



UWL REPOSITORY

repository.uwl.ac.uk

The role of pandemic planning in the management of COVID-19 in England from an infection prevention and control (IPC) perspective: results of a national survey

Greene, Carolynn ORCID logoORCID: <https://orcid.org/0000-0002-1170-376X>, Wilson, Jennie ORCID logoORCID: <https://orcid.org/0000-0002-4713-9662>, Griffin, Hannah ORCID logoORCID: <https://orcid.org/0000-0001-6874-9825>, Tingle, Alison, Cooper, Tracey, Semple, Malcolm G, Enoch, David, Lee, Andrew and Loveday, Heather ORCID logoORCID: <https://orcid.org/0000-0003-2259-8149> (2023) The role of pandemic planning in the management of COVID-19 in England from an infection prevention and control (IPC) perspective: results of a national survey. Public Health, 217. pp. 89-94. ISSN 0033-3506

<http://dx.doi.org/10.1016/j.puhe.2023.01.028>

This is the Accepted Version of the final output.

UWL repository link: <https://repository.uwl.ac.uk/id/eprint/9765/>

Alternative formats: If you require this document in an alternative format, please contact: open.research@uwl.ac.uk

Copyright:

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy: If you believe that this document breaches copyright, please contact us at open.research@uwl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

The role of pandemic planning in the management of COVID-19 in England from an infection prevention and control (IPC) perspective: results of a national survey

Abstract

Objectives

A national survey which aimed to explore how existing pandemic preparedness plans (PPP) accounted for the demands placed on infection prevention and control (IPC) services in acute and community settings in England during the first wave of the COVID-19 pandemic.

Study design

A cross-sectional survey of IPC leaders working within NHS Trusts or clinical commissioning groups/integrated care systems in England.

Methods

Survey questions related to organisational COVID-19 preparedness pre-pandemic and the response provided during the first wave of the pandemic (January to July 2020). The survey ran from September to November 2021 and participation was voluntary.

Results

In total, 50 organisations responded. 71% (n=34/48) reported having a current PPP in December 2019, with 81% (n=21/26) indicating their plan was updated within the previous three years. Around half of IPC teams were involved in previous testing of these plans via internal and multi-agency tabletop exercises. Successful aspects of pandemic planning were identified as command structures, clear channels of communication, COVID-19 testing, and patient pathways. Key deficiencies were lack of PPE, difficulties with fit testing, keeping up to date with guidance, and insufficient staffing.

Conclusions

Pandemic plans need to consider the capability and capacity of IPC services to ensure they can contribute their critical knowledge and expertise to the pandemic response. This survey provides a detailed evaluation of how IPC services were impacted during the first wave of the pandemic and identifies key areas which need to be included in future PPP to better manage the impact on IPC services.

Key words

COVID-19 Pandemic, Infection Control, Survey Methods, Hospital Preparedness

Background

In the United Kingdom (UK) National Health Service (NHS) trusts are required under the Civil Contingencies Act 2004 to prepare for emergencies, including pandemics (UK Public General Acts, 2004). These trusts are organisational units within the NHS of England and Wales, typically serving a general function in a defined geographical area or a specialised function across a wider area. The most recent UK government simulation which tested national pandemic influenza plans, Exercise Cygnus in 2016, identified that the UK was not sufficiently prepared in terms of plans, policies, and capabilities to respond to a pandemic (Public Health England, 2017).

Involvement of infection prevention and control (IPC) experts and practitioners in the development of emergency management and pandemic plans is key to assess and mitigate the potential impact of infection transmission during major incidents (Rebmann, 2009). In a pandemic, IPC provide specialist advice to support decision-making across all levels of an organisation in order to minimise the risk of infection to staff and patients (Rebmann, English and Carrico, 2007). This includes creating and revising policy and procedures in response to the situation as it develops. The critical role of IPC, and the increased demands placed on their services needs to be considered in pandemic plans.

Assessment of preparedness for national pandemics has been targeted at influenza, with an assessment tool published by the European Centre for Disease Prevention and Control (ECDC, 2006) and recommendations from the World Health Organization (WHO, 2005). However, specific planning for IPC services does not feature and there are currently no standards or guidelines to support this. Reidy *et al* (2015) surveyed influenza pandemic preparedness related to IPC services in hospitals in the Republic of Ireland. Areas which required improvement were testing of plans, emergency planning committees, isolation capacity, and stockpiling of personal protective equipment (PPE).

The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which caused the COVID-19 pandemic began to affect the UK in early 2020. Creating unique pressures on IPC services which were required to cope with enormous demands for advice, policy, decision-making, and activities required to control all permutations of transmission between patients and staff (Alsuhaibani *et al.*, 2022). Assessing how well existing pandemic preparedness plans (PPP) accounted for demands placed on IPC services is key to prepare for future responses. This study aimed to explore the impact on IPC services in England during the first phase of the pandemic and how the IPC response was informed by PPP.

Methods

An online survey captured data from IPC service leaders across acute trusts, community trusts, mental health trusts, and commissioning bodies. As no validated tool exists to assess pandemic preparedness specific to IPC services a survey was constructed based on best available evidence. Topic areas were informed by three existing tools and frameworks for general pandemic preparedness (Reidy *et al.*, 2015; Khan *et al.*, 2018; European Centre for Disease Prevention and Control, 2006). The research team highlighted additional topic areas based on their experiences of working within IPC services or NHS settings during the pandemic.

Two versions of the survey were developed to ensure questions were relevant to either service providers (52 questions) or service commissioners (39 questions) (Supplemental File 1). Service providers include NHS trusts set up to deliver hospital and community services and other aspects of direct patient care. Service commissioners encompass clinical commissioning groups (CCGs) or

integrated care systems (ICSs) who commission most of the hospital and community NHS services in the region in which they operate.

Surveys were created in Qualtrics software and data captured electronically. Survey links were distributed via NHS England and Improvement to all 209 healthcare trusts and 109 CCGs in England. Professional networks, including the Infection Prevention Society and Healthcare Infection Society, publicised the survey.

Ethical considerations

Ethical approval was received in September 2021 from the [university name] Research Ethics Committee (xxx/xxx/xxxx-01383). The Health Research Authority confirmed via personal correspondence that approval was not required from a national ethics committee. A voluntary sample completed the survey, with consent to participate implicit and presumed by survey completion. Details of the responding organisations were deidentified and identification codes used to represent the data to preserve confidentiality.

Data analysis

Data from completed surveys were entered into an Excel database. Quantitative data were analysed using Statistical Package for the Social Sciences (SPSS) software version 27. Descriptive statistics were used to explore and summarise the data. As not all questions were answered by all respondents, the number of responses is reported to provide clarity on the response rate to each question. Qualitative data from free text questions were managed in NVivo 12 software and organised into categories which best represented the data. These are presented as frequencies; the number of times each category was identified, and the number of organisations which identified it in their response. This reflects whether it was a common point raised across many organisations or a specific issue for single organisations.

Inclusion and exclusion criteria

Only healthcare organisations in England were included. Settings included acute hospitals (general and specialist trusts), mental health trusts, community trusts, combined (acute and community) trusts, CCGs and ICSs. Surveys were excluded if they had answered less than 50% of the questions.

Results

Number of responses

A total of 50 surveys were completed between September and November 2021, giving a response rate of 16% (50/318). Responses were received from 35 service providers and 15 service commissioners (Table 1). Of the providers, 50% (n=25/50) were acute hospital trusts (19 general hospitals, 6 specialist hospitals), 8% (n=4/50) community health service providers, 6% (n=3/50) combined acute and community trusts, and 6% (n=3/50) mental health trusts. Commissioners comprised the remaining 30% (n=15/50) which were CCGs (n=12), an ICS (n=1), and two unspecified.

[Table 1]

Organisation demographics

Most service providers had between 500 to 999 beds (50%, 16/32), followed by <500 beds (38%, 12/32), and 1000 to 1499 beds (13%, 4/32). Numbers of level 2 and level 3 critical care beds, and the number of single rooms, with and without negative pressure, on main wards and intensive care units can be seen in Table S1 and Table S2 in Supplemental File 2.

Existing pandemic preparedness plans (pre-December 2019)

A breakdown of survey results related to existing pandemic plans is shown in Table 2. Most service providers (82%, n=28/34) had a current PPP in December 2019, for service commissioners this was 43% (n=6/14). Plans tended to have been updated within the previous three years, with 19% (n=5/26) updated more than three years ago. For those who co-ordinated their PPP with other organisations (59%, n=19/32), this was commonly in conjunction with CCGs (n=12), local resilience forums (n=11), local authority public health agencies (n=9), the national public health agency Public Health England (n=9), ambulance service/other emergency responders (n=9), community health services (n=8), or NHS England (n=8).

Most organisations had tested their PPP in internal (67%, n=22/33) or multi-agency (70%, n=21/30) tabletop exercises in the previous two years. These exercises discuss scenarios aimed at assessing whether organisations could enact their plans effectively in a real-world event. Organisations stated that IPC teams were involved in around half of internal (59%, n=19/32) and multi-agency (55%, n=17/31) tabletop exercises.

Most service providers had on-site laboratory testing facilities (55%, n=17/31); with 27% (n=4/15) of those who responded reported having contingency plans for laboratory surge capacity. A similar proportion of organisations (30%, n=10/33) reported having plans regarding how to increase isolation capacity. For service provider IPC teams, only 13% (n=4/32) had contingency plans for increasing their capacity.

[Table 2]

Changes to IPC service provision and staffing

Most organisations reported increasing the capacity of IPC services in relation to working hours and staff availability. This included working longer hours (82%, n=37/45), working more days in the 7-day week (85%, n=35/41), and increasing on-call (68%, n=27/40). Some organisations commented that this additional work was unpaid or done on an unofficial, or goodwill, basis. Staff capacity was increased via redeployment of staff (51%, n=22/43), recruitment of new staff (38%, n=15/40), return of recently retired staff (35%, n=14/40) or volunteer IPC nurses (20%, n=8/40).

Implementation of pandemic plans in the first wave

Existing plans or policies organisations commonly identified as informing their COVID-19 response were pandemic influenza plan (70%, n=35/50), outbreak management plan (66%, n=33/50), and major incident plan (56%, n=28/50) (Table S3 in Supplemental File 2).

Impact on IPC services workload and essential supplies

Respondents were asked to rank IPC service activities based on the impact they had on their workload (Table S4 and Table S5 in Supplemental File 2). Activities with the highest impact included providing advice on PPE use, environmental control measures, patient placement, supporting incident command, policy/guideline writing and staff training.

Most (81%, n=35/43) organisations reported seeking PPE and other IPC supplies from outside the normal supply chain. Items included eye protection (n=32), FFP3 masks (n=28), long-sleeved

waterproof gowns (n=28), alcohol hand rub (n=24), fluid resistant surgical masks (n=20), and gloves (n=15).

Patient management

To prevent transmission, service providers segregated patients with and without infection by stopping elective admissions (n=24), re-designating wards (n=23), stopping services (n=18), reducing capacity on wards (n=14), and use of Nightingale hospitals (n=4).

Adequacy of COVID-19 testing

Testing capacity and turnaround time was adequate for 50% (n=6/12) of service providers during the first wave. The ability to test within the trust tended to be established during the first wave, with this occurring for 88% (n=7/8) of organisations. Point of care testing (POCT) only became adequate after the first wave for 91% (n=10/11) of organisations. The main factors which affected the ability of service providers to meet COVID-19 testing demands were staff resources (n=19), availability of reagents (n=14), and availability of test kits (n=14).

Most successful aspects of pandemic planning for first wave

Service providers

Service providers had clear commonalities in what they identified as successful in their pandemic planning (Table 3). Command structures (46%, n=11/24) were identified as key to supporting the response, with comments related to how decision-making was facilitated by gold (strategic), silver (tactical), and bronze (operational) team command and control meetings. Clear channels of communication (38%, n=9/24) were also important, alongside frequent meetings (often daily), effective communication, and being proactive. Successful COVID-19 testing programmes (21%, n=5/24) included testing of staff and asymptomatic testing, POCT in the emergency department, and screening patients.

Service commissioners

Service commissioners identified working across systems (73%, 8/11) as successful in their pandemic planning where developing relationships, joint working, and co-ordination across systems were key (Table 3). One organisation indicated the beneficial effect of the usual barriers to working across systems being removed. Creation of a local incident response centre (36%, n=3/11) was essential for some in providing infrastructure to workstreams.

[Table 3]

Least effective aspects of pandemic planning for first wave

Service providers

Services were asked to identify the least effective aspects of their pandemic planning (Table 3). These included a lack of PPE (35%, n=8/23) specifically having no central stock database, no pandemic stocks, difficulties with procurement, and short supplies. Difficulties around fit testing (30%, n=7/23) were highlighted with the pace of roll-out required, and lack of equipment. Keeping up to date with national guidance (26%, n=6/23) was a problem due to the frequency with which it changed, and the timings at which changes were released. Insufficient staffing (17%, n=4/23) was raised as an issue with staff shortages, IPC team size, and lack of administration staff.

Service commissioners

Issues included difficulties with working remotely (36%, 4/11) centred around inadequate technology, and the ability of individuals to create conditions conducive to home working (Table 3). Redeployment of staff (36%, 4/11) caused difficulties due to lack of planning and continuing with business as usual which prevented redeployment. Lack of PPE (27%, 3/11) was a problem for some, with supply chain issues, and insufficient PPE for care and residential homes. Effectiveness of communication (18%, 2/11) was negatively impacted by how information was managed and a top-down approach to dissemination. Again, keeping up to date with guidance (18%, 2/11) was identified, particularly the speed of updates and timing of release.

Key learning points from first wave review

Following the first wave of the pandemic, 63% (n=24/38) of organisations conducted a review to identify key learning points. These are summarised below.

Service providers

Seven acute organisations shared their key learning points. Of these, 43% (n=3/7) identified the need to embed PPE training and fit testing as part of an ongoing mandatory training programme. Staff wellbeing was identified as an issue (43%, n=3/7) in terms of resilience and the ability to deal with further waves of COVID-19. Coping with patient deaths was also raised, with one organisation providing staff counselling. Two providers (29%, n=2/7) identified problems with COVID-19 testing related to the speed of testing, and strategy for swabbing admissions.

Service commissioners

Three service commissioners shared their key learning points. The main issue reported was keeping up to date with guidance (67%, n=2/3). The remaining key learning points were only mentioned by single organisations, including staff wellbeing; IT issues; conflicting guidance; difficulties with resourcing; temporary discharge destinations needed; support for social care; and nurturing collaborative working.

Discussion

This survey found existing pandemic plans did not sufficiently prepare IPC services for the size and complexity of the response required during the COVID-19 pandemic, with clear unanticipated challenges across service providers and commissioners. Crucially some organisations, in particular service commissioners, had no pandemic plans in place in December 2019. Where plans did exist, a reported lack of involvement of IPC teams in tabletop exercises missed the opportunity for plans to be informed by IPC expertise. Even if IPC had been involved, this survey has shown that the potential impact of a pandemic on IPC services was not considered. Most organisations had no plans in place as to how to increase the capacity of the IPC team, and although teams increased their working hours and sought additional staff, they relied heavily on the goodwill of team members to meet service demands. Future planning needs to anticipate the pressures that pandemics place on this critical service and establish contingency plans to enable the IPC team to rapidly expand.

The management of patient pathways and cohorting to segregate known or potentially infected patients played a key role in preventing and controlling nosocomial spread of COVID-19. Organisations did not always have plans in place regarding how to increase capacity for laboratory surge testing, isolation capacity, or spaces where isolation was possible. Nosocomial spread was a

major issue in the UK, during the first wave. 11.3% and 20.1% of COVID-19 in-patients were estimated to have acquired the virus in hospital (Read *et al.*, 2021; Knight *et al.*, 2021). Rates high enough to impact on onward community transmission by discharged but infectious survivors. This demonstrates how the management of hospital in-patients is critical to controlling COVID-19 in the community.

Rapidly creating capacity or designing new ways to manage patient admissions may be required in a fast-moving pandemic situation. Patterson *et al.* (2020) describe innovating their patient isolation practices by triaging patients and allocating them to single rooms if they were thought to be at high risk of having COVID-19 and comorbidities linked to poor outcomes. This approach was taken as they realised their existing isolation plans would have quickly overwhelmed their single room capacity. Carefully planning scenarios for managing isolation and cohorting, drawing on the experience of this pandemic, is essential to inform how an organisation might minimise healthcare associated transmission in future pandemics.

Organisations reported shortages in PPE during the first wave, potentially making it difficult for frontline staff to adhere to IPC practices. Shortages were a clear challenge for IPC services globally (Tartari *et al.*, 2020). Countries with previous experience of an epidemic, such as the severe acute respiratory syndrome (SARS) epidemic in Asia, were more likely to have avoided this due to planned stockpiling (Matoori *et al.*, 2021). Whereas the UK was criticised for its lack of pandemic preparedness, particularly in relation to stockpiling due to its reliance on just-in-time supply chains (Bryce *et al.*, 2020). Organisations were able to find PPE or other essential IPC supplies from outside normal supply streams and in future, plans should where possible identify potential sources for emergency use.

Providing advice on PPE usage had the highest impact on IPC services workload. Insufficient supplies of PPE exacerbated the demands on IPC services to find more, and both training and reassuring staff in using PPE consumed large amount of IPC resource which had not been considered in plans. Many organisations reported IPC service time being spent on fit testing staff for FFP3 respirators. This is a key area for prior planning to ensure that there is an established ongoing programme of fit testing, and it does not consume IPC resources during a pandemic when they are spread so thinly.

The release of policy updates by national authorities caused difficulties. New guidance would commonly be released at the end of the week and IPC teams would have to review changes and incorporate into local guidance often over the weekend. Frequent changes made it difficult for organisations to implement consistent practice and assure staff of their safety. Cycles of rapidly changing guidance have previously been reported as a source of anxiety for frontline staff, leading to a feeling of unpreparedness (Vindrola-Padros *et al.*, 2020). Also creating challenges for IPC services in terms of providing information to healthcare workers, developing training materials, and creating evidence-based policies (Rebmann, Vassallo and Holdsworth, 2021).

Service commissioners experienced unique challenges, particularly a lack of planning regarding support for social care settings. Commissioners identified that collaborative working across a range of services and providers was crucial to their response. This included the removal of the usual organisational barriers which enabled working across systems, demonstrating the importance of co-ordinating plans with other organisations. The creation of ICSs, which combine both acute and community services, should improve cross-system working and facilitate the response to future

pandemics. New plans should incorporate new configurations and ensure that roles and responsibilities are clearly defined, and lines of communication established.

Around one third of organisations did not review the response they provided during the first wave. This missed a key opportunity to gain key learnings and adapt the ongoing response. Pandemic plans need to consider the capability and capacity of IPC services to ensure they can contribute their critical knowledge and expertise to the pandemic response and minimise the risk of transmission to both staff and patients. This survey provides detail of how IPC services were impacted by the first wave of the pandemic and identifies key areas which need to be addressed in plans to better manage the potential impact on IPC services.

Limitations

The response rate was low, though typical of this type of survey method. It must therefore be noted that the findings presented in this paper may not be representative of all healthcare organisations during the first wave of the pandemic. One potential reason for low uptake could be due to the survey running in autumn 2021 when the COVID-19 case load was high. The potential for further surge in cases and pressure to return healthcare services to pre-pandemic levels at this time may have meant IPC service leaders did not have time to participate. Some respondents left questions blank; in future survey questions could be set as mandatory to increase response rates though this may increase overall attrition. Respondents completed the survey around 21 months following the emergence of COVID-19, therefore there may have been a degree of recall bias however as this was such a unique time for IPC services responses are likely to capture their experiences accurately.

Conclusions

Obtaining the views, experiences and expertise of IPC service leaders is vital in designing and deploying an effective pandemic response in future. All IPC services will play a central role in any future pandemics, with particular focus on maintaining provision of healthcare services and the workforce needed to deliver care. The established command and control structures worked well with IPC services during the COVID-19 pandemic. However, future plans particularly need to consider how to manage communication of changing guidance; the impact of increased demand on IPC teams and PPE supplies; working collaboratively across services; managing massive demand for isolation and cohorting and establishing local laboratory testing.

Acknowledgements

We would like to acknowledge our patient and public involvement (PPI) representatives, [name] and [name] for their input in developing the survey and comments on drafts of this paper.

Ethics statement

Ethical approval was received from the [university name] Research Ethics Committee (xxx/xxx/xxxx-01383).

Funding

This study is funded by the National Institute for Health Research (NIHR) Policy Research Programme (PRP) (NIHRXXXXXX number blinded). The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.

References

- Alsuhaibani M., Kobayashi, T., McPherson, C., Holley, S., Marra, A.R., Trannel, A., Dains, A., Abosi, O.J., Jenn, K.E., Meacham, H., Sheeler, L., Etienne, W., Kukla, M.E., Wellington, M., Edmond, M.B., Diekema, D.J., and Salinas, J.L. (2022) 'Impact of COVID-19 on an infection prevention and control program, Iowa 2020-2021', *American journal of infection control*, 50(3), pp. 277-282. Available at: doi: 10.1016/j.ajic.2021.11.015.
- Bryce, C., Ring, P., Ashby, S. and Wardman, J. K. (2020) 'Resilience in the face of uncertainty: early lessons from the COVID-19 pandemic', *Journal of risk research*, 23(7-8), pp. 880-887. Available at: doi: 10.1080/13669877.2020.1756379.
- European Centre for Disease Prevention and Control (2006) Assessment tool for influenza preparedness in European countries - with a main focus on pandemic preparedness. Available at: https://www.ecdc.europa.eu/sites/default/files/media/en/healthtopics/seasonal_influenza/Documents/Tool/0609_Pandemic_Influenza_Assessment_Tool.pdf (Accessed: 03/05/2022).
- Khan, Y., O'Sullivan, T., Brown, A., Tracey, S., Gibson, J., Génèreux, M., Henry, B. and Schwartz, B. (2018) 'Public health emergency preparedness: a framework to promote resilience', *BMC Public Health*, 18(1344). Available at: doi: 10.1186/s12889-018-6250-7
- Knight, G.M., Pham, T.M., Stimson, J., Funk, S., Jafari, Y., Pople, D., Evans, S., Yin, M., Brown, C.S., Bhattacharya, A., Hope, R., Semple, M.G., Read, J.M., Cooper, B.S. and Robotham, J.V. (2021) 'The contribution of hospital-acquired infections to the COVID-19 epidemic in England in the first half of 2020', *BMC Infectious Diseases*, 22(556). Available at: doi: 10.1186/s12879-022-07490-4
- Matoori, S., Kuritzkes, D.R., Goh, Y., Quek, S.T., Wang, L., Sun, S., di Marco, F., Borleri, D., Buoro, S., Faggioli, S., Ferrari, T., Rizzi, M., Raimondi, F., Cesa, S., Koh, D.M., Froehlich, J. M., Janssen, S., Lange, B., Egle, A., Erb, S., Mossdorf, E., and Gutzeit, A. (2021) 'Preparing for future waves and pandemics: a global hospital survey on infection control measures and infection rates in COVID-19', *Antimicrobial resistance & infection control*, 10(1), pp. 170. Available at: doi: 10.1186/s13756-021-01029-z.
- Patterson, B., Marks, M., Martinez-Garcia, G., Bidwell, G., Luintel, A., Ludwig, D., Parks, T., Gothard, P., Thomas, R., Logan, S., Shaw, K., Stone, N., and Brown, M. (2020) 'A novel cohorting and isolation strategy for suspected COVID-19 cases during a pandemic', *The Journal of Hospital Infection*, 105(4), pp. 632-637. Available at: doi: 10.1016/j.jhin.2020.05.035.
- Public Health England (2017) *Exercise Cygnus Report*. Available at: <https://www.gov.uk/government/publications/uk-pandemic-preparedness/annex-a-about-exercise-cygnus> (Accessed: 03/05/2022).
- Read, J.M., Green, C.A., Harrison, E.M., Docherty, A.B., Funk, S., Harrison, J., Girvan, M., Hardwick, H.E., Turtle, L., Dunning, J., Nguyen-Van-Tam, J.S., Openshaw, P.J.M., Baillie, J.K. and Semple, M.G. (2021) 'Hospital-acquired SARS-CoV-2 infection in the UK's first COVID-19 pandemic wave', *The Lancet*, online. Available at: doi: 10.1016/S0140-6736(21)01786-4
- Rebmann, T. (2009) 'Assessing hospital emergency management plans: A guide for infection preventionists', *American Journal of Infection Control*, 37(9), pp. 708-714.e4. Available at: doi: 10.1016/j.ajic.2009.04.286.

Rebmann, T., English, J.F. and Carrico, R. (2007) 'Disaster preparedness lessons learned and future directions for education: Results from focus groups conducted at the 2006 APIC Conference', *American Journal of Infection Control*, 35(6), pp. 374-381. Available at: doi: 10.1016/j.ajic.2006.09.002.

Rebmann, T., Vassallo, A. and Holdsworth, J.E. (2021) 'Availability of personal protective equipment and infection prevention supplies during the first month of the COVID-19 pandemic: A national study by the APIC COVID-19 task force', *American journal of infection control*, 49(4), pp. 434-437. Available at: doi: 10.1016/j.ajic.2020.08.029.

Reidy, M., Ryan, F., Hogan, D., Lacey, S. and Buckley, C. (2015) 'Preparedness of Hospitals in the Republic of Ireland for an Influenza Pandemic, an Infection Control Perspective', *BMC Public Health*, 15(1), pp. 847. Available at: doi: 10.1186/s12889-015-2025-6.

Tartari, E., Hopman, J., Allegranzi, B., Gao, B., Widmer, A., Cheng, V.C., Wong, S.C., Marimuthu, K., Ogunsola, F., Voss, A., International Society of Antimicrobial Chemotherapy Infection and Prevention Control ISAC-IPC Working Group. (2020) 'Perceived challenges of COVID-19 infection prevention and control preparedness: A multinational survey', *Journal of global antimicrobial resistance*, 22, pp. 779-781. Available at: doi: 10.1016/j.jgar.2020.07.002.

UK Public General Acts (2004) *Civil Contingencies Act 2004*. Available at: <https://www.legislation.gov.uk/ukpga/2004/36/contents> (Accessed: 30/05/2022).

Vindrola-Padros, C., Andrews, L., Dowrick, A., Djellouli, N., Fillmore, H., Gonzalez, E.B., Javadi, D., Lewis-Jackson, S., Manby, L., Mitchinson, L., Symmons, S.M., Martin, S., Regenold, N., Robinson, H., Sumray, K., Singleton, G., Syversen, A., Vanderslott, S., and Johnson, G. (2020) 'Perceptions and experiences of healthcare workers during the COVID-19 pandemic in the UK', *BMJ open*, 10(11), pp. e040503. Available at: doi: 10.1136/bmjopen-2020-040503.

World Health Organization (2005) *WHO global influenza preparedness plan: the role of WHO and recommendations for national measures before and during pandemics*. Available at: <https://apps.who.int/iris/handle/10665/68998> (Accessed: 30/05/2022).