

## *Current Infectious Disease Reports*

# Defining international critical care pharmacist contributions to sepsis and exploring variability

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**Online Resource 2a (Supplementary Table).** An overview of themes, sub-themes and codes for Barriers Facing Intensive Care Unit (ICU) Clinical Pharmacists to Further Contribute to Sepsis Management

<b>Themes</b>	<b>Subthemes</b>	<b>Codes</b>
<i>Physical</i>	<i>Legislative</i>	National provision of clinical pharmacy services, regional heterogeneity, scope of pharmacist interventional licence, lack of clarity, poor international recognition of clinical pharmacy degrees, inability to change medications in time critical circumstances
	<i>Restricted Access</i>	ICU patient notes, to the ICU, therapeutic drug monitoring (TDM) assays, inability to share patient information between healthcare settings, microbiology results, drug charts, laboratory results, fluid administration charts, TDM concentration results, prioritisation to other wards or areas, physical location away from ICU bedside, ward round attendance, time to develop trusting relationships, dispensary duties, multiple ward commitments
	<i>Antimicrobial Resistance</i>	Inability to act on cultures and sensitivities, lack of effective antimicrobial agents
	<i>Digital</i>	Software heterogeneity between wards and hospitals, no interlinkage between separate patient record systems (laboratory/microbiology/ICU/other wards), electronic prescribing and medicines administration (ePMA) interface issues, number of different ePMA systems
	<i>Data Capture</i>	Infrastructure, patient harm and associated cost avoidance, inpatient and outpatient costs, financial quantification of clinical practice, demonstration of the depth and level of care provided, intervention time
	<i>Pharmacy Workforce</i>	Focus on dispensing activities, balancing multiple roles, contention between research and clinical commitments, protected time on ICU, management responsibilities, drug budget centred activities, back office requirements, lack of clinical development pathways, pharmacy team structure, no 24-hour seven-day ICU service, missing time sensitive sepsis contributions, competing roles (microbiologist/clinical pharmacologist/antimicrobial stewardship (AMS) nurse), nurse driven sepsis identification, hospital committees facilitating change, traditional medical prescribing models, inequality in professional structures, no historical pharmacist research posts, ward round structure, no infection prevention control (IPC) involvement, financial and staffing capacity, placement of specialist trained pharmacists in non-specialised posts, limited number of funded clinical pharmacy places, skillset shortages, patient demand, hospital management issues, national clinical pharmacist shortages, lack of pharmacy department, clinical pharmacist competence, poor pharmacist confidence, poor graduate standard, lack of pharmacist engagement in upskilling

	<i>Workload</i>	Medical colleagues lacking time to support adoption, operational pressures of other pharmacy commitments, patient number, clinical pharmacist to level 2/3 ICU patient ratios, unsafe staffing, bureaucracy, lack of time to make business case, lack of time to undertake quality improvement and research
	<i>Laboratory Facilities</i>	Lack of TDM assays for other antimicrobials, laboratory capacity, point of care (POC) devices, wearable drug monitors, regional hospital staff shortages, limited laboratory equipment, lack of a pharmacy integration, outsourced TDM, turnaround times, depleted national or regional resources
	<i>Communication</i>	Patient referral timing, missing time critical window for interventions, supplementary prescribing, prescribing under doctors' license, no autonomous decision-making, inter-ward and emergency department (ED), between pharmacy specialities
<i>Financial</i>	<i>Pharmacy Service</i>	Loss/lack of seven-day service funding, reimbursement model for pharmacist interventions, lack of TDM payment structure, contention with microbiologist led services, national and local commissioning, Bayesian dosing software expenses, lack of cost avoidance evidence informing reimbursement models, drug budgets not accounting for basic or complex multifaceted interventions, POC costs, costs of multidisciplinary team (MDT) required for clinical pharmacy presence, plateau in expanding role due to nature of cost-avoidance contribution, local and national funding for clinical pharmacy services, intervention contributions not individually reimbursed, lack of research funding, drug costs, dependency on drugs to provide clinical pharmacy service, not enough funding for dedicated ICU pharmacist, split clinical pharmacy roles, cost of TDM, billing for pharmacy services, innovation not incentivised, lack of remuneration for increased responsibility
	<i>Personal</i>	Financial de-incentivising compared to community or industry pharmacy roles, cost of additional clinical pharmacy education, poor compensation for residency training, no bonuses for complex interventions, hospitals creating 'residency' posts instead of paying full rates for substantial post, poor financial remuneration correlated to skillset

**Online Resource 2b (Supplementary Table).** An overview of themes, sub-themes and codes for Barriers Facing ICU Clinical Pharmacists to Further Contribute to Sepsis Management

Themes	Sub-themes	Codes
Social	<i>Hospital Managers</i>	No place for clinical pharmacist in ICU MDT, only advisory contributions accepted, poor understanding of skills and expertise, receptiveness of employer to consider pharmacy service contributions, pharmacy perceived as a non-priority service, pharmacy only associated with discharges, tangibility for commissioners to pay for cost avoidance associated with pharmacy services
	<i>Medical Team</i>	Competition with medical responsibilities, sepsis management perceived as an exclusive medical task, lack of understanding of clinical pharmacist skills and expertise, pharmacists' historically not a bedside MDT member, lack of pharmacist legal responsibility for clinical advice, pharmacists perceived as antimicrobial police, poor pharmacist communication skills, pharmacist competency, volume of negative prescribing feedback, TDM perceived as a microbiologist role, culture that pharmacists are non-decision makers, pharmacist advice perceived as not credible
	<i>Pharmacists</i>	Personal sacrifice, long training pathway, competitiveness, lack of public understanding of role, fear of rejection by MDT, culture that pharmacists are non-decision makers, having to justify role disproportionately compared to doctors or nurses, confidence to make interventions, social skills, determination and overcoming of disproportionate setbacks to establish an ICU service
	<i>Pharmacy Leaders</i>	Priority to medication supply related activities, historical perceptions that pharmacists are not a bedside MDT member, hospital remuneration structures not accounting for clinical contributions, archaic management structure, prioritisation of limited resources, business case generation required for clinical pharmacy roles, poor clinical pharmacy advocacy/leadership
	<i>Politicians</i>	Lack of understanding of clinical pharmacy role on ICU, lack of understanding of clinical pharmacist evidence base and cost-avoidance contribution, clinical pharmacist skills and expertise unknown, non-focus of pharmacy on political agendas, lack of pharmacist representation
	<i>Pharmacy Regulator</i>	Poor recognition of clinical pharmacy as a specialty, lack of recognition of international clinical pharmacy qualifications, poor incentives to increase clinical pharmacists' scope of practice, poor recognition of pharmacists as an MDT member, outdated legislation relating solely to medication creation and supply, absence of stakeholder pressure for change
	<i>Research Commissioners</i>	Requirement of physician principal investigator (PI) to oversee research proposals and supervision, lack of recognition of clinical pharmacists as independent researchers, limited number of medication safety and/or pharmacy themed grants
	<i>Personal</i>	Individual dedication, personal qualities (shy/inactive/not outgoing), motivation, poor career progression and financial incentives, self-directed learning, a lot of advice required, burn out, confidence, not feeling safe to intervene, personal goals

<i>Education and Training</i>	<i>Evidence Base</i>	TDM of certain antimicrobials, unlicensed dosing based on pharmacokinetic/pharmacodynamic (PK/PD) principles, improved cost-effectiveness and cost-avoidance with ICU clinical pharmacy presence, clinical and cost outcomes not reflecting updated roles in studies, poor dissemination and awareness among stakeholders
	<i>Leadership</i>	Lack of role models, few pharmacy leaders, interest in research, support from chief pharmacists, risk-taking, advocacy
	<i>Pharmacist</i>	Undergraduate and post-graduate education, ICU too specialised for undergraduate courses, lack of post-graduate support, national advocacy, unified educational resources and training programmes, awareness and knowledge of sepsis management, expertise to interpret TDM concentrations, length of training pathway, few competent clinical pharmacy teachers at Universities, clinical pharmacy training opportunities within hospitals, structured and homogenous clinical pharmacy education, lack of PK/PD expertise, AMS training, sepsis bundle training, no infectious diseases posts within hospital residency programmes, interprofessional education and training opportunities, no split residency posts with medical colleagues, microbiology training, decision making activities, mentorship to improve communication skills, few or no translational research development opportunities, ePMA training, business case generation training, ensuring pharmacists feel confident and safe to contribute to ICU MDTs
	<i>Multidisciplinary team (MDT)</i>	Knowledge of clinical pharmacist role and capabilities, little/no university or residency exposure, knowledge of clinical pharmacists' expertise, absence of hospital committee contribution, importance of TDM, positive experiences of clinical pharmacy, demonstration of clinical pharmacist value