delivery of care. Examples here were lack of IT investment and limited availability of virtual clinical environment.

Rationale for P90 values

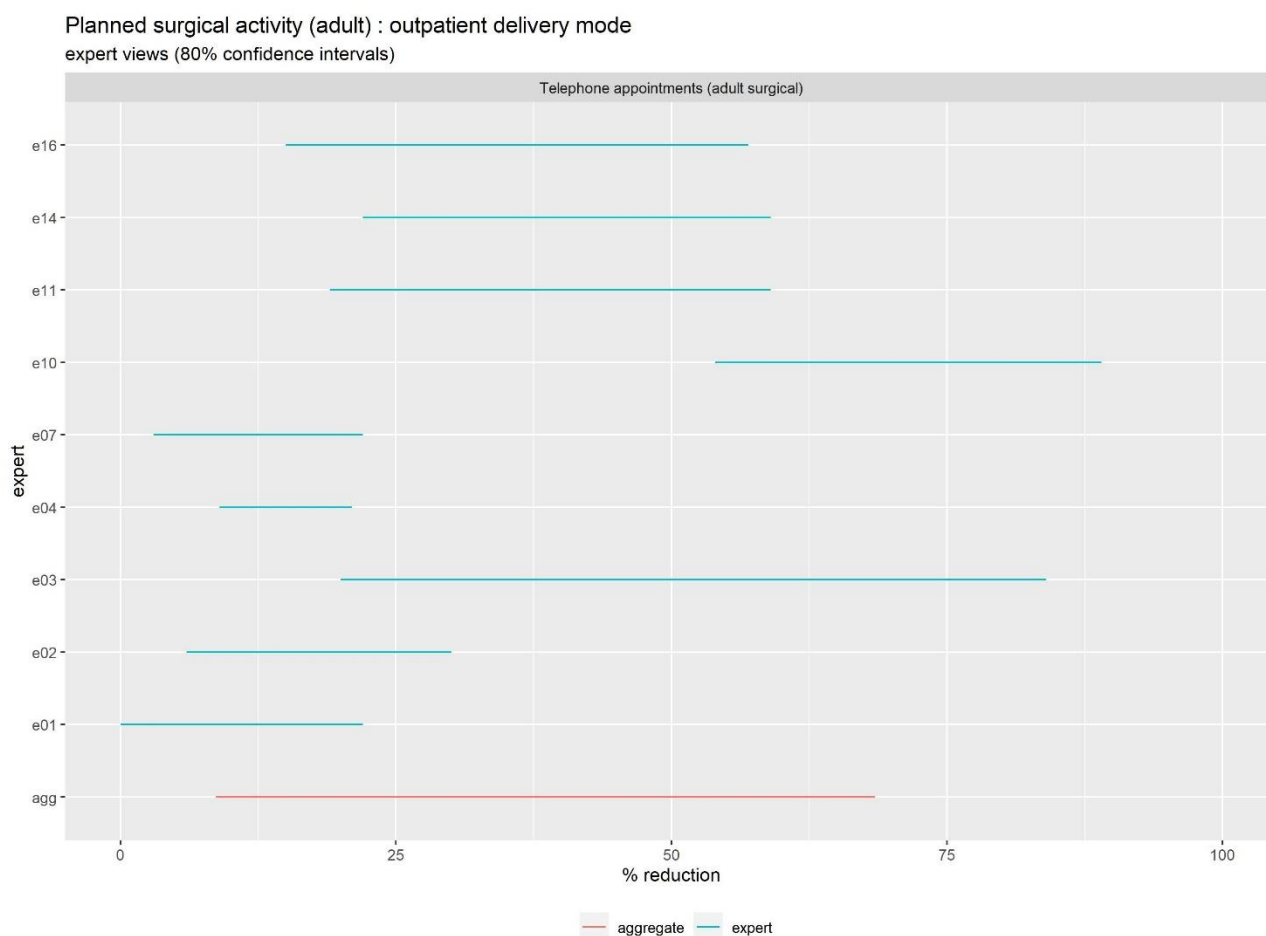
For consultant-to-consultant referrals, SMEs described greater efficiencies, the effective redirection and relocation of care. Examples included improved triage, a more holistic approach to care, a reversal in the trend towards specialisation, more robust pathways, strong policies relating to referrals, clinical decision support software for diagnostic tests and greater availability of both diagnostic tests and treatment options in community settings.

Similarly, for follow-up attendances, SMEs listed factors which mostly related to improving care, redirecting, and relocating care as mechanisms of mitigating activity. Rationing was also a mechanism highlighted here. Some SMEs described investment in new models of care, investment in virtual clinics where appropriate, more effective remote monitoring, improved patient education and significant investment in IT systems as well as stopping the offer of 'low value' follow up.

Forecasts for planned surgical activity for adults which might be mitigated by the model of outpatient delivery.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Telephone appointments (adult surgical)	8.66	68.50	9



Rationale for P10 values

SMEs listed factors relating to inefficiencies such as a lack of IT investment, low levels of clinical and operational buy-in, poor uptake of digital technology, problems with network speed, insufficient admin support as well as insufficient physical space for virtual clinic appointments to take place. Political pressure to prioritise in-person attendance, clinical concerns regarding the risk of missing abnormal physical findings in surgical patients were also cited.

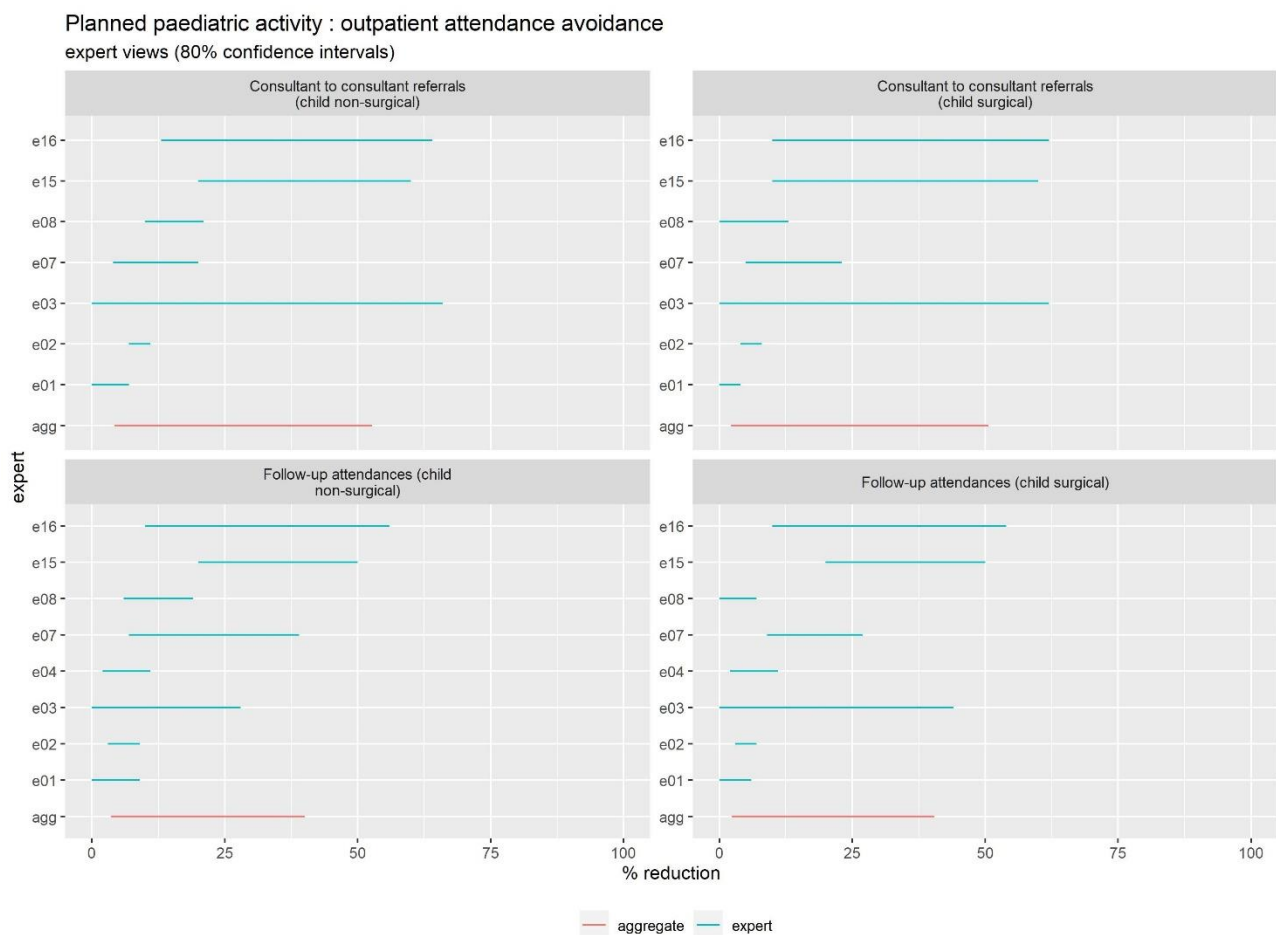
Rationale for P90 values

SMEs described improvements in delivery of care and the effective substitution of face-to-face consultations to tele or virtual consultations. SMEs referred to significant IT investment, good uptake of digital technology, high levels of clinical buy-in, sufficient admin support and physical space for virtual appointments. One SME described professional bodies leading a transition to tele-medicine becoming the standard outpatient appointment.

Forecasts for planned paediatric activity that might be mitigated by avoiding attendance to outpatients.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Consultant to consultant referrals (child non-surgical)	4.20	52.74	7
Consultant to consultant referrals (child surgical)	2.25	50.62	7
Follow-up attendances (child non-surgical)	3.56	40.02	8
Follow-up attendances (child surgical)	2.42	40.47	8



Rationale for P10 values

SMEs mostly highlighted the inefficiencies in the delivery of care resulting from the low experience of workforce, the risk averse culture in the management of children's health and increasing sub-specialisation. Some SMEs also cited high levels of parental demand for their child to be seen by a specialist as limiting factors for activity mitigation.

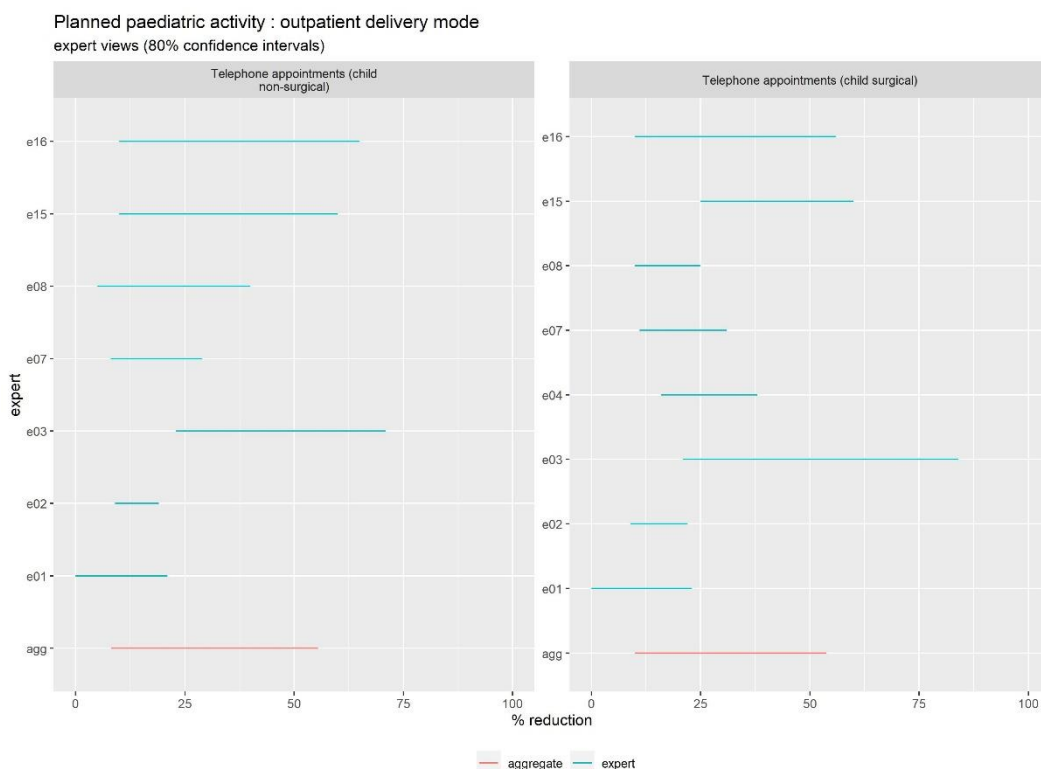
Rationale for P90 values

SMEs described the effective redirection and relocation of activity as well as efficiency improvements. SMEs listed investment in IT infrastructure with appropriate video consultation facilities, a cultural shift to towards patient-initiated follow-ups as the default follow-up after curative procedures, job planned time for clinicians to review submitted information, effective remote monitoring, and the availability of AHP services and diagnostic tests in a community setting. Some SMEs also referenced that an increased tolerance of risk, stronger MDT discussions, and the removal of variation for referral criteria would contribute to mitigating this activity. The adoption of patient initiated follow up as the default type of follow up described by some SMEs may be considered a type of rationing mechanism.

Forecasts for planned paediatric activity that might be mitigated by the mode of outpatient delivery.

The table below lists the types of activity that might be mitigated, and the accompanying figure shows the individual forecasts from SMEs and aggregate values.

Description	Aggregate P10	Aggregate P90	N
Telephone appointments (child non-surgical)	8.21	55.46	7
Telephone appointments (child surgical)	9.96	53.80	8



Rationale for P10 values

Most SMEs described a lack of improvements in the delivery in care. Rationales included descriptions of increased risk aversion in children's virtual health care management and a lack of clinical buy-in. SMEs referenced the challenge of virtually assessing the safety of children and a workforce with insufficient paediatric skills. Other factors cited by SMEs included poor uptake of digital technology, challenges with IT infrastructure or network speeds (applicable to clinicians as well patient families), poor quality referrals with limited information, insufficient admin support and insufficient physical space for virtual appointments.

Rationale for P90 values

SMEs cited improvements and the effective relocation of care. SMEs described better use of digital technology, investment in community diagnostic hubs, advances in remote monitoring, a focus on remote consultation as part of medical education or training and clear referral standards with enhanced quality of clinical information from referrers. SMEs also suggested that mitigation of activity would be dependent on clinical buy-in, sufficient admin support, access to electronic patient records for effective decision making, and sufficient physical space for virtual appointments. In addition, SMEs mentioned better communication with families to understand the preferences of children and young people and their families, as well as presenting information regarding carbon footprint and financial costs associated with face-to-face consultations.

Discussion

We undertook a rapid online exercise to elicit long term probabilistic forecasts from experts on the extent to which various types of hospital activity might be mitigated in the future. The exercise has provided the NHP with an initial or preliminary set of aggregate probabilistic forecasts which make explicit the distribution of uncertainty in respect of 77 types of hospital activity which, crucially, provide an outside view,^{8,9,10} for England (not a specific hospital).

The overall (n=77) aggregate means ranged from a low of 5.71% to high of 48.27% with an average width of 50.08%. The aggregate means varied by type of hospital activity and type of mitigation. The most optimistic forecasts were for mitigation of planned surgical and medical activity. The most pessimistic forecasts were for hospital activity amenable to psychiatric liaison and community psychiatry and public health interventions. The most optimistic forecasts were for outpatient delivery mode and length of stay reductions (albeit with wide variation). The most pessimistic forecasts were for inpatient admission avoidance (albeit with wide variation) and outpatient attendance avoidance. Experts treated the P10 and P90 values as scenarios where they highlighted four types of mitigation mechanism - prevention, displacement, quality improvement and revised treatment thresholds. In most cases, the scenario at p10 included continuing low and unfocused investment in primary and community care whereas the p90 generally assumed the opposite. These insights should be recognised by planners and any estimates of hospital activity mitigation should be accompanied by explicit plans for how investment is planned to change in primary and community settings.

The primary motivation for undertaking this exercise was to avoid the use of point estimates, the flaw of averages and cognitive biases associated especially with inside views in large projects⁵. The prevalent tendency to underweigh or ignore distributional information is a major source of error in forecasting^{5,8,10}. Moreover, the inside view, which refers to a perspective that focuses on the specific details and characteristics of a particular project, often yield an overly optimistic outlook due to a range of biases that include optimism bias, base-rate neglect and strategic misrepresentation¹⁰. In contrast, we sought an outside view by asking experts to make forecasts for England (not for a specific hospital). This simple reframing helps to counteract the over-optimism that can characterise the inside view by providing objective and realistic forecasts of uncertainty⁸. This is crucial. As Flyvbjerg states, "The comparative advantage of the outside view is most pronounced for non-routine projects, understood as projects that managers and decision makers in a certain locale or organization have never attempted before—like building new plants or infrastructure, or catering to new types of demand. It is in the planning of such new efforts that the biases toward optimism and strategic misrepresentation are likely to be largest."¹⁰

The national forecasts provide an outside view against which local forecasts can be evaluated. Moreover, the use of the NHP Model along with outside forecasts supports a more standardised approach for the NHP programme, along with an opportunity to learn and continually improve the process for planning a new hospital in England. This process for elicitation represents a formal data collection exercise which is systematic, transparent, and subject to scrutiny and continual

improvement. This is in marked contrast with the not uncommon “black box” approach to assumption setting which has attracted criticism.^{2,9,10}

This demanding elicitation exercise was undertaken under considerable time constraints and has several limitations.

We focused on the 77 mitigation factors that were presently in the current version of the NHP Model. Whilst this is already a considerable number, there may be additional hospital activities or types of mitigation (eg maternity care) which should be included in future exercises.

Our recruitment criteria were pragmatic and broad focused mainly on the appetite of participants to undertake the task by consent and choosing what to forecast, rather than any specific markers of expertise (eg age, experience, publications, memberships and peer-recommendation). The evidence, however, shows that such markers are poor indicators of someone’s ability to provide good forecasts. Indeed, the best approach to selecting experts for forecasting exercises is whether the participant can understand the questions being asked. Moreover, the inability to identify the best expert means that groups of multiple experts almost always perform as well as, or better than, the best regarded expert(s)⁴. Some SMEs opted to withdraw from the exercise because of lack of time and/or inability to engage with the exercise leading to a drop in participants at each stage. Although we were expecting a high drop out of SMEs primarily because of workload pressures the final number of participants is not inconsistent with the recommendation of 10-20 participants and evidence which also notes that only minor improvements in performance is gained by having more than 6-12 participants^{Error! Bookmark not defined.}⁴. We sought to maximise the appeal of the task by opting for an online approach because this was likely to minimise the time commitment from SMEs and so maximise the number of SME who could participate. We supported our participants with data science tools which used a combination of interactive graphics, numbers and text to enhance understanding of this demanding exercise. This multi-modal approach appears to be important in supporting more effective participation of women¹¹. Nevertheless, the elicitation literature does indicate that the quality of responses is enhanced by engaging with SMEs in interviews or workshops compared with discussions facilitated via email^{Error! Bookmark not defined.}. The remote online approach meant that the research team was not in a position to interactively quality assure the contribution of SMEs in the time available. For instance, although SMEs were encouraged to provide a clear rationale for their P10 and P90 forecasts, these were not always forthcoming. A few SMEs found the lower 0% bound problematic because they wanted to show an increase in activity (which is accommodated elsewhere in the model), whereas 0% meant that mitigation was wholly unsuccessful. Some SMEs referred to ageing population despite being asked to discount this (which is accommodated elsewhere in the model). For some SMEs, such nuances are probably best addressed via an interactive dialogue. A dialogue between SMEs may also lead to less variability in round 2 forecasts. Nevertheless, despite these limitations, the vast majority of responses from SME appeared to follow the elicitation protocol

with fidelity (about 10% of the responses were excluded from this analysis). The aforementioned limitations should be addressed in future elicitation exercises.

In project planning, it's often beneficial to balance both the inside view and the outside view. Whilst inside views are inherent in project planning, outside views are not routinely undertaken. We recommend outside view elicitation exercises should become integral to large-scale project planning. We also consider the principles adopted for this elicitation exercise would usefully strengthen the development of local hospital mitigation forecasts and so each local elicitation exercise would then complement this national exercise and add to our collective knowledge base about forecasting the mitigation of future hospital activity.

Finally, while the inside view is crucial for understanding the specifics of the project at hand, the outside view provides a valuable reality check and helps avoid overconfidence or overly optimistic projections. The aggregate judgements provided here reflect an outside view of the uncertainties associated with mitigation of various types of hospital activity that can now be explicitly incorporated into the planning process for a new hospital thereby providing an exciting opportunity to learn how outside and inside views interact and inform the planning process for hospitals in the NHP.

Conclusions

A national elicitation exercise has provided aggregate forecasts that makes explicit the variation and uncertainty associated with future mitigation activities from an outside view designed to overcome the limitations of point estimates, the flaw-of-averages, and the over optimism associated with inside views. These forecasts may now be incorporated into the planning process for new hospitals in the English NHS.

Acknowledgements

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Name	Job Title
James Butcher	Operations Lead Future System Programme
Mahesh Kotli	Specialty doctor in Oral and Maxillofacial surgery
Rehan-Uddin Khan	Regional Lead Gynaecologist
Jeanette Taylor	Matron
Robin David Proctor	Consultant Radiologist
Diane Goodwin	Operations Director – NHP
Matthew Needham	Consultant Intensive Care Medicine & Anaesthesia
Paula Miller	Chief Nursing Projects Officer, New Hospital Programme, James Paget NHS Trust
Nigel Wesley Smyth	Consultant Physician
Mary-Anne Christine Morris	Consultant Paediatrician, Clinical Director NHSE EoE CYP Transformation programme
Helena Margaret Earl	Professor Emeritus of Clinical Cancer Medicine
Stephen Winder	Consultant Ophthalmologist
Robert Selley	Strategy Delivery Director
Elaine Quick	GIRFT Radiology Advisor NHSE PACS Implementation Lead Northern Care Alliance
Donald Richardson	Chief Clinical Information Officer
Nicholas Kennedy	Consultant anaesthetist and Intensivist
Steve Canty	Consultant Trauma & Orthopaedic Surgeon, Divisional Medical Director for Surgery
Yvonne Susan Thackray	Imaging Academy Manager
Emma Jackson	Intensive Care Medicine Consultant
Paul Stevens	Consultant Nephrologist & Medical Examiner, Chair South East Clinical Senate
Richard Graham	Director of Research and Innovation and Consultant Radiologist
Rachel Hoey	Consultant and Divisional Director Emergency Medicine
Josie Harral	Head of Redevelopment Programme Analytics
Jenny Steel	GP & Medical Director Integrated Community Services
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Sophie Hargreaves	Director of Strategy
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Contributions

MAM is the study lead. TJ, JP & CB led the design and implementation of the online app and supported the execution of the study. JC analysed the free text data. SW & TJ undertook the statistical analyses. PS provided strategic guidance and support. All authors contributed to drafting the final manuscript.

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Appendix 1 – List of Parameters

No	Type of Mitigation	Parameter (https://connect.strategyunitwm.nhs.uk/nhp_dev/national_elicitation/)
1	inpatient admission avoidance	Alcohol related admissions (wholly attributable)
2	inpatient admission avoidance	Alcohol related admissions (acute conditions - partially attributable)
3	inpatient admission avoidance	Alcohol related admissions (chronic conditions - partially attributable)
4	inpatient admission avoidance	Obesity related admissions
5	inpatient admission avoidance	Smoking related admissions
6	inpatient admission avoidance	Falls related admissions
7	inpatient admission avoidance	Ambulatory care sensitive admissions (acute conditions)
8	inpatient admission avoidance	Ambulatory care sensitive admissions (chronic conditions)
9	inpatient admission avoidance	Ambulatory care sensitive admissions (vaccine preventable conditions)
10	inpatient admission avoidance	Emergency readmissions within 28 days
11	inpatient admission avoidance	Admission with no overnight stay and no procedure (adults)
12	inpatient admission avoidance	Admission with no overnight stay and no procedure (children)
13	inpatient admission avoidance	Medically unexplained symptoms admissions
14	inpatient admission avoidance	Mental health admissions via ED
15	inpatient admission avoidance	Intentional self-harm admission
16	inpatient admission avoidance	End of life care admissions (died within 2 days)
17	inpatient admission avoidance	End of life care admissions (died within 3-14 days)
18	inpatient admission avoidance	Frail elderly admissions (high frailty risk)
19	inpatient admission avoidance	Frail elderly admissions (intermediate frailty risk)
20	inpatient admission avoidance	Medicines related admissions (explicit)
21	inpatient admission avoidance	Medicines related admissions (implicit - anti-diabetics)
22	inpatient admission avoidance	Medicines related admissions (implicit - benzodiazepines)
23	inpatient admission avoidance	Medicines related admissions (implicit - diuretics)
24	inpatient admission avoidance	Medicines related admissions (implicit - NSAIDS)
25	inpatient admission avoidance	Interventions with limited evidence - ENT
26	inpatient admission avoidance	Interventions with limited evidence - General surgery

27	inpatient admission avoidance	Interventions with limited evidence - GI surgery
28	inpatient admission avoidance	Interventions with limited evidence - MSK
29	inpatient admission avoidance	Interventions with limited evidence - Urology
30	inpatient admission avoidance	Interventions with limited evidence - Vascular
31	inpatient admission avoidance	Cancelled operations
32	length of stay reduction	Emergency admissions of older people
33	length of stay reduction	Stroke early supported discharge
34	length of stay reduction	Excess beds days (elective admissions)
35	length of stay reduction	Excess beds days (emergency admissions)
36	length of stay reduction	Admissions with mental health comorbidities
37	length of stay reduction	Ambulatory emergency care (low potential)
38	length of stay reduction	Ambulatory emergency care (moderate potential)
39	length of stay reduction	Ambulatory emergency care (high potential)
40	length of stay reduction	Ambulatory emergency care (very high potential)
41	length of stay reduction	Enhanced recovery (bladder surgery)
42	length of stay reduction	Enhanced recovery (breast surgery)
43	length of stay reduction	Enhanced recovery (colectomy)
44	length of stay reduction	Enhanced recovery (hip surgery)
45	length of stay reduction	Enhanced recovery (hysterectomy)
46	length of stay reduction	Enhanced recovery (knee surgery)
47	length of stay reduction	Enhanced recovery (prostate surgery)
48	length of stay reduction	Enhanced recovery (rectal surgery)
49	length of stay reduction	Elective spells with overnight stay before surgery
50	length of stay reduction	Elective surgery - recommended mainly outpatient procedure
51	length of stay reduction	Elective surgery - recommended occasional day case
52	length of stay reduction	Elective surgery - recommended mainly day case
53	length of stay reduction	Elective surgery - recommended mainly outpatient procedure or day case

54	outpatient attendance avoidance	Consultant to consultant referrals (adult surgical)
55	outpatient attendance avoidance	Consultant to consultant referrals (adult non-surgical)
56	outpatient attendance avoidance	Consultant to consultant referrals (child surgical)
57	outpatient attendance avoidance	Consultant to consultant referrals (child non-surgical)
58	outpatient attendance avoidance	Follow-up attendances (adult surgical)
59	outpatient attendance avoidance	Follow-up attendances (adult non-surgical)
60	outpatient attendance avoidance	Follow-up attendances (child surgical)
61	outpatient attendance avoidance	Follow-up attendances (child non-surgical)
62	outpatient delivery mode	Telephone appointments (adult surgical)
63	outpatient delivery mode	Telephone appointments (adult non-surgical)
64	outpatient delivery mode	Telephone appointments (child surgical)
65	outpatient delivery mode	Telephone appointments (child non-surgical)
66	A&E attendance avoidance	Frequent attenders (adult ambulance conveyed)
67	A&E attendance avoidance	Frequent attenders (adult walk-in)
68	A&E attendance avoidance	Frequent attenders (child ambulance conveyed)
69	A&E attendance avoidance	Frequent attenders (child walk-in)
70	A&E attendance avoidance	Patients who leave before being seen (adult ambulance conveyed)
71	A&E attendance avoidance	Patients who leave before being seen (adult walk-in)
72	A&E attendance avoidance	Patients who leave before being seen (child ambulance conveyed)
73	A&E attendance avoidance	Patients who leave before being seen (child walk-in)
74	A&E attendance avoidance	Low cost discharged attendances (adult ambulance conveyed)
75	A&E attendance avoidance	Low cost discharged attendances (adult walk-in)
76	A&E attendance avoidance	Low cost discharged attendances (child ambulance conveyed)
77	A&E attendance avoidance	Low cost discharged attendances (child walk-in)

Appendix 2 – Instructions for experts

You are required to provide forecast intervals for the percentage reduction in certain types of hospital activity at the England level over a twenty-year time horizon. The focus here is exclusively on hospital activity which may be mitigated. You must not incorporate factors which increase hospital activity into your judgements because such factors are accommodated elsewhere in the model.

In total there are 77 parameters to forecast. The app will only offer you those parameters which you opted to select in the consent form (if you selected all options then you will have 77 parameters to forecast). All the parameters are presented at the England level.

The app will automatically close on Tue 24 October (midnight). Please try and complete your assignment before then. If you do not complete all the assignment, we will still endeavour to use what we can.

For each parameter, there is a descriptive text box that provides an outline of why reducing the type of activity is desired along with some information about how the type of activity is identified. There is a plot of historical trends across England. These plots show data based on routinely collected Hospital Episode Statistics (HES) data. The trends are provided for information only.

Please pay close attention to the vertical axis on each chart as this will tell you the type of change you are forecasting, in many cases it will be the rate of admissions or attendances, but some parameters require different assumptions, for example, about how length of stay might reduce or how the proportion of cases that are undertaken in a particular setting might reduce.

In some instances, the plots may show an unusual change or pattern. This is likely to reflect data quality issues and/or a change in the clinical coding process. Please discount these unusual patterns.

Your task

To review the description and plot for each parameter. If you see an unusual pattern on the timeseries plots, please ignore these patterns as they are most likely to be data/coding issues.

To thoughtfully list out the factors which you think will lead to a surprising (low or high) value. We want realistic, plausible, surprising values. We don't want unrealistic, implausible, extremely surprising values.

In listing factors which might mitigate certain types of hospital activity we want you to consider those things that could be done to prevent, reduce or divert (away from the hospital) such activity. In general, such factors will relate to enhanced provision of primary and community care, novel models of care, changes to existing services or public health interventions. The impact of the population ageing and healthy life expectancy are accommodated elsewhere in the model and so should not be incorporated in your judgments.

For example, in 2019, about 4 out of 100 hospital admissions were falls related admissions. You might consider that these could be reduced by factors such as enhanced falls prevention services in the community, increased provision of home care, increased provision of telehealth monitoring, public health campaigns and social prescribing. The impact of the population ageing and healthy life expectancy should not be considered. You should not modify your prediction about falls admissions on the basis that there will be more older people in the population because this is accommodated elsewhere in the model.

Use the slider to select the lower and upper % values for your forecast based on the factors you have listed. The percentage reductions can only go from 0% (no reduction) to 100% (total reduction).

Upon completion you will see the final "completed" screen.

Your work is automatically saved and the app will remember your progress.

If you have any queries, please email strategy.unit@nhs.net

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