

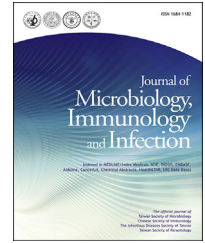


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Perspectives

Seventeen years after first implementation of traffic control bundling

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The 2003 severe acute respiratory syndrome (SARS) epidemic caused by SARS coronavirus (SARS-CoV) was the first readily transmissible novel emerging infectious disease with pandemic potential in the 21st century.¹ The SARS outbreak mostly attacked hospitals and healthcare workers (HCWs) where infected patients were treated. Globally, 21% of HCWs acquired SARS infections during the 2003 pandemic.² Seventeen years later the COVID-19 pandemic also saw HCW infections reaching 20–40% in certain highly affected regions. In many cases, the resultant hundreds of casualties caused significant strain on healthcare systems.^{2–4}

In Taiwan, hospital outbreaks of 2003 SARS continued even after initial containment and despite efforts to contain droplet and contact transmission by HCWs wearing N95 masks/personal protect equipment (PPE) and isolating patients in negative pressure isolation rooms (NPIR).⁵ Of Taiwan's 347 recorded SARS deaths, 70% were nosocomial infections of which 30% were among HCWs.⁶ It became clear that during the height of the pandemic, HCWs often failed to adhere to strict infection control protocols as they grappled with large influxes of panicking patients. However, even when closely adhered to, the protocols provided a false sense of security. Having gloved and

gowned up, HCWs thought themselves safe from infection and in many cases failed to wash their hands. The result was that HCWs accidentally contracted and spread the virus, either through close contact with SARS patients (within 1 m) or even when working away from SARS patients as a result of fomite transmission in contaminated environments.^{7–9}

In response, Taiwan developed an integrated infection control strategy called Traffic Control Bundling (TCB) which draws on Six Sigma principles.⁶ TCB incorporates three components: 1. Patient triage prior to entering hospitals; 2. Patient containment within designated zones of risk (clean-transition-contamination zones); 3. Checkpoint hand disinfection coupled with PPE use in between zones. Piloted in two hospitals, TCB proved highly effective in protecting HCWs from SARS infection.⁵ Having proven effective, Taiwan implemented TCB nationwide with the result that hospital infections among HCWs dropped to zero. This was an important contributor to SARS being controlled within two weeks.⁵

Despite its success, TCB was not again implemented, even in response to the 2009 H1N1 pandemic and the 2015 Korean MERS epidemic. Only when COVID-19 arrived in Taiwan 17 years later was it revived, and then in a modified form - enhanced Traffic Control Bundling (eTCB).¹⁰ eTCB includes adaptations that take into account the highly transmissible nature of SARS-CoV-2 by: 1. Dividing outdoor screening stations into distinct tents to treat patients by

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risk group based on testing, symptoms and travel history; 2. Designating distinct isolation wards, each incorporating a quarantine zone where suspected patients are kept under observation for the incubation period.¹¹ Since a/pre-symptomatic patients admitted to the hospital general ward (for routine treatments) may be infectious, previously defined clean zones are compartmentalized,¹² each with its own designated staff, so as to avoid cross contamination among HCWs and patients; 3. Requiring alcohol dispensers for hand sanitizing at regular checkpoints throughout wards and in publicly accessible locations throughout hospitals, such as near elevator entrances. Prior to entering a hospital, all HCWs and visitors are required to don masks and disinfect their hands (Fig. 1).¹¹

Implemented across Taiwan in March 2020, eTCB proved highly effective at eliminating transmissions via droplet and contact, especially via fomites.^{10,11} As a result, HCW infections and the single identified hospital cluster were eradicated.¹³ Furthermore, by breaking the community-hospital-community transmission cascade,¹⁰ eTCB also contributed to curtailing community spread, thereby mitigating the COVID-19 pandemic in Taiwan.¹⁴

Taiwan is not the only battle-tested example of TCB/eTCB. In the current issue of JMII, De Georgeo et al. report successfully implementing eTCB in a number of hospitals in the US as part of their COVID-19 response strategy.¹⁵ As the article describes, hospitals implementing eTCB experienced much lower HCW infection rates than non-implementing hospitals. Many implementing hospitals report very few infections among HCWs, and in some, there were no HCW transmissions reported despite dealing with heavy COVID-19 patient volumes (personal communication).

De Georgeo et al. also explain adaptations to eTCB necessitated by unique local conditions. For example, as

there can be no clear “safe zone” due to the possibility of a/pre-symptomatic transmission, the “green zone” described in eTCB was altered to a “gray zone” – recognizing the need for ongoing vigilance even in seemingly safe areas of hospitals.¹⁵ This form of risk stratification is an adaptation that highlights the necessity for flexibility when implementing eTCB in different circumstances. It also highlights the benefits of six sigma principles when refining and adapting response plans.¹⁶ In this case, the key was to distinguish among the zones and remain vigilant about disinfection when moving among them.

As noted, eTCB has been successfully implemented in long term care facilities (LTCF) in Taiwan,¹² where to date no residents have been infected with COVID-19.¹³ ETCB has also been implemented in the UK. However, in this case, it was implemented only after COVID-19 casualties were mounting. Even in this situation, eTCB has proven effective. In a separate report, Fewster et al. describe how their UK group integrated an adapted eTCB into their standard infection prevention and control (IP&C) strategy for care homes (the equivalent of LTCFs).¹⁷ In line with eTCB, their strategy emphasizes clear delineation of risk zones and widespread installation of alcohol checkpoints for constant hand hygiene (even when wearing gloves) between zones. However, due to space limitations in care homes, Fewster et al. adapted eTCB protocols to allow flexibility in the zones. Each zone may be given a new designation based on need, undergoing environmental de-contamination with sodium hypochlorite bleach prior to re-designation. According to Fewster et al., since its implementation, eTCB has had a clear and positive impact in a number of care homes.

For example, Fewster et al. note that in one care home facility that doubles as a neurorehabilitation center the eTCB zoning approach combined with IP&C contributed to

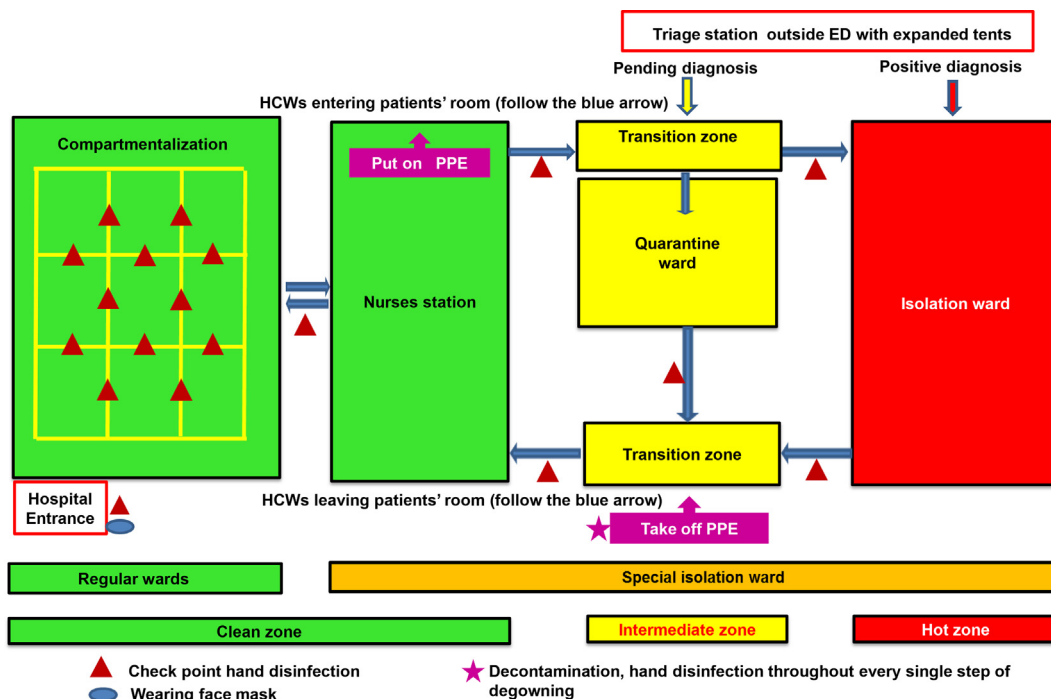


Figure 1. Conceptual scheme of enhanced Traffic Control Bundle (eTCB).

declining transmissions. Establishing distinct zones as described in eTCB has since been adopted by the British Geriatric Society, and the UK Care Quality Commission and has been included in updated recommendations for the UK national care home strategy. Plans now exist to build a national training program coupled with regular care homes inspections to ensure compliance.¹⁸

Reflecting increasing acceptance of eTCB as a tool for mitigating COVID-19 transmission in long-term care facilities, the WHO European Region has referenced the Fewster et al. model, highlighting eTCB principles such as restricting visitors and screening staff prior to entering care homes; establishing differentiated care pathways; maintaining clearly delineated risk zones; and providing environmental and engineering controls to reduce fomite transmission.^{19,20}

Seventeen years after it was first conceptualized in Taiwan as TCB, the new, eTCB model is proving itself beyond Taiwan's shores. As we have argued, jurisdictions adopting eTCB should adapt their implementation to local conditions and resource constraints, even while recognizing the eTCB "gold standard".¹² Here we have described various adaptations to eTCB, but anticipate and encourage further adaptation moving forward.

The key is to understand the importance of zone separation and re-designation based on conditions as well as disinfection when moving among them. In extreme situations, entire hospitals may be designated special isolation hospitals adhering to clear zone delineation and appropriate PPE use. This editorial and the article demonstrate how eTCB, first developed for Taiwan's unique conditions, can be adapted and proven effective in other countries with differing conditions. This kind of feedback and engagement by the international community is key to improving our response effectiveness in the face of the current COVID-19 pandemic and those that will come in the future.

Declaration of competing interest

We declare no competing interests.

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