

Meeting today's healthcare needs: Medicine at the interface

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ABSTRACT

The demographic of Singapore has undergone dramatic change. Historically, younger patients with communicable diseases predominated, whereas patients are now older with chronic multimorbidity and functional impairment. This shift challenges existing health and social care systems in Singapore, which must pivot to meet the changing need. The consequences of mismatched health and social care to patient needs are the fragmentation of care, dysfunctional acute care utilisation and increasing care costs. In Singapore and internationally, there is an inexorable rise in acute care utilisation, with patients facing the greatest point of vulnerability at transitions between acute and chronic care. Recently, innovative care models have developed to work across the boundaries of traditional care interfaces. These “Interface Medicine” models aim to provide a comprehensive and integrated approach to meet the healthcare needs of today and optimise value with our finite resources. These models include Acute Medical Units, Ambulatory Emergency Care, Extensivist-Comprehensivist Care, Virtual Wards, Hospital-at-Home and Acute Frailty Units. We describe these models of care across the acute care chain and explore how they may apply to the Singapore setting. We discuss how these models have evolved, appraise the evidence for clinical effectiveness, point out gaps in knowledge for further study and make recommendations for future progress.

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The demographic of Singapore has undergone dramatic changes. Historically, younger patients with communicable diseases predominated; however, patients are now older with chronic multimorbidity and functional impairment. This demographic shift challenges existing health and social care systems in Singapore, which must pivot to meet the changing need. The consequences of mismatched health and social care to patient needs include fragmentation of care among different specialties,¹ and between the acute hospitals and the community, as well as dysfunctional acute care utilisation² with increasing care costs.³ A recent Singapore study found at least 36% of patients experience care fragmentation.¹ A large cross-sectional study of regional health in east Singapore found heterogeneous chronic comorbidity patterns across population segments, associated with high acute care utilisation and cost.² Despite having

one of the most cost-efficient healthcare systems in the world (4.9% of the national gross domestic product in 2018), healthcare inflation in Singapore is one of the highest in Asia (average 2.2% per annum).³

In Singapore and across the world, there is an inexorable rise in acute care utilisation. The rate of increase in emergency department (ED) attendance in Singapore far outstrips population growth (5.6% versus 1.3% in 2016),⁴ exacerbated further by the recent COVID-19 pandemic. Additionally, the point of greatest vulnerability appears to be at the interfaces of care, particularly the transition of acute and chronic care as ongoing care needs extend beyond the acute care episode.⁵ Because of these challenges, there are calls for a paradigm shift in how healthcare systems deliver acute and chronic care to be fit for purpose.

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Recently, innovative care models have developed to work across the boundaries of traditional care interfaces between the acute hospital and primary care. These include, not exhaustively, Acute Medical Units (AMUs), Ambulatory Emergency Care (AEC), Extensivist-Comprehensivist Care, Virtual Wards, Hospital-at-Home (HAH) and Acute Frailty Units (AFU). These “Interface Medicine” models aim to provide an integrated approach to meet the healthcare needs of today, with some commonalities across the models. Firstly, the practising physician is advantageously a generalist who can effectively manage acute presentations while optimising chronic disease, and necessarily comfortable with managing clinical uncertainty while working over different environments and settings. Secondly, there is a focus on appropriate gatekeeping of health resources, relational continuity with patients and carers, effective multidisciplinary team-working, and functional knowledge of manoeuvring resources to meet patient needs. Thirdly, the adoption of evolving technology—such as electronic health records, point-of-care testing, teleconferencing and remote monitoring—has enabled effective care across care settings. We describe these models of care (Tables 1 and 2) across the acute care chain (Figs. 1A and 1B) and explore how they may apply to the Singapore setting.

Acute Medical Unit (AMU)

The Royal College of Physicians Acute Medicine Taskforce report in 2007 outlined key aspects of quality for acute medical care,⁶ forming the basis of core functions for AMUs. AMUs are dedicated receiving wards for the assessment, investigation, and stabilisation of those with acute medical conditions, and provide continuing care for up to 72 hours. Key enabling structures include sufficient bed-base to be able to discharge at least 50% of admissions without the need for further downstream ward movement, appropriate staffing and competence (e.g. 12-hour, 7-day consultant presence) for levels of patient acuity and throughput, geographic co-location to ED and timely access to diagnostics, specialist opinion and therapy services.

AMUs have spread to Europe, Australia and Asia. Acute Medicine has evolved into a medical specialty in the UK. The authors are aware of at least 5 AMUs in Singapore public hospitals.^{7,8} Systematic reviews⁹ and observational studies¹⁰ suggest AMUs are associated with reductions in length of hospital stay (mean 0.3 to 2.62 days), improved patient experience, and possibly overall mortality reduction (+0.1% to −8.8% mortality rate) compared with non-AMU wards.

Ambulatory Emergency Care (AEC)

Also termed Same Day Emergency Care (SDEC), AEC involves the redesign of patient pathways to allow assessment and treatment of emergency conditions within the same day as an alternative to hospital admission. They involve observation units paired with rapid access to clinic facilities, diagnostics, and medical procedures. They have evolved to also reduce the length of stay for those with ongoing diagnostic or care requirements, who no longer require hospitalisation.

AEC models may target specific conditions for pathway creation. Alternatively, validated tools such as the Amb score are used for patient selection. Co-location with ED or AMU has been found to increase throughput, and adopters find that up to 30% of acute medical admissions can be managed via AEC. The evidence for the effectiveness of AEC arises mainly from observational studies¹¹ and are condition-specific (e.g. venous thromboembolism and pneumonia), but demonstrate high patient satisfaction and lower costs. An implementation of AEC at a Singapore public hospital was associated with reduction in 30-day readmission (0.5%) and cost to the patient (45% reduction), as well as acute bed days saved (mean 1.2 days) compared to pre-implementation.¹²

Extensivist-Comprehensivist

The hospitalist movement expanded rapidly in the 1990s within the US, with a focus on improving patient outcomes and reducing acute care costs. This involved having inpatient care managed and coordinated by a generalist physician specialised in the care of hospitalised patients rather than primary care physicians, which was normal practice at the time. The subsequent break in care continuity between primary and secondary care may adversely affect some patients, manifested as frequent ED attendance and acute hospitalisation.¹³

The Extensivist-Comprehensivist model, which is resource intensive, seeks to empanel patients with previous high acute care utilisation and complex care needs to intensive outpatient management by a multidisciplinary team. A secondary care generalist physician leads the team in patient care, rather than hand over the patient to a primary care physician after hospitalisation. To further improve longitudinal care continuity and strengthen the physician-patient relationship, the inpatient and outpatient episodes are ideally managed by the same physician or team. Implementation of this model by the US CareMore Medical Group resulted in a 20% reduction in hospitalisation, 23% reduction in acute bed days and

Table 1. Interface Medicine models and characteristics

Model	Value proposition	Purpose	Population target	Competence	Temporality	Location
Acute Medical Unit (AMU)	“Right Physician, Right Place, Right Time, First Time for the patient with acute medical illness”	• Patient safety • Optimised patient flow through hospital • Decreased length of hospital stay	Majority of undifferentiated acute medical hospital admissions	Acute Medicine Curricula (UK); specialty or internal medicine	• 24/7 • Extended consultant coverage (e.g. 0800–2000 hours)	• Co-located with ED and diagnostics • Some include semi-critical care setting
Ambulatory Emergency Care (AEC)	“Treating emergency medical conditions without bed & breakfast”	• Admission avoidance • Decreased length of hospital stay	Acute emergencies in patients who can be managed in ambulatory fashion	Specialty or internal medicine	• Mostly 0900–1700 hours • Few extended hours and weekends	• Co-located with ED and diagnostics • Some housed within AMU
Extensivist-Comprehensivist Care	“Empanelment of patients to care-coordination and intensive out-patient care to prevent hospitalisation”	• Admission avoidance • Decreased cost of care • Continuity of care	History or persistent high acute care utilisation	Internal medicine; care coordination; complex case management	• Inpatient care as usual • Intensive outpatients	• Same physician manages inpatient and outpatient episodes
Virtual Ward	“Patients followed up in their homes by medical team using ward level processes”	• Patient safety • Decreased length of hospital stay • Admission avoidance • Continuity of care	Patients who do not fulfil criteria for continuing inpatient hospital stay but require frequent review of condition	Specialty, internal medicine or family practice	• Once a day “ward” round • Can be simple (e.g. telephone) or tech-enabled interaction (e.g. remote monitoring of vitals)	• Patient in own home but reviewed as part of team ward round
Hospital-at-Home	“Hospital level treatment and monitoring in the patients’ own home”	• Patient safety (nosocomial morbidity) • Decreased length of hospital stay • Admission avoidance • No need to build hospitals!	Fulfil criteria for inpatient care (monitoring, skilled nursing, therapy e.g. O ₂) to be provided in patients own home	Specialty, internal medicine or family practice	• Mostly 0900–1700 hours • Few out-of-hours service	• Patient in own home
Acute Frailty Unit	“Early review of frail older persons by skilled older persons team to facilitate early discharge”	• Patient safety for vulnerable elderly • Decreased length of hospital stay • Prevent decline	Older person with frailty or complex social needs	Frailty and comprehensive geriatric assessment; knowledge of and access to community resources	• Mostly 0900–1700 hours	• Co-location with ED

AMU: Acute Medical Unit; AEC: Ambulatory Emergency Care; ED: emergency department

Table 2. Main benefits and challenges of each Interface Medicine models

Model	Benefits	Challenges
Acute Medical Unit	• Early diagnosis and treatment	• Break in continuity of care
Ambulatory Emergency Care	• Manage acute/emergency conditions without the need for hospital admission • Potential reduction in nosocomial harm (e.g. infection)	• Only benefits “mobile” patients (e.g. contactable by phone, able to return to hospital, degree of self-care and activation implicit)
Extensivist-Comprehensivist	• Longitudinal care across acute and chronic setting by generalist physician • Care-coordination	• Resource intensive—costly if patient selection not appropriate
Hospital at Home	• Provision of acute care in patients own home • Potential reduction in nosocomial harm (e.g. infection)	• Resource intensive—costly if patient selection not appropriate • Ideally requires out-of-hours support
Virtual Ward	• Hospital ward level processes and monitoring to patient in their own home	• Resource intensive—costly if patient selection not appropriate
Acute Frailty Unit	• Comprehensive geriatric assessment and management early in acute care journey	• Acute care environment not conducive for frailty assessment and longitudinal management

4% decrease in average length of hospital stay compared to Medicare average.¹⁴

Virtual Ward

Virtual wards were first introduced in Croydon, UK in 2006 as having 2 components: a predictive model to identify populations at risk of future acute hospitalisation (e.g. PARR-30), paired to a period of intense multidisciplinary care with the patient residing at home using the systems, staffing and daily processes of a hospital ward.¹⁵ This model has been adopted internationally and applied in diverse populations, such as for chronic respiratory disease and frailty. A recent systematic review finds a reduction in mortality and acute hospitalisations in those with heart failure, but not undifferentiated chronic disease.¹⁶

In Singapore, the model has been applied to post-discharge patients assessed to have a high risk of rehospitalisation, with evidence of reduced ED attendances (incidence rate ratio [IRR] 0.67, 95%

confidence interval [CI] 0.52–0.86, $P=0.001$) and acute hospitalisation (IRR 0.60, 95% CI 0.46–0.79, $P<0.001$) compared to usual care, sustained up to 6 months.¹⁷ More recently, in response to pressures for hospital beds, virtual wards have been used to reduce acute hospitalisation rates for higher-risk COVID-19-positive patients who were ineligible for the Home Recovery Programme.

Hospital-at-Home (HAH)

The HAH model started in mid-1990s in the US, UK and Australia in response to rising demand for hospital beds and concerns of nosocomial injury to a vulnerable aged subgroup (e.g. functional decline, delirium and infection). The model aims to provide hospital-level monitoring and treatment for a subgroup of patients in their own home. Studies evaluating HAH take the form of small single-centre trials. A systematic review of HAH for the purposes of hospital admission avoidance reports reduced institutionalisation rates (risk ratio [RR] 0.35, 95% CI 0.22–0.57, $P<0.0001$) with no significant difference in acute hospital readmission rates compared to usual care.¹⁸ A systematic review of HAH for the purpose of early hospital discharge finds moderate evidence of reduction of length of stay (7 days, 95% CI 10.19–3.17 days), particularly for elective surgery, but increased risk of hospital readmission for medical patients (RR 1.25, 95% CI 0.98–1.58) compared to usual care. Both reviews report improved patient satisfaction and no increase in mortality, but no clear evidence of cost reduction.¹⁹ The authors know of at least 3 HAH services at Singapore public hospitals.

Acute Frailty Unit (AFU)

Also termed Acute Care for Elders (ACE) unit, AFUs started in the mid-1990s with the aim of reducing functional impairment in older adults with acute hospitalisation. The 4 principles include a specially designed environment, patient-centred care, comprehensive discharge planning and comprehensive medical review to minimise polypharmacy or unwarranted procedures. Systematic reviews find AFUs are associated with fewer falls (RR 0.51, 95% CI 0.29–0.88), delirium (RR 0.73, 95% CI 0.61–0.88), functional decline (RR 0.87, 95% CI 0.78–0.97) and institutionalisation (RR 0.82, 95% CI 0.68–0.99) compared to usual hospital admission.²⁰ An implementation of an AFU within the ED of a Singapore public hospital was associated with reduction in conversion to hospital admission from ED attendance (81.4%), with no increase in ED reattendance or hospital readmission at 6 months compared to usual care.²¹

1A

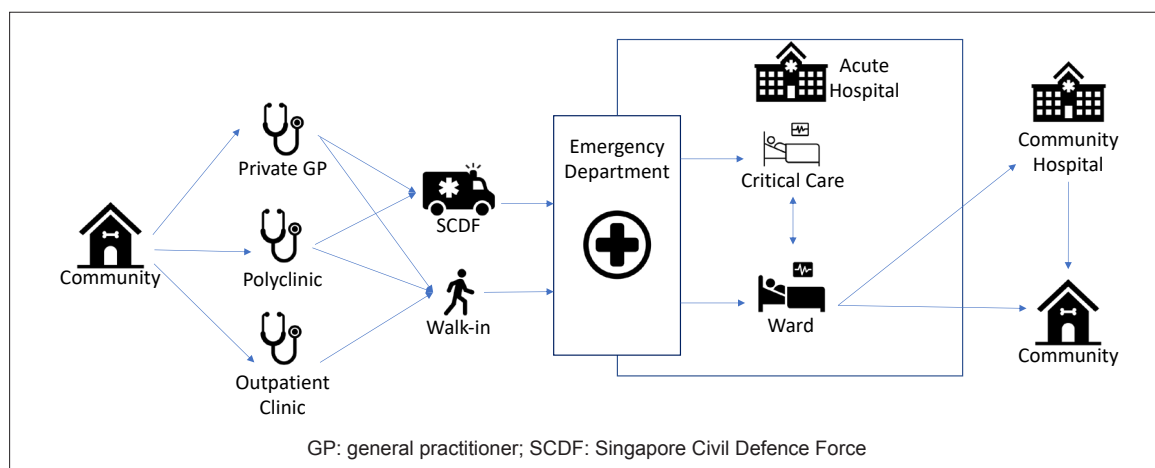


Fig. 1A. The Acute Care Chain in Singapore. The flow of patients into the hospital is via the emergency department (ED) from walk-ins, polyclinics, private general practitioners and specialist clinics, with ambulant patients approaching ED directly or patients being conveyed by ambulance. Patients move from the ED into hospital wards (including critical care), and from hospital wards to home or a community facility.

1B

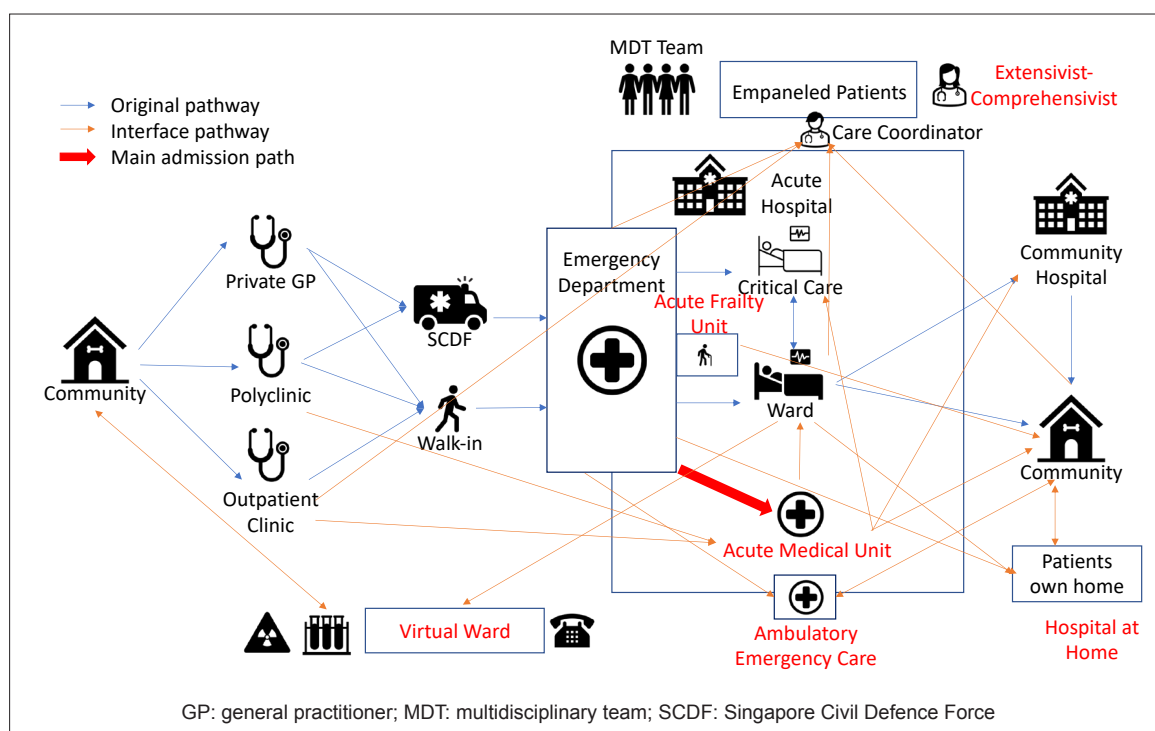


Fig. 1B. Interface Models in relation to acute care chain in Singapore.

Acute Medical Unit (AMU): The majority of medical admissions to the hospital flow through AMU, with some patients from polyclinic or specialist clinic being admitted directly bypassing ED. Patients are discharged directly from AMU (72 hours) to home or community facility or flow to an appropriate specialist hospital ward for ongoing care.

Ambulatory Emergency Care (AEC): Selected patients from ED are discharged on the same day with ongoing investigations, treatment and review via rapid access follow-up clinic.

Extensivist-Comprehensivist: Frequent acute hospital attenders are managed intensively in outpatient settings supported by a multidisciplinary team and patient navigator.

Virtual Ward: Multidisciplinary care with the patient residing at home using the systems, staffing and daily processes of a hospital ward.

Hospital-at-Home (HAH): Hospital-level monitoring and treatment for a subgroup of patients in their own home.

Acute Frailty Unit (AFU): Early review of frail older persons by a skilled older person team to facilitate early return to the community from acute hospital.

As health systems organise to meet the needs of the patients they serve, functional interfaces of care delivery naturally arise. For some, where demographic change increases vulnerability, these care interfaces can be dysfunctional and lead to care fragmentation, increased risk of adverse outcomes, poor experience, and excess cost. These models of care aim to bridge these gaps, to improve patient safety and health system effectiveness.

There are common challenges and opportunities. Firstly, as these care models span the divide across interfaces of care, they are often challenged by fragmented governance and financial structures. Integrating these structures into a cohesive, cost-effective configuration is a crucial step for scale-up and spread. Secondly, these care models are not mutually exclusive and overlap in population target and value proposition. This importantly allows for synergistic relationships between models without the need for extra resources, especially in terms of workforce. For example, many AMUs house AEC units maximising existing resources, while increasing throughput. Understanding how these models may work together to meet patient needs with optimal effectiveness and efficiency is a research priority. Lastly, the models have been heterogeneously implemented, with evidence of their effectiveness based on single-centre trials or observational studies. Health service interventions are often complex and occur in the “open-range” of a working health system. Given finite resources, implementing new models of care risks destabilising existing systems. Rigorous evaluation of real-world effectiveness is a priority. A deeper understanding of contextual factors is required for optimal implementation, otherwise we risk creating new health system dysfunction, which paradoxically these models seek to eradicate.

Over time, evolving understanding of the natural sciences has allowed the development of efficacious therapeutics. The practice of medicine has also continued to evolve to be more effective in meeting patient needs. The blurring of healthcare across the community, primary and secondary settings is a growing international phenomenon. These models of care continue to evolve and may be the future of mainstream practices. The challenges and opportunities described are a roadmap for future development and study.

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