

COVID-19: lessons learned from a paediatric high consequence infectious diseases unit

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In 2018, the government commissioned four paediatric and five adult airborne high consequence infectious diseases (HCID) units in preparation for the emergence of a new airborne viral infection in the UK. St Mary's Hospital (Imperial College Healthcare NHS Trust), London was one of the paediatric centres, partnered with the Royal Free Hospital for adults. St Mary's was ideally placed to look after children with possible airborne HCID, with a newly designed and built suite of HCID rooms and an expert and collaborative group of paediatric intensivists and infectious diseases consultants. It was exciting to prepare for these eventualities, which felt unlikely as we focused instead on Brexit and the environment. In retrospect, I am ashamed of thinking that this would be exciting, as we now live through a pandemic whose proportions go well beyond my wildest nightmare.

In mid-January 2020, all trusts in England were contacted by the chief medical officer with advice about 'Wuhan Novel Coronavirus', later named SARS-CoV-2. The four key principles were to identify possible cases as soon as possible, isolate to prevent transmission to other patients and staff, avoid direct physical contact unless wearing appropriate personal protective equipment, and get specialist advice from a local microbiologist, virologist or infectious disease physician at your local trust. At this time, there were 10 confirmed cases outside of China and none in Europe. Locally, preparations were underway both at a trust level and locally within paediatrics. Together with the site team, adequate supplies of personal protective equipment (PPE) were identified and training exercises prepared for immediate response teams in donning and doffing protocols. A programme for 'fit-testing' all staff members for FFP3 respiratory masks was initiated. Algorithms for management of suspected

cases presenting to all areas of the trust, including adult and paediatric A+E, ambulatory care and maternity services, were prepared. Together with our adult HCID partner, the Royal Free Hospital, we rapidly amended standard operating protocols for admission of confirmed cases.

Shortly afterwards, as an HCID, we were contacted by NHS England (NHSE) specialised commissioning to ringfence a bed for a confirmed case, and ensure all resources were available to provide clinical and nursing support for that bed. Regular paediatric HCID teleconferences hosted by NHSE were established weekly to ensure standardised approaches and identify areas of need/challenges.

The following day, the first case in the UK was diagnosed. Over the next few days, we ran simulation exercises with the children's acute transport services and the National ambulance resilience unit, as well as locally with our team (infection control, site managers, security, estates, cleaning, nursing and medical team members). A first version of trust guidance for management of paediatric suspected and confirmed cases was drafted. The nursing and clinical rotas were addressed to ensure the right mix of staff would be available for every shift. Pandemic 'table-top' exercises and workforce planning were time-tabled.

Reassuringly, all data from China suggested that children were the age group least affected by coronavirus disease 2019 (COVID-19). However, it quickly became apparent from frequent advice calls and emails from regional colleagues in district general hospitals, community care and primary care that we had quite a head start in preparations due to our position as an HCID. As the situation developed and a pandemic was declared, it became worryingly clear that there were many challenges to ensure safe care for children, despite their relatively safe status, both regionally and nationally. Here, I collate some of the challenges faced to date, some of the current solutions, and importantly, what we can do to be ready for any future pandemics, particularly those which may affect children as significantly as

COVID-19 affects older patients (table 1). I expand in detail on two areas specific to paediatrics and which due to our role as an HCID centre we have the ability to address as a contingency for future outbreaks; the use of PPE and ongoing workforce planning/training.

One of the main areas of anxiety for healthcare workers has been access to, and adequacy of, PPE. Guidance about the use of PPE is published by national public health bodies (eg, Public Health England (PHE)). As the SARS-CoV-2 virus was originally designated as a HCID, the highest level of PPE was recommended for all possible interactions. As further information about the virus, such as the method of transmission (droplet spread) became available, the PPE guidance was appropriately changed, both internationally by WHO and nationally. However, this led to confusion and misinformation, as many felt that the decision to downgrade the choice of PPE was due to stock shortages, confounded by difficulties distributing PPE by procurement teams nationally as so many healthcare settings ordered it simultaneously.

The PPE recommended for high-risk contact with SARS-CoV-2 included FFP3 mask, visor, long-sleeved fluid-resistant gown and gloves. There are clear guidelines about how to safely don and doff PPE of this type, including ensuring that the FFP3 mask fits appropriately.¹ Although at ICHT, 'fit-testing' of FFP3 masks for critical care and inpatient ward staff and training in how to safely don and doff PPE started in January, there were still concerns that we had inadequate numbers of our workforce trained to care for patients by the time a pandemic was announced, and many centres had not yet started to prepare their workforce. A number of staff were unable to 'pass' fit-testing, both due to issues with the testing method and as not all face sizes and shapes suited the mask available locally. Furthermore, as procurement became more challenging, a variety of shapes and brands of FFP3 mask were delivered, all of which ideally required further rounds of 'fit-testing', a very time-consuming task. But as staff safety is paramount, and as this has been on the agenda at every internal meeting attended (four times a day), the daily ICHT staff update email, every local, regional, national and international webinar on COVID-19 and the majority of news headlines and social media discussions over the last 2 months, finding a better strategy is crucial.

On discussion with medical colleagues in Canada who had first-hand experience of the first SARS outbreak in 2003/2004,

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Table 1 Summary of challenges faced by paediatric services during COVID-19 outbreak

Challenge	Details	COVID19 Responses	Proposed future strategy
Personal protective equipment (PPE)	<ul style="list-style-type: none"> Unfamiliarity with PPE, including donning and doffing procedures Time required to train all of workforce Adequate stores/logistical issues 	<ul style="list-style-type: none"> Real-time training of staff (time consuming) Some trusts chose not to complete recommended training/fit-testing due to time constraints Lack of trust from frontline healthcare workers in employers/public health bodies with impact on staff retention 	<ul style="list-style-type: none"> New strategy for fit-testing of healthcare workers – for example, mandatory fit-testing of selection of FFP3 masks at start of job for all healthcare staff, variety of fit-testing methods employed Regular donning and doffing training and simulation of caring for patients wearing PPE Hub and spoke approach to training, supported by HCID centres
Workforce Planning	<ul style="list-style-type: none"> Shortage of staff working in frontline areas (A+E, Critical care etc) No centralised record of staff skills and vulnerabilities Staff in 'wrong place', no NHS passport, difficulties in mobilising staff 	<ul style="list-style-type: none"> Line-managers contacting staff to gather information re skills/vulnerabilities Occupational health overwhelmed by staff requests Unclear guidance for 'vulnerable' staff Complex discussions between trusts at executive level to arrange memorandum of understanding 	<ul style="list-style-type: none"> Regularly updated records of staff skills and vulnerabilities to allow rapid and appropriate deployment of healthcare workers (HCW) NHS passports for all HCW – rapid mobilisation between trusts if necessary Standardised and transparent guidance for deployment/protection of vulnerable staff
Maintenance of essential services	<ul style="list-style-type: none"> Primary care overwhelmed by increased patient load and staff self-isolation/illness Community services not adequately in place to support hospital at home Frontline community workers/carers not initially provided with PPE or training to use Parental fear of attending healthcare settings to receive vaccines and so on 	<ul style="list-style-type: none"> Elective procedures cancelled to free up space and workforce Slow change in configuration of community services Slow delivery of information /reassurance to public re services 	<ul style="list-style-type: none"> Pre-planning for back up of essential services for example, pharmacy/school nurses to deliver primary immunisations and so on Early clear public information regarding which services will continue Pre-identification of 'pandemic free' clinical areas to conduct clinical work for these services Recent recognition of importance of basing paediatric services in the community should be expanded and established more permanently
Paediatric Critical Care	<ul style="list-style-type: none"> Unavailable real-time information of level 2 and level 3 critical care capacity Limited back up work force available for rapid expansion Limited adult critical care skills within paediatric workforce Children with life limiting conditions, often very vulnerable to such viruses with poor outcomes, not having had appropriate discussions about emergency care planning with their home clinicians. This had led to sometimes inappropriate, stressful and occasionally futile PICU admissions 	<ul style="list-style-type: none"> Regional leads for paediatric critical care (PCC) calling all PICU daily for updated admission information, capacity inaccurately published Rapid webinar-led training of other hospital staff – uncertainties, anxiety and possible inadequate care Difficult conversations with families under extremely stressful circumstances, limited visitors due to COVID and sub-optimal end of life care Difficult conversations over telephone regarding end of life care with families Shortages of certain medication and access to renal replacement therapy and loss of PIC beds and staff to meet AICU demand – required rapid modelling based on previous PICANET data to ensure enough PIC capacity ring fenced for any critically ill children at this time. 	<ul style="list-style-type: none"> NHS digital support for real-time information of level 2 and 3 critical care capacity all the time, not just during pandemics. All hospital based healthcare training (medical and nursing) should include at least one placement in critical care; adult and paediatric ICU staff should have shared learning Early community led discussions with families of those children for whom critical care may be unsuitable with support from hospital teams Premade e-learning packages as well as simulations and resources to aid rapid critical care learning for non-intensivists Templates for "cheat sheets" – for day to day management of critically ill children or adults that can be rapidly modified to meet need. Continue to improve modelling based on paediatric critical care needs to ensure appropriate PIC capacity maintained Early joint discussions with AICU, pharmacy, nephrology network to plan cohesively for future pandemics
Protection of Vulnerable Populations	<ul style="list-style-type: none"> Over-inclusion of many patient cohorts into high-risk populations High level of anxiety 	<ul style="list-style-type: none"> Centralised definitions of at risk populations, rather than by specialist clinicians/societies Mixed messages from NHSE/PHE versus specialist groups/societies 	<ul style="list-style-type: none"> Early involvement of specialist groups/societies to identify at risk groups & unified single response to avoid confusion/anxiety National registry for chronic conditions to allow rapid information dissemination to relevant populations
Communication	<ul style="list-style-type: none"> Top down communication with poor cascading Unclear routes of dissemination Centralisation of decision making, without involving those at the frontline eg junior doctors, nursing staff and so on Poor initial use of tele/video communications 	<ul style="list-style-type: none"> Delayed recognition of importance of regular transparent messaging to frontline staff High level of anxiety, concern re concealment of truth, lack of trust in those in positions of authority Development of daily communication emails, information on intranet Eventual recognition of importance of in-person or face-to-face information delivery 	<ul style="list-style-type: none"> Recognition that although information is limited at the start of the outbreak, transparency about decision making crucial to gain trust of frontline staff Early regular conveyance of information, even if caveats about need to be flexible included Early use of established networks to disseminate information and share decision making process
Time	Clinical and nursing staff involved in planning doing so on top of usual work commitments	Exhaustion and over work	Early recognition that those in planning/organising role need to rescind other responsibilities for duration of outbreak
Innovation	<ul style="list-style-type: none"> Extraordinary ability to make decisions and act during 'major incident' mode Multiple competing research studies for same patient cohort Rapid roll out of funding, ethics and regulation to allow appropriate research to be done Initially poor standardisation of clinical management 	<ul style="list-style-type: none"> Extraordinary leaps due to need Dormant studies with ease to 'awaken' re opened Standardisation of treatment - utilise established networks to share guidance nationally and internationally Shared experience internationally – learning from those countries who entered the pandemic first 	<ul style="list-style-type: none"> Early centralised approach to research to minimise duplication More important to get accurate results than early results into literature – peer review still necessary Continue rapid rate of innovation and clear decision making pathways after outbreak Retrospective review of data to inform future outbreaks Review of which management strategies were effective and which were counter-productive
Response to pandemic	Didn't think big enough early enough	Planning for next two phases, rather than for the next ten phases	When preparing guidance write for today, tomorrow, this week, this month and this year at the same time – consider all worse case scenarios

it transpired that all Canadian healthcare staff are 'fit-tested' with a variety of mask types as part of induction training for each job and had regular mandatory fit-testing reviews to ensure their safety in the event of needing to wear this type of PPE.² As such, recommending that all healthcare settings stock a selection of mask shapes

and types, and that all staff undergo mandatory fit-testing regularly seems proportionate. Alongside this, regular training and refresher sessions of donning and doffing PPE, including for simulated resuscitation scenarios is recommended. It is proposed that scenarios involving patients presenting unwell with a possible

airborne HCID are routine in simulation educational programmes nationally.

Up-to-date training and skills required for containing epidemic-type diseases must be better integrated into the training of all healthcare professionals, not only those specialising in infectious diseases, or working in an HCID centre. Establishing

formal networks using a hub-and-spoke approach from the HCID centres to identify, transfer and rapidly 'upskill' experienced healthcare professionals in the event of future outbreaks could result in more rapid 'upskilling' of staff in the event of another major pandemic. The team in an HCID centre, composed of key clinicians, nurses, pharmacists, allied healthcare professionals and possibly even security and cleaners, should practise regular simulations. These sessions could include training for healthcare workers from other centres and in addition, web-based training materials should be developed for online training.

It is clearly unreasonable, both from a financial and practicality perspective, to have the capacity to admit 20 000 extra patients generated as part of a 'once-in-a-lifetime' pandemic at all times in England. This would divert essential funding from other areas of the national health service. However, it is reasonable to be ready to rapidly upskill and change routine practice flexibly and with ease to accommodate this potential cohort, and having a prepared workforce is key to this.

Further to this, we recommend that paediatric training includes critical care training for all, and all paediatric intensive care trainees should do secondments to adult intensive care (and vice versa).

Although I highlight challenges, the most striking thing about this outbreak has been the willingness of all staff to work towards a single aim, minimising the impact on children. Supporting our colleagues to continue to do this, and indeed to do it as safely as possible, is vital.

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