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Frontiers of Improvement

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Using the Systems Engineering Initiative for Patient Safety (SEIPS) model to describe the planning and management of the COVID-19 pandemic in Hong Kong

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Introduction

The COVID-19 pandemic has had massive impact on healthcare systems highlighting that the relatively deficient medical facilities to cater the high patient load and the shortage of personal protective equipment (PPE) to ensure staff safety are the major problems to tackle [1, 2]. Hong Kong public hospitals faced the same challenges. It is crucial for the hospital management to formulate decisive strategies through a systems approach and take swift actions to handle these situations.

The Systems Engineering Initiative for Patient Safety model

The Systems Engineering Initiative for Patient Safety (SEIPS) model, consisted of five main domains namely organization, person, tasks, technologies and tools, and environment, is a renowned tool which adopts human factors principles and offers a comprehensive conceptual framework in facilitating hospital management to understand its own system [3, 4]. Evidence showed that this model had been successfully applied in handling the COVID-19 pandemic [5]. The aims of this article are to apply the SEIPS model to systematically describe the strategies and actions taken by the five public hospitals in the New Territories West Cluster (NTWC) of Hong Kong Hospital Authority and examine if the SEIPS model could support organizations in planning for and managing a pandemic. The strategies and actions taken in the NTWC since the COVID-19 pandemic in February 2020 are summarized in Table 1, and the key actions of each domain are highlighted below.

Organization: leadership, communication and coordination

The hospital management played a key leading role in formulating strategies and action plans to face the pandemic. The 'NTWC Management Committee in COVID-19 Pandemic' was set up at the outset of the pandemic by the Cluster Chief Executive (CCE) who oversaw the hospital operations. This Committee, consisted of key hospital leaders, served as a communication platform for all stakeholders to continuously monitor the rapidly changing situation, make swift decisions and disseminate important messages. The CCE also communicated closely with the Hospital Authority Head Office and other regional clusters on the strategic approaches at the corporate level.

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Table 1 Strategies and actions to tackle the COVID-19 pandemic summarized by the Systems Engineering Initiative for Patient Safety (SEIPS) model

Components	Strategies	Actions
Organization	Lead and coordinate at management level	• Formed then 'NTWC Management Committee in COVID-19 Pandemic' led by CCE to formulate overall strategies and action plans • Formed a PPE Taskforce to coordinate and monitor PPE supply and consumption
	Follow central command and coordination	• Worked closely with Hospital Authority Head Office and disseminated corporate directions and strategies
	Plan for sudden surge of COVID-19 cases	• Developed contingency plans to handle foreseeable sudden surges of COVID-19 admissions
	Provide incentives to engage staff	• Followed the corporate strategy to introduce Special Emergency Response Allowance and Special Rental Allowance schemes to express gratitude to staff working in high risk areas
	Enhance staff communication to reduce fear and anxiety	• Conducted frequent ad-hoc special management meetings to enhance communication between hospital management and clinical department heads • Conducted regular staff forum and published newsletters to share the latest situation, knowledge and updates in COVID-19 and the hospital management actions
	Promote positive hospital and staff image	• Published stories and articles to media and newsletters to publicize staff's efforts and contributions
Person	Increase staff knowledge	• Conducted regular mortality and morbidity meetings to discuss clinical management issues of COVID-19 patients and share experience by core team staff
	Empower staff	• Appointed experienced physicians to form designated COVID-19 medical teams • Formed designated COVID-19 teams in anaesthesia and physiotherapy to conduct aerosol generating procedures and sputum suction procedures
	Avoid staff burnout	• Adopted biweekly staff rotation in designated COVID-19 teams
	Address staff psychological needs	• Promoted staff psychological support services to all ranks of staff • Provided rapid psychological support to staff in need, e.g. in clinical areas with outbreaks
Tasks	Increase manpower	• Deployed staff from non-medical wards to work in medical wards and isolation facilities • Recruited retired, part-time and locum staff
	Spare resources to handle COVID-19 pandemic	• Reduced non-emergency services including elective operations and geriatric day and out-patient services
	Ensure proper and rational use of PPE	• Reviewed standards on the types of PPE to wear in different clinical and operational scenarios • Collected staff feedback on PPE usability and liaised with responsible parties to enhance the PPE design
	Speed up fit testing of respirators for all staff	• Opened additional fit test centres and sessions and purchased extra fit testers • Arranged on-site fit test sessions
	Avoid staff being infected at work	• Promoted infection control and ensured availability and proper use of PPE • Conducted regular inspections to wards and clinical areas by Infection Control Team
	Minimise cross transmission in hospitals	• Adopted 'one-patient-one-cuff' strategy for blood pressure measurement in wards • Conducted rapid investigation, isolation and contact tracing by Infection Control Team when a suspected case occurred • Implemented stringent screening processes at all entrances of hospitals • Introduced drug-refill mechanism for patients with chronic diseases to minimize patient traffic at out-patient clinics
	Reduce patients' needs to go to hospitals	• Promoted public-private partnership programmes and encouraged patients to use private healthcare services
Technologies and tools	Reduce staff's contamination risks	• Unified the practice of wearing working clothes during duties in clinical areas
	Introduce telemedicine to replace face-to-face consultation	• Applied tele-consultation services in rehabilitation, psychiatry, elderly care and allied health departments
	Ensure adequate stock of medical consumables	• Purchased additional stock of medical consumables including minor items like alcohol rubs and swabs
	Monitor PPE consumption	• Developed an electronic system to closely monitor the PPE usage and stock at unit level
	Review PPE usability	• Collected staff feedback on PPE usability and reflected to suppliers
Environment	Increase isolation capacity	• Converted some general medical wards to isolation wards • Set up Triage and Test Centres at Accident and Emergency Departments
	Provide adequate and comfortable accommodation to staff	• Renovated the staff quarters and increased the capacity of staff accommodation
	Ensure up-to-standard air quality for infection control	• Increased the monitoring by facilities management and engineers to ensure air quality including air flow and exchange to meet the required infection control standards

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Person: staff education and psychological support

COVID-19 is a newly emergent disease without effective cure to date [6]. Keeping staff's knowledge updated on the management and infection control precautions is important to ensure staff safety and alleviate fear. The formation of designated clinical COVID-19 teams including anaesthesia and physiotherapy allowed staff to acquire clinical experience in handling COVID-19 patients. Evidence also showed that healthcare professionals had high burnout due to workload and stress in the pandemic [7]. Therefore, rapid psychological support including support kits for quarantined or infected staff and stress management and resilience workshops was available to support the well-being of the workforce.

Tasks: infection control and PPE supply

Shortage of PPE supply has been a global issue since the pandemic. The PPE standard was regularly adjusted according to the latest understanding of the disease. The Infection Control Team is responsible for updating relevant guidelines and informing staff the required standards for infection precautions [1, 8]. A PPE taskforce was formed to closely monitor the stock, supply and consumption of PPE in the cluster and ensure staff wearing PPE rationally and appropriately through unit visits.

Technologies and tools: telemedicine

In order to ensure social distancing and reduce patient encounters in hospitals, telemedicine was introduced in services like rehabilitation, psychiatry and allied health in the NTWC to provide patient access to care [9]. Since it was a new service model to the NTWC, further study on the staff and patient satisfaction has to be conducted to evaluate its effectiveness.

Environment: hospital settings and air quality

Stringent precautionary measures were taken at hospital entrances to reduce people traffic and perform screening of febrile visitors. Foreseeing the admission pressure of COVID-19 patients, the NTWC management proactively converted some general medical wards to isolation facilities to hospitalize suspected and confirmed COVID-19 patients. Air quality including air flow and exchange was maintained by the Facilities Management Unit to meet the required infection control standards. Triage and Test Centres were also set up at the Accident and Emergency Departments which were successful in segregating patients with suspected COVID-19 symptoms at designated areas before consultation.

Conclusion

The SEIPS model was used to describe the work taken by the NTWC in combatting the COVID-19 pandemic. It highlights the importance of systems thinking in different aspects from the staff to the organization to ensure that a comprehensive management framework is planned, implemented and monitored in a pandemic.

Abbreviations

CCE = Cluster Chief Executive
COVID-19 = Coronavirus disease 2019
NTWC = New Territories West Cluster
PPE = Personal protective equipment
SEIPS = Systems Engineering Initiative for Patient Safety

Contributorship

All authors contributed to the design and strategies. WK, CM and YK contributed to the manuscript. All authors read and approved the final manuscript.

Ethics approval

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