

# Evaluating The Implementation of A National COVID-19 Hospital Guideline In Wales

Rhys Jefferies (✉ [jefferiesrhys@gmail.com](mailto:jefferiesrhys@gmail.com))

Public Health Wales NHS Trust: Public Health Wales <https://orcid.org/0000-0002-3101-7900>

Mark J Ponsford

Cardiff University

Simon Barry

Cardiff and Vale NHS Trust: Cardiff and Vale University Health Board

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## Research

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# Abstract

## Background

The COVID-19 pandemic created a unique situation where a national clinical guideline would address uncertainty, and provide a trusted source for up-to-date information and advice. We developed a dynamic online infrastructure together with a dedicated implementation team to deliver this at scale and pace. The guideline was implemented through a digital implementation framework (SIMPSI framework) deploying facilitators to maximise guideline adoption, particularly targeting senior clinical decision makers (consultants) involved with the care of COVID-infected patients across six Health Boards (HB) in Wales.

## Methods

We evaluated guideline implementation using the Taxonomy of Implementation Outcomes Model. The primary outcome was consultant engagement, with a target of 193 registrations. We assessed wider impact through analysis of guideline platform activity and a user survey, with additional sensitivity analysis to derive penetration ratios, catchment population, clinical staff, acute beds, and COVID-19 admissions.

## Results

The guideline platform had 4521 total registrants, with over 170,000 page views during the first wave. We exceeded the target nearly six-fold (1159 consultant registrants). This represented 45% of all medical consultants in Wales, and made up the highest proportion of guideline registrants of all professional groups (23%, 1159/4521). We observed significant variation in guideline penetration across the six HBs, ranging from 31% to 74% of consultants registered. The HB with highest penetration had the most active guideline facilitator. The HB with the lowest penetration was the region first impacted and most affected by COVID-19 at the time of guideline publication (37% inpatients of peak, versus 10% or less for the other HBs).

## Conclusion

We utilised a digital implementation framework to construct a system that could be rapidly applied throughout all hospitals in Wales. Whilst we exceeded the intended target demonstrating full implementation, we identified two key factors to account for differences in the penetration rates across the different HBs. First, an experienced and active facilitator with the capacity to undertake the role was associated with significantly better penetration. Second, timeliness of implementation was crucial as evidenced by lower penetrance in the one HB that was impacted earliest by COVID-19 at the time of guideline dissemination. Nevertheless, the rapid implementation of the guideline has coincided with Wales demonstrating more favourable intensive care survival rates and maintaining one of the lowest mortality rates when compared to the UK as a whole for the first wave of the COVID-19 pandemic.

## Contributions To The Literature

- The COVID-19 pandemic created a contextual backdrop to align government, Health Boards and hospital clinicians at a time of profound uncertainty.
- The guideline was a trusted source for up-to-date instruction during a period where the evidence base was limited and fast changing.
- Readiness was greatest when local alternatives were not routinely being applied, emphasising the value of timeliness in implementing large-scale programmes.
- Active dissemination delivered through local facilitators with good understanding of dissemination and implementation methodology increased guideline penetration.
- An integrated digital implementation framework improved accessibility and reach, facilitating scale and pace.

## Background

The emergence of a highly infectious novel coronavirus (SARS-CoV-2) in December 2019 has given rise to the greatest challenge faced by our healthcare system in the last century. Over 120 million infections and almost 3 million deaths worldwide to date (1). This has been associated with a rapidly evolving evidence base surrounding the optimal management of individuals with COVID-19. At the start of the pandemic, we surmised that a lack of clear guidance would lead to confusion amongst Healthcare Professionals (HCP) and create variation in care and outcomes. We responded to this challenge through the rapid creation and implementation of a real-world national guideline; underpinned in design and delivery by the principles of implementation science. This can be defined as the scientific study of methods to promote the systematic uptake and application of research findings and other evidence-based practices into routine practice to improve the quality and effectiveness of health services and care (2). At its core is the question: *"How do we get what works to the people who need it, with greater speed, fidelity, efficiency, quality, and relevant coverage?"* (3). Contextualised and rearranged, we asked – *How do we get timely, relevant information, instruction and advice for the management of COVID-19 to clinical decision-makers, in an easily accessible format to help improve COVID-19 survival rates across the country?*

### Guideline design

The guideline was designed so that HCPs could easily access and understand the basic principles of COVID-19 management, with supplemental detail that could change as new evidence emerged. The fixed component of the guideline represented flow through the system (Fig. 1). This was compatible with all hospital structures and therefore sufficiently flexible for local adoption across all HBs in Wales. The dynamic component of the guideline is represented by the QR codes with web links to new clinical instruction as it emerged. Local experts from a variety of different professional groups provided contextual and instructional education, a factor that has shown to increase the rate of adherence substantially (11). Updates were delivered in a contemporary format, with information distilled into brief 3–5 minute videos with summaries, graphs and other visual aids incorporated during the editing process to promote ease of

information transfer. We hosted these on a single, unique web-based platform to increase reach and accessibility – thereby facilitating a rapid response to the expected changes in clinical instruction.

Leading experts in respiratory, intensive and palliative care developed the guideline content, with the national respiratory lead for Wales (S.B) acting as the primary author and guideline coordinator. The office of the Chief Medical Officer (CMO) in Welsh Government mandated the use of the guideline in each HB in Wales. The national lead considered all decisions about what to include as updates for the guideline, then invited experts to deliver an update in a video format on specific topics. Many of these were practical in nature, for example – how to deliver Continuous Positive Airway Pressure (CPAP) therapy, how to prone patients, or how to provide palliative support, with others outlining emerging national evidence from clinical trials. Consultation amongst a network of clinical colleagues enabled consensus decisions around issues with a limited evidence base, such as the target oxygen saturation ranges, or decisions about thromboprophylaxis.

#### Guideline Implementation

The guideline was implemented using the SIMPSI framework, a digital framework influenced by the Active Implementation Framework (4), the Translating Evidence into Practice Model (5) and the Quality Implementation Framework (6). Broadly, it incorporates a set up phase, and active delivery phase. We established an implementation organisational structure (Fig. 2), facilitating central control through the Implementation Team (ImT). The ImT could then manage locally positioned facilitators to increase widespread adoption by the target audience – clinical decision makers responsible for managing patients admitted with COVID-19. This specifically included Emergency Department (ED), Respiratory, Intensive Care, and Palliative Care consultants, which we calculated to be around 193 clinicians across Wales (7). The central guideline management team primarily supported facilitator activity, but could also respond quickly to any technical issues, user requirements and requests.

Implementation software supported the implementation process, enabling locally selected facilitators to increase reach and regional acceptance. A Guideline Facilitation Dashboard (GFD) provided engagement and activity tools with feedback. Implementation data was viewed, analysed, and reported, in real-time by the ImT. The Welsh Government received periodic implementation reports to support strategic decision-making.

## Methods

#### Study aims

Here, we evaluate guideline implementation using the Taxonomy of implementation Outcomes Model (ToIOM) (8). We focus on the evaluation of the implementation process of the COVID-19 Hospital Guideline, rather than assessing the effectiveness of the clinical recommendations made within it. Fundamental to this article is distinguishing guideline implementation effectiveness from guideline instruction effectiveness; this is critical for transporting interventions from controlled settings to real-world clinical practice. When such efforts fail to deliver, it is important to know if the failure occurred because the intervention [guideline] was ineffective in the new setting – intervention failure – or if a good intervention was deployed incorrectly, leading to – implementation failure (8). Whilst the guideline was available to everyone, the primary target group were senior decision-makers with clinical responsibility for patients admitted with COVID-19. We hypothesised that implementation of the guideline would inform local operational practices, subsequently influencing clinical behaviour.

#### Guideline setting

The guideline was implemented across six of the seven HBs in Wales (Aneurin Bevan UHB, Cardiff and Vale UHB, Hywel Dda UHB, Swansea Bay UHB, Betsi Cadwalladr UHB and Cwm Taf Morgannwg UHB, randomised in no particular order in the results section). The remaining HB, Powys was not included since it did not have any DGH within its boundaries. We collected data from all DGHs, but not from smaller rehabilitation or community hospitals, which did not have facilities for acute medical care, and were not sites for admitting patients with acute COVID-pneumonitis.

#### Implementation Evaluation

We assessed guideline engagement through analysis of guideline platform activity and a user survey. Implementation was evaluated using ToIOM (8) which best reflected the aims of this project, and the methodology applied. Other common implementation evaluation tools considered were the PRECEDE-PROCEED framework (9) and the RE-AIM framework (10). However, the ToIOM best reflected the aims of this project, and the implementation methodology applied.

Guideline activity was analysed for the period comprising the first wave of the COVID-19 pandemic (21/3/20 to 15/8/20). The entire guideline registrant database of 4521 HCPs based within NHS Wales was analysed, thereby representing registrations for the first wave of the COVID-19 pandemic. We used Survey Monkey to conduct an anonymised registrant survey from 8/6/20, for a period of two weeks. The survey was emailed to all participants with a further two reminders within the two week period to increase participation (Appendices 1). This comprised 11 multiple-choice questions, 3 open questions, a star rating for overall quality, and sliding scales to determine ease of use and by how much the guideline had influenced their practice. Penetration ratios were calculated by dividing the total number of registrations within a HB by relevant metrics to standardise for variation in HB size, capacity, and burden of COVID-19 admissions for the implementation period, derived from publically available hospital data sources (7)(11). Data curated in Microsoft Excel. Chi-squared testing performed using GraphPad Prism (version 6.06).

## Results

#### Scale and pace

From March 21st to March 28th, 18 DGHs in Wales received several hundred hardcopy guideline posters, subsequently distributed in areas where relevant HCPs could easily access them, such as COVID-19 wards, medical assessment units and emergency departments. Figure 3 highlights the publication of the guideline coincided when total confirmed COVID-19 inpatients and COVID-19 deaths were low. Registration rates increased substantially around 28th March in response to a range of alignment and facilitation activity, including email campaigns, formal guideline on-boarding, and discussions promoting adoption with executive teams. New registration rate slowed commensurate with a reduction in the rate of patients admitted to hospital and dying from COVID-19 (Fig. 3). Total registrants reached 4521 during the first wave (Fig. 4).

#### Penetration of the target

The primary target audience, consultants, accounted for the greatest proportion of professionals registered with the guideline platform (23%). We observed uptake across allied health professionals (including physiotherapists, pharmacists, dieticians and occupational therapists) accounted for 21.4%, and nurses 20.6%. We next evaluated uptake for consultants predicted to manage patients admitted with COVID-19, estimated as the sum of all ED, Respiratory, intensive care, and palliative care consultants across Wales (Supplemental Table A). We next compared this to all consultants. From a possible 2505 consultants employed in Wales (7), 1131 (45%) registered with the guideline. As the total number employed within each HB was known, we used this to normalise uptake between HB and derive a penetration ratio (Fig. 5). HB6 showed the greatest penetration, with 73.7% (325 of a possible total 440) of all consultants registered, followed by 51.9% (111 of 214) within HB5. Uptake was lowest in HB1 at 30.5% (131 of 429 consultants) but still superseding the original target (x3.6). This variation in consultant uptake between HBs was highly significant (Chi-squared testing,  $p < 0.0001$ ).

Given the potential impact of sickness and staff transfers on this estimate of guideline uptake, we conducted additional sensitivity analysis to derive penetration ratios, using publicly available figures for total HB catchment population, total number of clinical staff, number of acute beds, and COVID-19 admissions (Supplementary Table B). This confirmed the observed trend in guideline registration between HBs. Remarkably; we observed a ratio of four HCPs registering within HB6 for every COVID-19 admission. Within HB1 (with the lowest penetration), this fell to approximately one HCP for every two COVID-19 admissions.

To better understand the potential influencers for guideline registrations we assessed facilitator activity. We calculated the number of unique interactions (number of logged in page visits) with the GFD. There were 972 interactions in total. Of these, HB6 had the highest-most interactions (642, 67%) (Fig. 6). The HB with least interactions was HB1, with nine interactions (0.9%). This is a similar figure to HB5 (1.4%) suggesting penetration accounted to more than facilitator activity alone.

To explore further reasons for the low penetration in HB1 we investigated the burden of COVID-19 within each HB at the time of guideline publication. This estimated the degree of organisational readiness across each HB. At the time of guideline launch, HB1 had the greatest number of COVID-19 inpatients when compared to the other HBs. This equates to a greater percentage of the peak number of inpatients (37.4%) when compared to other HBs (4.9%, 10.4%, 6.3%, 5.7%, and 5.9%, respectively) (Table 1). This suggests HB1 had low organisational readiness at the time of guideline release.

Table 1  
– Table of figures representing inpatient numbers at time of guideline launch against its peak for each HB.

Health Board	COVID-19 inpatients around the time of the guideline launch (data from 22nd March)	Maximum COVID-19 inpatient count during the first wave	COVID-19 inpatients around the time of the guideline launch as percentage of peak
HB1	107	286	37.4%
HB2	12	243	4.9%
HB3	26	250	10.4%
HB4	13	208	6.3%
HB5	5	88	5.7%
HB6	12	202	5.9%

#### Survey Responses

In total, 178 healthcare professionals responded to the survey representing 3.9% of the total number of registrants at the time. Of all responses 33.9% of these were consultants, with 23.1% nurses and 26% reported as 'other'. The average rating of the guideline platform was 4.01 out of a maximum of five stars. Of all respondents from the survey, 68% had encouraged others to use the guideline platform, 28% had not. The majority of respondents reported using the guideline weekly (26.6%), 23.2% using it 2–3 times per week and a further 22.6% used it daily. The majority of respondents accessed the guideline most often whilst on duty at work (53.2%), whilst 26.3% accessed it most often from home, whilst not on duty, and a further 19.3% during work, whilst off duty. The majority of respondents accessed the guideline using a hospital computer (57.3%), 24.0% accessed using mobile phones, 20.5% using their personal computer, and 7.0% using a tablet device. A commonly reported complaint to the central guideline management team however, was accessibility issues using hospital computers, where local firewalls blocked access to the guideline website and/or video play function. The mean sliding scale score for the extent to which the guideline informed their practice was 63 out of 100 indicating the majority of reported the guideline informed their clinical practice. Eighty one per cent of respondents indicated that they would like the update emails to continue.

#### Volume of content available

At the time of writing, 7 national pathways and approximately 260 information pages are freely available to HCPs online ([www.covid-19hospitalguideline.wales.nhs.uk](http://www.covid-19hospitalguideline.wales.nhs.uk)). More than 180 pre-recorded video tutorials featuring 45 clinical specialists are freely available to registrants, which have

resulted in 31,000 video plays. During the first wave alone, there were nearly 170,000 page views from those signed in. Google analytics show approximately 40,000 sessions, consisting on average of 4.2 page views per session and average session duration of over 5 minutes. The guideline continues to provide weekly updates throughout the second wave. There were 101 email campaigns (mail-out clinical updates and video synopses, to registrants). In total, 207 registrants unsubscribed to the emails (4.6% of total registrants). This equates to 2.5% unsubscribes per email campaign, or 0.04% of all users per email campaign. Of the un-subscribers who entered their job title (n = 189, 91% of un-subscribers), the highest proportion came from Medical Students – 21% (n = 40), followed by 'Other Healthcare Professional' – 17% (n = 33) and Registrars – 16% (n = 31).

## Discussion

The fundamental principle underpinning implementation science is to reduce the gap between knowing and doing, which, for ease of expression can be termed the 'know-do gap' (12). We were aware that standard approaches to disseminating guidelines would not be effective in such a rapidly changing scenario, such as that presented by the COVID-19 pandemic. We sought to maximize the effectiveness of a national COVID-19 guideline by adopting implementation science principles, which have proven to improve outcomes for patients by increasing rates of adoption of evidence-based practice (13). Successful implementation is dependent on the relationship between three key factors – the nature of the evidence, the quality of the context, and facilitation (14). We propose adding a fourth – timeliness. Timeliness is the optimal window of organisational readiness to adopt a new intervention. Our results indicate that when the window of readiness is missed this has a detrimental impact on guideline penetration. During the first wave of the COVID-19 pandemic, the evidence-base was initially weak, and subsequently subject to rapid changes. Therefore, a decisive and adaptive communication system was necessary to render the guideline usable, accessible, effective, and sustainable (15).

### A Useable Intervention

Acceptability is the perception among implementation stakeholders that an intervention is agreeable, palatable, or satisfactory. Lack of acceptability has long been noted as a challenge to implementation (16). Typically, a paucity of evidence makes guideline design and clinical acceptance a significant barrier to wider adoption (7), but this was not the case with this guideline. We have demonstrated a rapid uptake of new registrants across the whole of Wales, mirroring the rise in new hospital cases and deaths. We surpassed our consultant registration target six-fold, with almost half of all consultants in Wales registering. Although limited in size, user responses within our survey gave excellent feedback, with an overall guideline rating was 4.1 out of a total rating score of five with over 80% of respondents requesting on-going email updates and nearly 70% of respondents endorsing the guideline by recommending it to others. Finally, analysis of website traffic demonstrated sustained and significant engagement with the online resources, consistent with the role of this tool in informing clinical practice.

Of interest, nurse registrants remained a substantially lower proportion of the total nursing workforce (4.6%) when compared to consultants (45%). They were not the primary target group and subsequently there was less alignment within the nursing hierarchy to support usage and adoption of the guideline. A consequence of this was more barriers for nurses accessing the guideline. Registration rate and platform activity was greater mid-week than the weekend, consistent with the results from the user survey where 53% accessed the guideline most often whilst at work, when on duty, with 57% choosing to use a hospital computer. Barriers to nurses (and other allied HCP) in accessing the guidelines included the following: first, nurses rarely use NHS emails so would not get notifications of updates, second, it was impractical for ward-based nurses to access the guideline via QR links as they are prohibited from using personal mobile devices whilst on duty. Third, some hospital firewalls blocked the video play function from generically logged on ward-based computers. This latter problem happened despite involving national IT specialists in the planning phase. Therefore, dissemination activity was greatest in those with greater access to NHS emails or personal mobile devices. This observation emphasises the importance of considering technical practicalities in real world settings as potential barriers affecting user engagement and satisfaction (17).

### Creating Readiness

The implementation phase was initiated in only three weeks from date of commissioning the guideline. The speed of delivery was vital to ensure it kept pace as the pandemic unfolded. It is therefore of interest that we have demonstrated that the HB with the lowest penetrance (HB1) was the region with the first surge of cases. COVID-19 affected different HBs asymmetrically and that early exposure to large numbers of cases before launch of the guideline reduced its effective uptake. At the time of publication of the guideline, HB1 already had 107 inpatients with confirmed COVID-19, representing 37.4% of their maximum number of inpatients at the peak of the first wave and a much higher proportion than for the other HBs. Thus, even a short delay meant that the guideline lost traction since the window of readiness closed – that is, the extent to which organisational members are psychologically and behaviourally prepared to adopt an intervention (18). Readiness was low as the national guideline competed with local solutions already established to address the crisis. HCPs were more likely to view the guideline as undesirable, subsequently avoiding, or resisting its use (18). A corollary to this argument is that as the case load and death rate from COVID-19 reduced, the rate of new registrants reduced significantly. Overall, the clear conclusion was that one of the main drivers for guideline adoption was organisational readiness, a factor influenced by the timeliness of guideline implementation.

### Increasing Capacity

Whilst the guideline was available to everyone, the primary target group was senior decision-makers with clinical responsibility for patients admitted with COVID-19. It is an accomplishment therefore, that 1159 consultants registered with the guideline – six-fold our indented target, which equates to 45% of all consultants appointed in Wales. This is a remarkable number given that many consultants, such as those in surgical specialities, pathology, mental health, and sub-specialities within medicine were not directly dealing with COVID-19 patients. It is reasonable to conclude that the guideline increased hospital capacity by preparing staff for their anticipated redeployment to COVID-19 wards. Evidence that consultants continued to find the guideline of value was that they are the professional group least likely to unsubscribe from email updates (0.4% of all consultants registered). This contrasts with medical students, who have the least decision-making responsibility, and were most likely to unsubscribe (15% of all medical students registered).

## Facilitation

Despite endorsement and indeed mandating guideline usage from Welsh Government, we observed variation in penetration between HBs, with over three times the number of staff registering in HB6 compared to HB1. This appeared consistent across multiple indices of penetration accounting for differences in HB size. The ImT had little control over selection of local HB facilitators, who demonstrated variable influence in guideline penetration. It is notable that HB6 employed a facilitator with previous expertise in implementation methodology. They actively engaged in promoting guideline dissemination and utilised the facilitator dashboard significantly more frequently than the other facilitators used it. HB6 also mandated that all local HCPs managing COVID-19 patients register with the guideline and undertake the COVID-19 assessment demonstrating good alignment with policy leads. No other HB offered a similar local mandate. These observations coincided with better engagement and uptake within HB6, particularly greater consultant penetration (74% of all consultants employed). Furthermore, HB6 had a significantly higher proportion of registrants undertaking the guideline assessment – translating to 68.9% of all assessments passed (627/910), demonstrating greater fidelity than all other HBs

## Guideline Impact

The purpose of the guideline was to improve clinical outcomes by standardising practice and reducing variation. It is of relevance therefore that Wales had one of the lowest mortality rates in the UK for COVID-19 during the first wave of the pandemic (75.7 deaths per 100,000 people (confidence interval (CI) 72.7–78.6) versus 90.9 deaths per 100,000 in England (CI 90.1–91.8)) (19). In addition, the Intensive Care National Audit & Research Centre (ICNARC) report showed that intensive care survival rates for the first wave were more favourable in Wales when compared to the UK as a whole (61.7% compared to 59.6%, respectively), albeit not a statistically significant difference (20). These results are unusual since Wales has a significantly older population (21) and a higher proportion of people with co-morbidities than England (22), both known to be important factors for increasing the probability of death from COVID-19 (23) (24). This data suggests that creating consistency and reducing variation by actively implementing a relevant national guideline improves clinical outcomes.

## Conclusion

Dissemination and implementation of a national clinical guideline can happen in a matter of only a few weeks, provided the context and demand allows, and an effective implementation framework is applied. This is in marked contrast to the 17 years posed by Balas & Boren (25). However, for one HB, even this was too late, emphasising that the timely publication and dissemination within a window of organisational readiness, is paramount to guideline implementation success. A key enabler was an active and experienced implementation facilitator, which resulted in three quarters of employed consultants registering with the guideline in the most engaged HB. The dynamic features of the guideline have undergone 18 iterations highlighting the rapidly changing context. The platform now contains 30-fold the number of videos from the six proposed in the original specification. This is largely testament to the implementation success and value proposition offered by the guideline.

We understand that the COVID-19 pandemic has exerted extreme pressures on governments and health systems to react at a scale and pace far beyond the norms of practice. The building of field hospitals, PPE procurement and vaccination strategies can only be understood in this context. It is unreasonable to expect organisations to replicate the speed of implementation of our guideline across other clinical areas, particularly without the urgency imposed from COVID-19. However, we suggest that the implementation methodology that underpins this COVID-19 guideline remains valid, replicable, and transferable to other disciplines.

## Future work

In June 2020, Welsh Government formally approved a nation-wide data collection tool for all hospitals across Wales. This has collected specific outcome data for every person admitted to hospital with COVID-19. Using the digital implementation framework, local hospital data collectors record a whole host of data for every patient in their hospital onto pre-loaded tablets. Data from the first wave has been submitted for publication from the first wave (26) and is currently being collected from the second wave, which will inform further iterations of the hospital guideline. Senior managers and Welsh Government also have access to data dashboards for each hospital across Wales. Welsh Government has also commissioned a national primary and community care COVID-19 guideline using the same design and implementation principles, as well as a national COVID Recovery App for patients.

## Abbreviations

BTS – British Thoracic Society

CMO – Chief Medical Officer

CPAP – Continuous Positive Airway Pressure

DGH – District General Hospital

ED – Emergency Department

HB – Health Board

HCP – Healthcare Professional

ICNARC – Intensive Care National Audit & Research Centre

ICU – Intensive Care Unit

ImT – Implementation Team

NIV – Non-Invasive Ventilation

PPE – Personal Protective Equipment

QR – Quick Response

ToIOM – Taxonomy of Implementation Outcome Model

## Declarations

The Respiratory Health Implementation Group (RHIG), NHS Wales, will fund publication charges for this article.

## Ethics approval and consent to participate

Not applicable.

## Consent for publication

Not applicable. Welsh Government have been informed.

## Availability of data and materials

The data generated and analysed during the study are available from the corresponding author upon reasonable request.

## Competing interests

The authors report no competing interests.

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## Authors' contributions

RJ is the primary author and member of the guideline implementation team. MJP is a secondary author and provided statistical support and advice. SB is a secondary author and clinical lead and content coordinator of the guideline. All authors have read and approved the final manuscript.

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## Author's information

Mr. Rhys Jefferies – [rhys.jefferies@wales.nhs.uk](mailto:rhys.jefferies@wales.nhs.uk)

RJ is National Programme Manager for the Respiratory Delivery Plan in Wales and is currently undertaking a PhD with Swansea University in the application of implementation science principles for a range of interventions in healthcare.

Dr. Mark Ponsford – [PonsfordM@cardiff.ac.uk](mailto:PonsfordM@cardiff.ac.uk)

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Dr. Simon Barry – [simon.barry@wales.nhs.uk](mailto:simon.barry@wales.nhs.uk)

S.B is the National Clinical Lead for Respiratory Medicine across NHS Wales and respiratory consultant in Cardiff and Vale University Health Board.

## References

1. JohnHopkins University of Medicine. COVID-19 Map - Johns Hopkins Coronavirus Resource Center [Internet]. 2020 [cited 2021 Mar 25]. Available from: <https://coronavirus.jhu.edu/map.html>.
2. Eccles MP, Mittman BS. Welcome to Implementation Science. *Implement Sci* [Internet]. 2006;1(1):1. Available from: <https://doi.org/10.1186/1748-5908-1-1>.
3. Sherr K. The University of Washington [Internet]. The UW Implementation Science Resources Hub. [cited 2020 Sep 2]. Available from: <https://impsci.uw.edu/implementation-science/learn/implementation-science-overview/>.
4. Naoom S, Blase K, Friedman R, Wallace F, Fixsen D. Implementation Research: A Synthesis of the Literature Dean L. Fixsen. *Natl Implement Res Netw*. 2005 Jan 1;97.
5. Pronovost P, Berenholtz S, Needham D. Translating evidence into practice: A model for large scale knowledge translation. *BMJ* [Internet]. 2008 Oct 25 [cited 2020 Aug 21];337(7676):963–5. Available from: <https://www.bmj.com/content/337/bmj.a1714>.
6. Meyers DC, Durlak JA, Wandersman A. The Quality Implementation Framework: A Synthesis of Critical Steps in the Implementation Process.
7. Welsh Government. Staff directly employed by the NHS in Wales [Internet]. *Statistics for Wales*. 2020 [cited 2021 Mar 11]. Available from: <https://stats.wales.gov.wales/Catalogue/Health-and-Social-Care/NHS-Staff>.
8. Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, et al. Outcomes for Implementation Research. *Conceptual Distinctions, Measurement Challenges, and Research Agenda*; 2010.
9. Crosby R, Noar SM. What is a planning model? An introduction to PRECEDE-PROCEED. *J Public Health Dent* [Internet]. 2011 Jan [cited 2020 Sep. 2];71(SUPPL. 1):S7–15. Available from: <http://doi.wiley.com/10.1111/j.1752-7325.2011.00235.x>.
10. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: The RE-AIM framework [Internet]. Vol. 89, *American Journal of Public Health*. American Public Health Association Inc.; 1999 [cited 2020 Aug 25]. p. 1322–7. Available from: [www.ori.org](http://www.ori.org).
11. Welsh Government. NHS beds by date and use [Internet]. *Stats Wales*. 2021 [cited 2021 Feb 22]. Available from: <https://stats.wales.gov.wales/Catalogue/Health-and-Social-Care/NHS-Hospital-Activity/nhs-activity-and-capacity-during-the-coronavirus-pandemic/nhsbed-by-date-use>.
12. Hunter DJ. Meeting the challenge of the “know-do” gap: Comment on “CIHR health system impact fellows: Reflections on ‘driving change’ within the health system.” *Int J Heal Policy Manag* [Internet]. 2019 Aug 1 [cited 2021 Mar 25];8(8):498–500. Available from: <http://ijhpm.com>.
13. Emmons KM, Colditz GA. Realizing the potential of cancer prevention - The role of implementation science [Internet]. Vol. 376, *New England Journal of Medicine*. Massachusetts Medical Society; 2017 [cited 2020 Sep 2]. p. 986–90. Available from: [/pmc/articles/PMC5473684/?report = abstract](https://pubmed.ncbi.nlm.nih.gov/35473684/).
14. Kitson A, Harvey G, McCormack B. Enabling the implementation of evidence based practice: a conceptual framework. Vol. 7, *Quality in Health Care*. 1998.
15. O’Cathain A, Croot L, Duncan E, Rousseau N, Sworn K, Turner KM, et al. Guidance on how to develop complex interventions to improve health and healthcare. *BMJ Open* [Internet]. 2019 Aug 1 [cited 2020 Oct 5];9(8). Available from: [/pmc/articles/PMC6701588/?report = abstract](https://pubmed.ncbi.nlm.nih.gov/354701588/).
16. Davis FD. User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *Int J Man Mach Stud* [Internet]. [cited 2020 Sep 3];38(3):475–87. Available from: [https://www.academia.edu/502926/User\\_Acceptance\\_of\\_Information\\_Technology\\_System\\_Characteristics\\_User\\_Perceptions\\_and\\_Behavioral\\_Impacts](https://www.academia.edu/502926/User_Acceptance_of_Information_Technology_System_Characteristics_User_Perceptions_and_Behavioral_Impacts).
17. Fischer F, Lange K, Klose K, Greiner W, Kraemer A. Barriers and Strategies in Guideline Implementation—A Scoping Review. *Healthcare* [Internet]. 2016 Jun 29;4(3):36. Available from: <http://www.mdpi.com/2227-9032/4/3/36>.
18. Shea CM, Jacobs SR, Esserman DA, Bruce K, Weiner BJ. Organizational readiness for implementing change: A psychometric assessment of a new measure. *Implement Sci* [Internet]. 2014 Jan 10 [cited 2021 Mar 30];9(1):7. Available from: <http://implementationscience.biomedcentral.com/articles/10.1186/1748-5908-9-7>.
19. Office for National Statistics. Coronavirus (COVID-19) roundup, 24 to 28 August 2020 - Office for National Statistics [Internet]. 2020 [cited 2021 Mar 25]. Available from: <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19roundup24to28august08-28>.
20. Intensive Care National Audit & Research Centre. ICNARC – Reports [Internet]. 2020 [cited 2021 Mar 24]. Available from: <https://www.icnarc.org/Our-Audit/Audits/Cmp/Reports>.
21. Office for National Statistics. Living longer: trends in subnational ageing across the UK - Office for National Statistics [Internet]. 2020 [cited 2021 Mar 24]. Available from: <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/ageing/articles/livinglongertrendsinsubnationalageingacrosstheuk/07-20>.

22. Bevan G, Karanikolos M, Exley J, Nolte E, Connolly S, Mays N. The four health systems of the United Kingdom: how do they compare? Source report [Internet]. 2014 [cited 2021 Mar 25]. Available from: .
23. Guan W, Ni Z, Hu Y, Liang W, Ou C, He J, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med [Internet]. 2020 Apr 30 [cited 2021 Apr 1];382(18):1708–20. Available from: <http://www.nejm.org/doi/10.1056/NEJMoa2002032>.
24. Williamson EJ, Walker AJ, Bhaskaran K, Bacon S, Bates C, Morton CE, et al. Factors associated with COVID-19-related death using OpenSAFELY. Nature [Internet]. 2020 Aug 20 [cited 2021 Apr 6];584(7821):430–6. Available from: <https://doi.org/10.1038/s41586-020-2521-4>.
25. Balas EA, Boren SA. Managing clinical knowledge for health care improvement. 2000 [cited 2020 Sep 2]; Available from: <https://augusta.openrepository.com/handle/10675.2/617990>.
26. Ponsford MJ, Jefferies R, Davies C, Farewell D, Humphreys IR, Jolles S, et al. The burden of nosocomial covid-19: results from the Wales multi-centre retrospective observational study of 2518 hospitalised adults. medRxiv [Internet]. 2021 Jan 20 [cited 2021 Apr 6];2021.01.18.21249433. Available from: <https://doi.org/10.1101/2021.01.18.21249433>.

## Figures

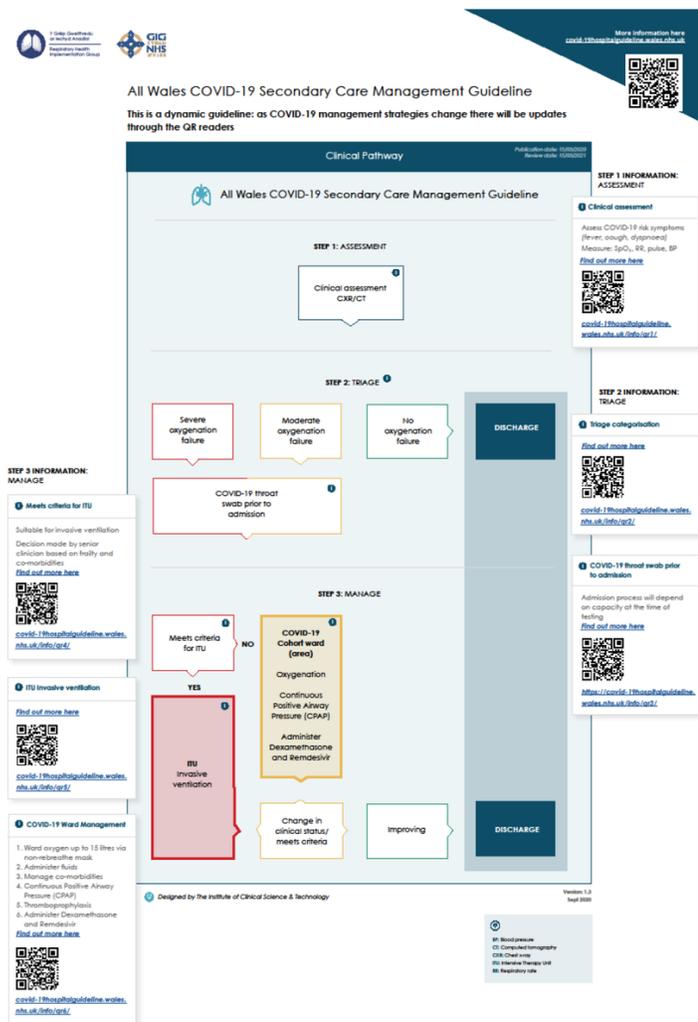


Figure 1

All Wales COVID-19 Secondary Care (Hospital) Guideline – digital version on the guideline platform, colour posters displayed across each hospital across Wales

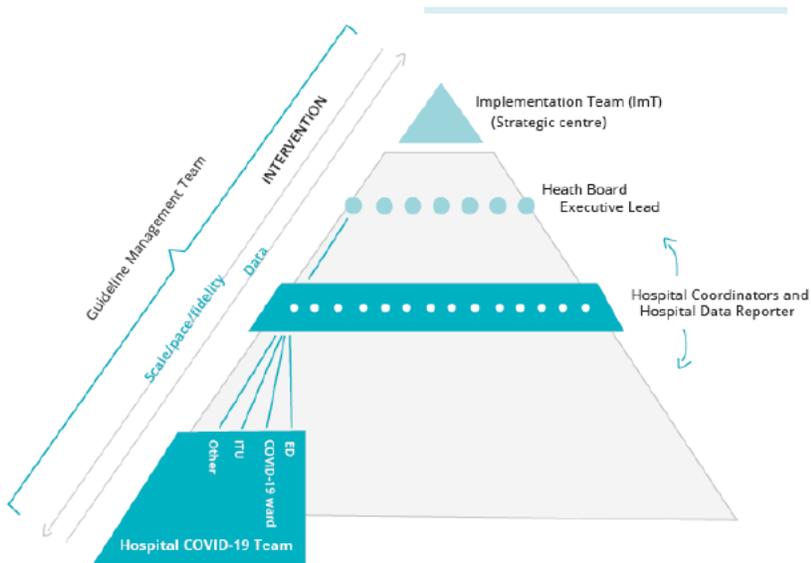


Figure 2

The Implementation Organisational Structure utilised for the dissemination of the national COVID-19 hospital guideline.

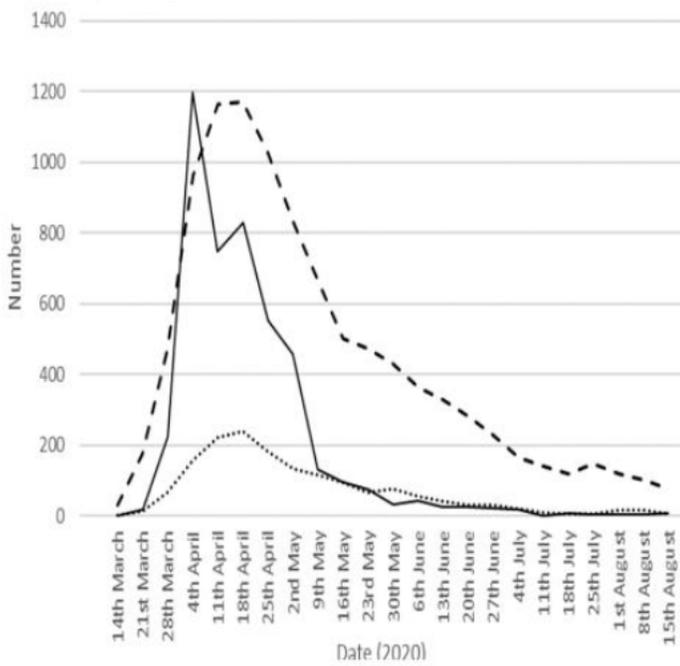
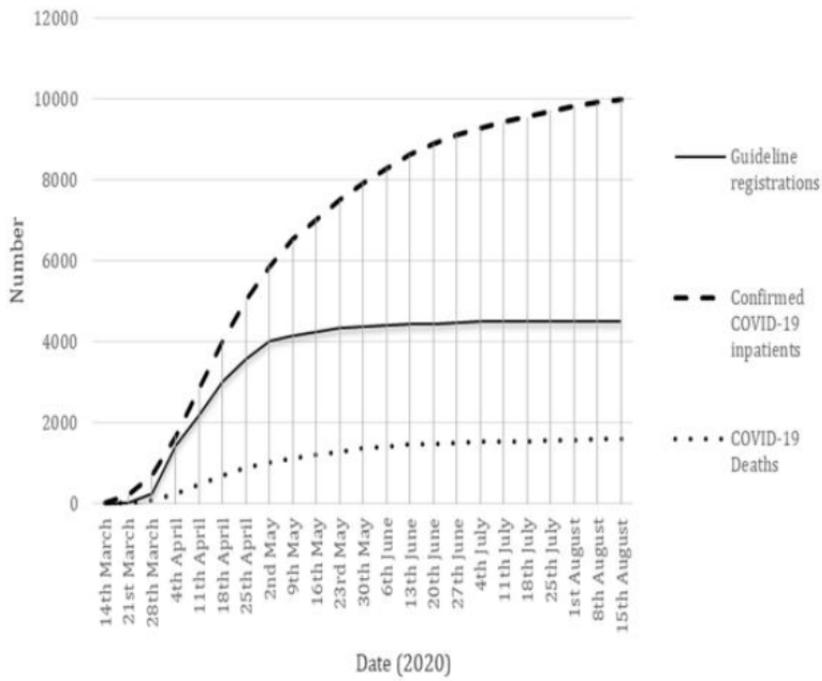
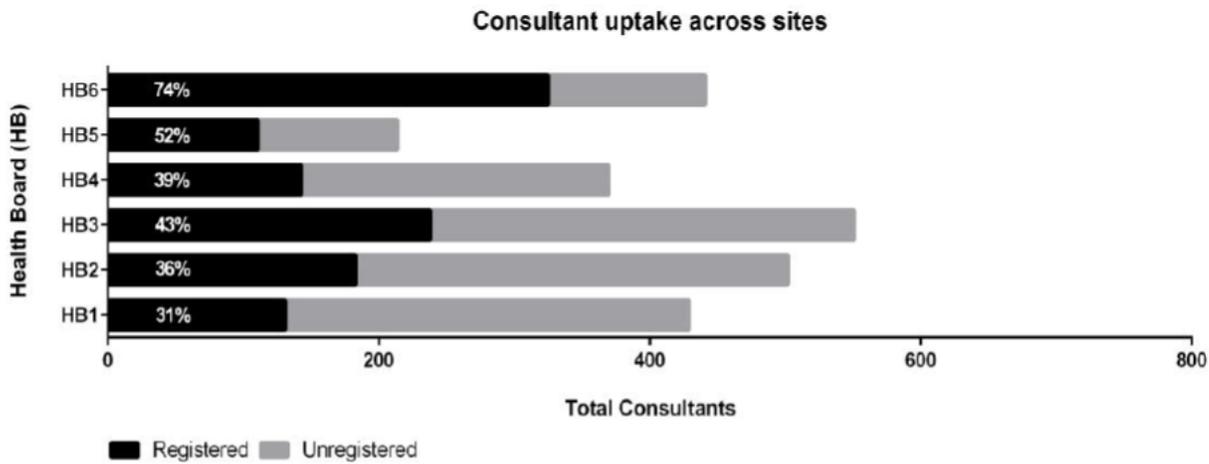


Figure 3

Total new guideline registrations, confirmed COVID-19 inpatients and COVID-19 deaths for Wales as 7-day intervals during the first wave of the COVID-19 pandemic.



**Figure 4**  
 Cumulative number and trend patterns for guideline registrants, confirmed COVID-19 inpatients, and COVID-19 deaths for Wales during the first wave of the COVID-19 pandemic.



**Figure 5**  
 Consultant grade guideline registrants as a proportion of all consultant staff employed within each HB

■ HB1 ■ HB2 ■ HB3 ■ HB4 ■ HB5 ■ HB6

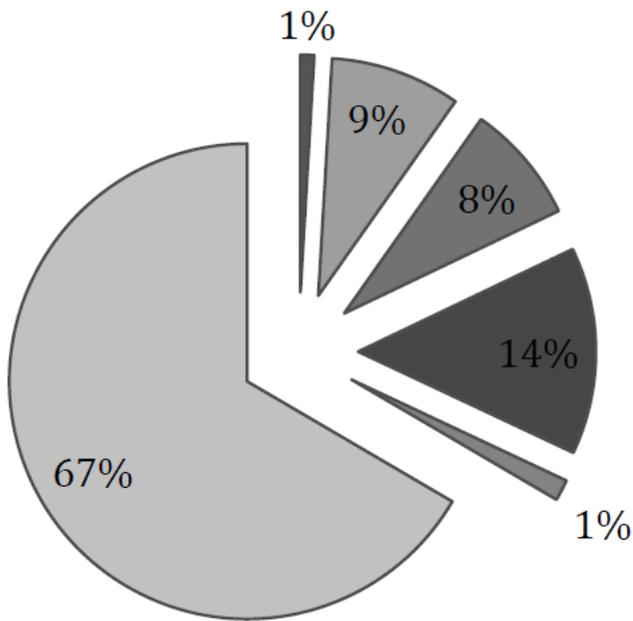


Figure 6

Relative proportion of all 972 interactions with the Guideline Facilitator Dashboard per HB

### Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Appendices.docx](#)
- [TIDieRchecklistCOVIDguideline.docx](#)