Received: 27 March 2024 | Accepted: 27 March 2024

DOI: 10.1002/jac5.1951

jaccp Journal of the American College of Clinical Pharmacy

ACCP WHITE PAPER

Identifying ideal pharmacist-to-patient ratios for the successful provision of clinical pharmacy services

Jay L. Martello Pharm.D. | Zack Dumont BSP, MSPharm, ACPR, FCSHP | Wiyanna Bruck Pharm.D., BCIDP, BCPPS, BCPS | Mitchell S. Buckley Pharm.D., FCCP, FASHP, FCCM, BCCCP, BCPS | Christopher T. Buckley Pharm.D., MS, BCCCP | Nicolette Centanni Pharm.D., BCGP, BCPP, BCPS | Elizabeth A. Chester Pharm.D., MPH, FCCP, BCPS | Jeffrey Gonzales Pharm.D., MS, BCPS, CDCES, PDE-C | Gina Harper Pharm.D., BCPS | Miranda Howland Pharm.D., BCCCP | David Gutenschwager Pharm.D. | Kendra Langham | Rachel Meyers Pharm.D., BCPPS, BCPS, FPPA | Russel J. Roberts Pharm.D., BCCCP | Ashley R. Selby Pharm.D., BCCCP, BCIDP, BCPS | Emily Shin Pharm.D., BCACP | Kristen Szempruch Pharm.D., BCPS | Elizabeth Van Dril Pharm.D., BCACP, BCPS, CDCES | Sharon Wu Pharm.D., BCACP

American College of Clinical Pharmacy, Lenexa, Kansas, USA

Correspondence
American College of Clinical Pharmacy, 13000 W. 87th St. Parkway, Suite 100, Lenexa, KS 66215-4530.
Email: accp@accp.com

Abstract

Clinical pharmacists add significant value to the health care team and are associated with reduced hospital mortality, drug costs, length of stay, and adverse drug reactions. However, there remains a paucity of evaluative data regarding optimal clinical pharmacy practice models. Identifying optimal patient (or bed)-to–clinical pharmacist ratios is one mechanism to assess the allocation of resources. The ACCP Task Force on Clinical Pharmacy Services was charged with developing a white paper to examine optimal ratios in different care settings, considering confounders and other factors that affect the interpretation of ratio data. The committee performed an extensive search of the pharmacy, medical, and nursing literature to identify existing data on provider-to-patient ratios. Recommendations on ratios are mainly from survey data or statements from various health care organizations. Many factors affect the capacity of clinical pharmacists to achieve patient care and non-patient care responsibilities. Examples include general differences in baseline expectations; nonstandardized

This document was prepared by the 2023 ACCP Task Force on Clinical Pharmacy Services: Jay L. Martello, Pharm.D., BCPS (Chair); Zack Dumont, BSP, MSPharm, ACPR, FCSHP (Vice Chair); Wiyanna Bruck, Pharm.D., BCIDP, BCPPS, BCPS; Mitchell S. Buckley, Pharm.D., FCCP, FASHP, FCCM, BCCCP, BCPS; Christopher T. Buckley, Pharm.D., M.S., BCCCP; Nicolette Centanni, Pharm.D., BCGP, BCPP, BCPS; Elizabeth A. Chester, Pharm.D., MPH, FCCP, BCPS; Jeffrey Gonzales, Pharm.D., M.S., BCPS, CDCES, PDE-C; Gina Harper, Pharm.D., BCPS; Miranda Howland, Pharm.D., BCCCP; David Gutenschwager, Pharm.D.; Kendra Langham; Rachel Meyers, Pharm.D., BCPPS, BCPS, FPPA; Russel J. Roberts, Pharm.D., BCCCP; Ashley R. Selby, Pharm.D., BCCCP, BCIDP, BCPS; Emily Shin, Pharm.D., BCACP; Kristen Szempruch, Pharm.D., BCPS; Elizabeth Van Dril, Pharm.D., BCACP, BCPS, CDCES; Sharon Wu, Pharm.D., BCACP

Approved by the American College of Clinical Pharmacy Board of Regents on August 1, 2023.

program performance metrics; variable hospital/practice setting types; variable patient acuity and complexity; competing priorities and other resources; industry-wide rates of and variability in addressing burnout; inconsistent means for justifying numbers and historical corporate structures; and external endorsements and mandates. Although some areas of practice such as critical care pharmacy have more robust evidence for specific ratios, others such as pediatrics are far less clear. A clinical pharmacist ratio must be established as a starting point. This will allow for better allocation today and serve as a springboard for future determinations. Furthermore, clinical pharmacist ratios should be preserved to offer reliable patient care 365 days per year. As clinical pharmacist services shift from beneficial to essential, continuous daily patient care services must be the practice model moving forward.

KEYWORDS
attrition, burnout, career ladder, clinical pharmacist, non-academia, workforce

1 | INTRODUCTION

The American College of Clinical Pharmacy (ACCP) defines clinical pharmacy as "a health science discipline in which pharmacists provide patient care that optimizes medication therapy and promotes health, wellness, and disease prevention."[1] As such, clinical pharmacy services are offered in essentially all value-driven health care systems in the United States and internationally. Furthermore:

> The practice of clinical pharmacy embraces the philosophy of pharmaceutical care, blending a caring orientation with specialized therapeutic knowledge, experience, and judgment to ensure optimal patient outcomes. As a discipline, clinical pharmacy has an obligation to contribute to the generation of new knowledge that advances health and quality of life.[1]

The ACCP has articulated core competencies for clinical pharmacists composed of six domains (Table 1) to support the provision of comprehensive clinical pharmacy services in team-based, direct patient care.[2] As the role of pharmacy support personnel and the evolution of medication processes and technology advances, the role of the clinical pharmacist continues to expand. Not only are clinical pharmacists responsible for patient care activities such as comprehensive medication management (CMM), pharmacokinetic evaluation, order entry and verification, and direct patient care services, but they also have responsibilities beyond care provision, including didactics, precepting learners, committee involvement, and scholarship/research activities.

TABLE 1 Clinical pharmacist competencies.[2]

ACCP clinical competency domains	
1	Direct patient care
2	Pharmacotherapy knowledge
3	Systems-based care and population health
4	Communication
5	Professionalism
6	Continuing professional development

Clinical pharmacists add significant value to the health care team and are associated with reduced hospital mortality, drug costs, length of stay, and adverse drug reactions.[3,4] Rech and colleagues showed a potential monetary cost avoidance-to-pharmacist salary ratio of between $3.3:1 and $9.6:1 for critical care clinical pharmacists and between $1.4:1 and $10.6:1 for emergency medicine clinical pharmacists.[5,6] Subsequently, non-pharmacy health care professionals and organizations are advocates for clinical pharmacy services.[7,8]

However, there remains a paucity of evaluative data regarding optimal clinical pharmacy practice models. Although pharmacist roles and responsibilities have evolved away from distributive functions to more patient-centered medication management, evaluation of optimal resource allocation in contemporary clinical pharmacy practice remains elusive. Investigations largely remain exploratory, and literature is generally limited to subspecialties of clinical pharmacy (e.g., critical care) or extrapolations from non-pharmacist professions (e.g., nursing).

Identifying optimal patient (or bed)-to-clinical pharmacist ratios is one mechanism to assess or plan the allocation of resources. The ACCP Task Force on Clinical Pharmacy Services was charged with developing a white paper to examine optimal ratios in different care settings, considering confounders and other factors that affect the interpretation of ratio data. Establishing an optimal clinical pharmacist ratio may address burnout among clinical pharmacists by improving workload management while also working toward standardization. Furthermore, a defined ratio may improve or clarify the expectations of other health care professionals and the public and allow for strategic workforce planning. This paper approaches the issue from the broadest view, attempting to capture and account for the many confounders that have made ratios elusive and/or of questionable

usefulness. This ACCP Task Force Committee consisted of members representing various clinical pharmacy specialties and health care settings. The committee performed an extensive search of the pharmacy, medical, and nursing literature to identify existing data on provider-to-patient ratios, burnout, outcomes associated with the overburdening of health care providers, and factors that affect these patient ratios. Interpretation and implementation of these findings is complex; nevertheless, a clinical pharmacist ratio must be established as a starting point. This will allow for better allocation today and serve as a springboard for future determinations.

2 | CURRENTLY AVAILABLE EVIDENCE

2.1 | Pharmacist-to-patient ratios

Currently available recommendations on ratios are mainly from survey data or statements from various health care organizations rather than evaluative literature. One international organization's clinical pharmacist committee proposed pharmacist ratios of 1:15 for critical care, 1:20 for specialty units, 1:30 for medical, 1:40 for surgical, 1:50 for day surgery, and 1:90 for hospice and long-term care.[9] Other positions on clinical pharmacist ratios have come from the critical care specialty, with proposals for 0.05–0.1 full-time equivalent (FTE) clinical pharmacists per critically ill patient, whereas another organization recommends that clinical pharmacist ratios in the ICU be based on patient acuity and complexity.[8,10] These statements are a helpful foundation but may be scrutinized for their subjectivity. There is emerging research to serve as a more rigorous backstop. For example, one study of the critically ill population with an average pharmacist-to-patient ratio of 1:26.8 found that increased ratios were associated with increased length of ICU stay and decreased interventions.[11]

Although limited, some investigators have included information on clinical pharmacist staffing and the impact on clinical outcomes. One institution that implemented a ratio of 1:30 for acute care settings and 1:18 for critical care settings found a reduction in 30-day readmissions in a population at high risk.[12] A survey of 141 hospitals that measure medication-related quality metric goals (e.g., appropriate use of antimicrobial agents) found that institutions that met their goals had pharmacist ratios of at least 1:48 in medical and surgical units and 1:23 in critical care.[13] Additional evidence, including information from 885 hospitals, suggests that increased pharmacist staffing per 100 occupied beds is associated with reduced deaths per 1000 admissions, though exact ratios were not identified.[14]

When addressing pharmacist ratios in community pharmacy, evidence is limited and based on prescription volume rather than patient (or bed) volume. One study of community pharmacist survey data and pharmacy benefit manager information showed an average of 14.1 prescriptions filled per pharmacist hour, 1.2 FTE pharmacists per hour open, 1375 prescriptions filled per week, and 32.1 potential drug–drug interactions (DDIs) dispensed, with DDIs being a marker that increases as a ratio widens. Significant predictors of higher numbers of dispensed potential DDIs were pharmacist workload on the basis of prescription volume, ability to customize DDI alerts, and automated telephone systems for prescription orders.[15]

Although there is increasing recognition of the value that clinical pharmacists bring to primary care and ambulatory care practices, a standardized staffing model has not been established. One study evaluated successful primary care practices to inform recommendations for a patient-centered medical home (PCMH) staffing infrastructure.[16] A common finding among successful practices was the addition of a clinical pharmacist to support medication management, chronic disease care, and provider consultation. Their recommended staffing ratio was 0.2 FTE clinical pharmacists for every 1.0 FTE primary care provider based on a provider panel of 2150 patients.[16] Another report from key stakeholders looking at payment reform to support PCMH practices recommended a ratio of 0.25 FTE clinical pharmacists for every 1.0 FTE primary care provider based on a provider panel of 1250–1500 adult patients as part of a risk-adjusted comprehensive payment and bonus model.[17]

A workforce model analysis by the Agency for Healthcare Research and Quality considered four different adult patient populations and their staffing implications: typical primary care practice (index model), high geriatrics caseload, high social needs, and rural practice. Assuming 10 000 adult patients per practice model, recommended ratios were 1.0 FTE clinical pharmacist (to support medication therapy management) for all models with the addition of a 1.0 FTE pharmacy assistant for the high geriatric and high social needs populations. It was also recognized that the rural communities will likely have smaller patient populations and the number of clinical pharmacist FTEs needed would decrease accordingly, but the ratio would stay the same (e.g., 0.5 FTEs for 5000 patients).[18]

The Veterans Health Administration (VHA) Patient Aligned Care Teams offer another staffing model, where a 1.0 FTE clinical pharmacist is allotted to 3600 patients.[19] Estimates suggest the clinical pharmacist offloads around 1600 patient encounters with a primary care provider annually.[20] Building on this model, one author offers a practical approach to estimating clinical pharmacist FTEs: identify the patient population and patient care activities (that the pharmacist supports) and their associated visit intensity. After understanding the size of the population and the approximate number and duration of visits involved, that information can be used to calculate the clinical pharmacist FTE. For calculations to be realistic, other considerations must be factored in as well, such as vacation time and any non-patient care responsibilities the pharmacist may have. Using a more sophisticated analysis, a recent study evaluated the appropriate pharmacist panel size for their organization on the basis of provider panel size, pharmacist workload, quality metrics, and patient access (time to third available appointment).[21]

2.2 | Medical doctor-to-patient ratios

Many fields within health care share the challenge of finding the ideal ratio where patient care outcomes improve and harmful workload is

minimized.[22,23] In various areas of medicine, it has been found that increased patient volume provides more repetition and experience and that too high of a volume can result in suboptimal patient outcomes.[24,25] Compared with the available pharmacy literature, medicine provider–to-patient ratios in non-ICU settings have been found to be 1:15, whereas in the ICU setting, they are ideally 1:8–1:11, though these numbers can vary.[23,26,27] In the ambulatory care setting, more than three or four patient visits per hour have been found to decrease optimal visit content and patient satisfaction.[28] With an increase in support staff, including pharmacists, the number of clinic visits per hour could potentially increase.

2.3 | Nurse-to-patient ratios

The Centers for Medicare & Medicaid Services (CMS) mandates that hospitals provide an adequate number of licensed registered nurses to provide nursing care to patients.[29] However, CMS regulations do not specify specific nurse ratio requirements but instead leave ratio decisions up to the individual state or institution. As of March 2022, 16 states have put legislation in place to address nurse staffing, mainly in the form of mandated hospital-based staffing committees that set staffing plans or mandated disclosure of staffing levels to the public and regulatory bodies.[30,31] However, two states (California and Massachusetts) have passed legislation mandating specific nurse-to-patient ratios.[32] In 2004, California led the way and instituted mandated ratios for all hospital patient care areas (e.g., 1:1 for ICUs and 1:5 for medical-surgical units), and in 2014, Massachusetts mandated ratios just for the ICU (1:1 or 1:2, depending on acuity).[33,34] Although the optimal nurse ratios have not been defined for specific care areas, research suggests that lower nurse-to-patient ratios are associated with improved patient outcomes, including reduced mortality, medication errors, pressure injuries, falls, restraint use, hospital-acquired infections, length of stay, and readmission rates.[31,35,36] A recent systematic review and meta-analysis involving 175 755 patients from six studies in the ICU or cardiac unit setting indicated that lower nurse-to-patient ratios were associated with a 14% reduction in hospital mortality.[36] In addition, more incongruent nurse-to-patient ratios have been associated with a higher incidence of nurse burnout, fatigue, emotional exhaustion, depersonalization, stress, and job dissatisfaction.[34,36]

3 | BARRIERS TO ESTABLISHING RATIOS

The following section outlines systemic, professional, departmental, and individual factors—both internal and external—that may affect clinical pharmacist workload. Often, these factors increase the demands of the clinical pharmacist, and occasionally, they lessen them. Nevertheless, these factors contribute to inconsistency in clinical pharmacists' day-to-day work and are thus barriers to establishing standardized ratios.

3.1 | General differences in baseline expectations

Although higher numbers of pharmacists have been associated with lower mortality rates, variability exists in the expectations and job descriptions among clinical pharmacists.[37,38] Expectations are rooted in observations of existing practice environments and the resources that have been dedicated without a unifying professional strategy. Some services that clinical pharmacists provide are outlined as essential, whereas others are desirable for routine care in specialty settings.[8] It is also important to keep in mind the optimal continuum of care for patients when outlining these roles because divergence in expectations increases the challenge to delineate optimal clinical pharmacist ratios.

3.2 | Nonstandardized program performance metrics

Significant efforts have been made to establish clinical pharmacy key performance indicators, though widespread adoption is lagging.[39–42] Different areas of practice, such as ambulatory care, may have discordant targets to achieve. For example, A1C targets are drastically different from time-to-first-dose antibiotic administration, yet both process measures are strongly associated with important clinical outcomes. Moreover, specialty practice areas vary widely (e.g., emergency department pharmacy practice compared with internal medicine pharmacy practice, critical care practice, and so on); each has its own overall patient care metrics, medication therapy focus, sensitivity to pharmacist involvement, and so forth.[43,44] Furthermore, institutions may have goals that are specific to the community they serve, which may not be as applicable in different areas. For example, obesity is more prevalent in West Virginia than in Colorado, so weight-loss clinics may be a higher priority in West Virginia than in California.[45] Often, decisions on how to gauge pharmacist program performance come down to financial drivers and weighing the cost–benefit and cost-avoidance inherent in pharmacy services against the opportunity costs.

3.3 | Variable hospital/practice setting types

Demands on clinical pharmacists' time can vary depending on the educational-affiliation status of the hospital or health system. Teaching institutions may require significant pharmacist education for resident physician training, such as on order entry; conversely, more pharmacy residents may be available for services such as medication reconciliation for transitions of care. Institutions with little or no academic involvement may face fewer incorrect medication orders from learners but slow adoption of new practices by providers, as well as the challenge of contacting providers who are often community-based practitioners rather than the hospital-based teams.

3.4 | Variable patient acuity and complexity

Patients with higher acuity—often using more and/or higher-risk medications—require improved clinical pharmacist ratios for optimal care.[3] For example, a critically ill heart transplant recipient immediately after an operation has significantly greater pharmaceutical care needs than a patient after an elective knee replacement. Similarly, in the outpatient setting, clinical pharmacist support for that heart transplant recipient will be more complex than for the patient with a knee replacement. In addition, social determinants of health such as health literacy can increase patient complexity irrespective of care setting, making what might otherwise be a routine patient care concern one that requires excessively more time to manage appropriately.

3.5 | Competing priorities and other resources

When expectations vary, the time a clinical pharmacist dedicates to each patient varies depending on the practice site and patient acuity and complexity. Clinical pharmacists are often tasked with many different non-patient care duties throughout the day, and these must be considered when determining workload and thus ratios. In addition to patient care responsibilities, many clinical pharmacists are involved in various types of scholarship, teaching, and precepting that often require hours of dedicated time. Students and residents can serve as a great help for clinical pharmacists, but time is also needed to train and educate, evaluate, remediate, and so forth. Pharmacy technicians can serve as a pharmacist extender in many cases by taking on some of the operational duties like performing medication histories. Once again, however, regulations differ from location to location, and time to supervise technicians would need to be accounted for.

3.6 | Industry-wide rates of and variability in addressing burnout

Burnout is estimated to affect up to 66% of clinical pharmacists. Suspected contributing factors to this include incongruent workload and personnel and a lack of recognition or reward for accomplished work.[46] Multiple responsibilities in addition to a clinical pharmacist's primary role can lead to decreased work-life balance and reduced time for personal and professional growth. More research could be conducted to determine whether certain patient ratios reduce or worsen clinical pharmacist burnout, though the value of this research might be limited to confirming curiosity. A 2014 survey reported that 66% of responding pharmacists felt they experienced a high or excessively high workload, with 45% reporting it negatively affected their health.[47] The lack of reward or compensation can take the form of feeling not appropriately compensated for time spent, lack of opportunities for advancement, and lack of support to maintain or advance oneself (e.g., reimbursement or payment for advanced education).[48]

3.7 | Inconsistent means for justifying clinical pharmacist-to-patient ratios

It may be difficult to justify the resources needed for optimal clinical pharmacist ratios. This may depend on what health system administrators value the most among competing priorities and limited resources. Increased pressure or requests from other members of the health care team, cost savings, improvement in patient outcomes and enhanced patient safety, and clinician well-being may be key motivators for administrators to recognize the need for optimal clinical pharmacist ratios. Although some practice models aim to work with existing resources as opposed to using patient outcomes to guide the need for new resources, established clinical pharmacist ratios can contribute to the justification of resource reallocation even in these cases.[49]

3.8 | External endorsements and mandates

External endorsements of and/or mandates for clinical pharmacists as essential members of the health care team currently exist for only a few clinical pharmacy specialties. The essential role of the critical care clinical pharmacist has the support of ACCP, the American Society of Health-System Pharmacists (ASHP), and the Society of Critical Care Medicine. Other endorsements highlight the importance of having a designated clinical pharmacist. Examples of this include having pharmacy expertise leading or co-leading hospital antibiotic stewardship programs by the CDC and clinical pharmacists' involvement in the primary care PCMH by the Patient-Centered Primary Care Collaborative.[50–52] CMS mandates the involvement of pharmacology services as a standard for the transplant team, a role largely composed of clinical pharmacists.[52] The Joint Commission implies the importance of pediatric clinical pharmacists as it highlights sentinel events resulting from pediatric medication errors.[53] The improvement in public health through vaccination and testing efforts was provided and driven by pharmacists, especially during the COVID-19 pandemic. The lack of consistent external endorsement across all practice settings and specialties makes it difficult to establish required clinical pharmacist–to-patient ratios.

4 | PHARMACY SPECIALTY-SPECIFIC COMMENTARY

Because of the vastly different drivers and pressures in each area of patient care, additional, targeted investigations are required to identify the "right" number of clinical pharmacists in each. Table 2 serves as a global summary of the many areas of pharmacy practice and identified ratios suggested by the literature, the corresponding level of evidence, and additional commentary from the committee. The following section provides supplemental considerations where applicable.

TABLE 2 Summary of evidence for specific ratios in different areas of clinical pharmacy practice.

Role	Evidence summary	Recommended ratio[a]	Strength of recommendation[b]	Level of evidence[b]
Ambulatory care	1.0 FTE to 3600–5000 patients	1.0 FTE to 3600 patients	Weak	Low
Antimicrobial stewardship	2–3 FTEs per 1000 beds	3.0 FTEs per 1000 hospital beds	Weak	Low
Cardiology, noncritical	No specific ratio(s) identified	1.0 FTE to 30 beds	Weak	N/A
Cardiology, critical	No specific ratio(s) identified	1.0 FTE to 12 beds	Weak	N/A
Community pharmacy	No specific ratio(s) identified	None	Weak	Very low
Critical care	1.0 FTE to 8–30 beds	1.0 FTE to 12 beds	Weak	Moderate
Emergency medicine	No specific ratio(s) identified	None	Weak	N/A
Geriatrics/long-term care	No specific ratio(s) identified	None	Weak	N/A
Medicine, inpatient	1.0 FTE to 30–48 beds	1.0 FTE to 30 beds	Weak	Low
Mental health, inpatient	No specific ratio(s) identified	1.0 FTE to 30 beds	Weak	Very low
Oncology, inpatient	No specific ratio(s) identified	1.0 FTE to 30 beds	Weak	Very low
Pediatrics	No specific ratio(s) identified	1.0 FTE to 20 beds	Weak	Low
Surgery, inpatient	1.0 FTE to 30–48 beds	1.0 FTE to 30 beds	Weak	Low
Transplant, inpatient	No specific ratio(s) identified	None	Weak	CMS mandates pharmacology services on transplant team

Abbreviation: N/A, not applicable.
[a]All recommended ratios depend on patient acuity and the many factors outlined above.
[b]1.0 FTE = 40 hr/wk.

4.1 | Acute care

In a 2019 survey of 141 acute care pharmacy departments, data were collected on pharmacy practice models, pharmacist resource allocation, training of pharmacy residents, postgraduate training, and board certification.[54] This information was then pooled with clinical metric performance data to identify top-performing pharmacy departments. Metrics for performance included response time for high-priority interventions, completed interventions, intravenous-to-oral conversions, warfarin dosing and monitoring, gastric acid–reducing agent days of therapy, antimicrobial de-escalation, vancomycin dosing and monitoring, and fluoroquinolone use in the treatment of UTIs. Analysis was done on the subset of high-performing hospitals to determine optimal pharmacist ratios in certain acute care settings on weekdays during the day shift (7:00 a.m. to 3:00 p.m.). The authors found an average medical-surgical pharmacist-to-patient ratio of 1:48, hematology/oncology 1:39, and behavioral health 1:47 in the top-performing hospitals. They also concluded that hospitals were more likely to meet clinical metrics if more than 51% of time was spent on patient care activities. During a rigorous development of an acute care clinical pharmacist productivity model, Simmons et al. focused on more current clinical pharmacist roles compared with older models that included product-based (rather than patient-centric) metrics such as order verification. The final consensus of this workgroup was that 50% of time should be spent rounding or reviewing patient profiles, 25% on order verification, and 25% on transitions of care.[55]

4.2 | Critical care and emergency medicine

Recommendations have proposed staffing ratios ranging from 8 to 30 patients per ICU clinical pharmacist (Table 3). However, these recommendations are based on expert opinion without robust supporting data. A recent survey of 185 critical care clinical pharmacists was conducted to identify their perception of optimal patient ratios.[13] Participants reported slight disagreement that assuming care for more than 30 patients was optimal, whereas 25% ($n = 43$) of all respondents with ratios above this threshold described having actual direct patient care responsibilities at their respective institutions. Incorporation of other personnel, such as pharmacy technicians, into ICU clinical pharmacist workflow may allow for increased patient loads.[61] As previously discussed, patient-specific factors must also be considered.

TABLE 3 Critical care clinical pharmacist staffing ratio recommendations.[56–60]

Organization	No. of patients per ICU pharmacist recommendation
The United Kingdom Clinical Pharmacy Association	10–20
The Hospital of the University of Pennsylvania	8–14
The Joint Faculty of Intensive Care Medicine of Ireland	10–20
The Society of Hospital Pharmacists of Australia Practice Standards	12
Horn 2006[59]	20–30
Allied Health Professionals and Healthcare Scientists	10–20

Results from a large multicenter cohort study showed that increased medication regimen complexity was associated with increased ICU mortality (OR 1.09; 95% CI, 1.08–1.11; $p < 0.01$), and increased patient-to–clinical pharmacist ratios were associated with increased ICU length of stay (β coefficient 0.02; 0.00–0.04; $p = 0.02$).[11] Although there are many similarities, ICU clinical pharmacists' roles and responsibilities still vary across sites. A multiorganizational position paper outlines recommendations for critical care clinical pharmacist activities and categorizes them as "foundational" or "desirable" roles depending on the acuity level of the ICU.[8] In most ICUs, the ICU clinical pharmacist–to-patient ratio is defined according to patient acuity and complexity in addition to the scope of clinical and operational services provided.

4.3 | Pediatrics

Pediatric patients pose unique challenges, given that their ever-changing pharmacokinetics and pharmacodynamics necessitate individualized dosing of a different complexity from adult patients. This increased level of complexity has been shown in the literature. For example, one study found that medication adverse drug events were 3 times as likely in pediatric patients as in adults.[62] This might be attributed to the need for dosing calculations and the reduced ability of pediatric patients to report adverse drug events and adverse effects. Dosing and monitoring information for pediatric patients is often lacking in approved product monographs, resulting in the need to conduct literature searches and develop innovative dosing regimens for this population.

The literature advocating for clear pediatric clinical pharmacist staffing ratios for patient load is lacking, and extrapolation from other fields of pharmacy practice may provide an incomplete picture.[63–66] Because of the aforementioned need for more frequent literature searches, safety double- and triple-checks, and patient-specific dosing calculations, ratios adapted from, for example, internal medicine pharmacy practice, may underestimate the workload of a pediatric clinical pharmacist.

TABLE 4 Antimicrobial stewardship pharmacist staffing level recommendations in other countries.[67–74]

Country	Pharmacist staffing standard
Australia	0.3 FTEs per 100 acute-care beds
Canada	3.0 FTEs per 1000 acute-care beds
Austria and Germany	2.0 FTEs (at least one physician and one pharmacist) per 1000 acute-care beds
France	2.5 FTEs per 1000 acute-care beds

4.4 | Antimicrobial stewardship

One-half of hospitalized patients receive at least one antimicrobial medication during their admission, and around 50% of that use may be inappropriate.[67–70] In 2014, the CDC established seven core elements of antibiotic stewardship programs (ASPs) for hospitals.[70] According to the report, pharmacists are deemed essential to the hospital-specific program as leader or co-leader. Almost 95% of U.S. hospitals in 2021 met these CDC core elements.[71] Despite the ubiquity of inpatient ASPs, in part from the CDC initiative and requirements from the Joint Commission in 2017 and CMS in 2019, there are relatively few publications on ideal pharmacist ratios. In 2016, the Infectious Diseases Society of America/Society for Healthcare Epidemiology of America/Pediatric Infectious Diseases Society physician task force determined resources for initiating and sustaining ASPs.[72] The report included 244 survey responses from 43 states; responding hospitals reported ASPs were present for a median of 5 years (interquartile range [IQR] 1–10 years). Recommended benchmarks for the number of pharmacist FTEs dedicated to ASP per bed numbers ranged from 1 per 100–300 beds to 3 per more than 1000 beds. Remarkably, each 0.50-increase in combined physician and pharmacist FTEs resulted in a 1.48-fold increase in program efficacy.

A VHA publication found a median ASP FTEs of 1.1 (IQR 1.0–1.47) per 100 occupied beds in 12 facilities surveyed in 2014.[73] This contributed to the 2019 VHA Directive 1031 and National Antimicrobial Stewardship Task Force recommendations for ASP pharmacist FTEs on the basis of facility complexity levels (level 1 is the most complex and level 3 is the least complex). Specific minimum staffing levels may be set using a specific VHA calculator with individual medical facility criteria, ranging from 1.5–4 FTEs for the highest level of facility complexity to 0.25–0.5 FTEs for the least complex facilities.

Established standards outside the United States have been determined in developed countries. A European Society of Clinical Microbiology and Infectious Diseases Study Group for Antimicrobial Stewardship survey from 26 countries identified national staffing recommendations, which are listed in Table 4.[74]

4.5 | Ambulatory care

In the ambulatory care setting, previous literature evaluating clinical pharmacist ratios focused on clinical pharmacist FTEs in relation to provider panel sizes. Recommendations have varied from 0.5 to 1.0 FTE per a full-time provider panel size of 5000 patients.[16–21] However, estimating clinical pharmacist FTEs from provider panel size is challenging without considering the patient population and clinical pharmacist's direct patient care and non-direct patient care responsibilities. Clinical pharmacist panel sizes need to be adjusted to account for the medical complexity of the patient population because of medication management needs, challenges encountered with social determinants of health, scope and intensity of ambulatory pharmacy services provided, and other activities factoring into pharmacist workload (i.e., administrative, scholarship, and teaching duties).[18,20,75,76]

Patient panel size for a pharmacy service in the ambulatory care setting may initially be estimated using population health or hospital discharge statistics identifying patients who would benefit from clinical pharmacist–led services (e.g., those targeted at reducing heart failure readmissions or improving quality measures). As previously mentioned, the VHA model offers a strategy for making this estimation.[20,77] Additional factors are summarized in Table 1, and adjustments can be made to accommodate for service growth and integration of pharmacy extenders.[78] Another study used scheduling capacity to help determine appropriate panel size; however, evidence for this approach may have been affected by variation in patient turnover across study sites.[21] The use of pharmacy extenders, such as pharmacy technicians and trainees, may help increase access to patient care and expand patient panel size for clinical pharmacists providing direct patient care services in the ambulatory care setting.[79–83]

4.6 | Community-based

There are few formalized data on outpatient/community pharmacy clinical workloads within the United States. The data that do exist do not account for the impact of interruptions such as receiving and making telephone calls, providing patient counseling, managing patient insurance coverage issues, administering vaccines, or communicating with providers, nor do they account for the subjective workload from the perception of organization-, job-, and task-related demands.[15,83]

According to the 2019 National Pharmacist Workforce Survey, over 80% of responders in chain, mass merchandiser, and supermarket practice settings reported that workload demands had increased or greatly increased compared with the previous year, and 82%–91% rated their workload level as "high" or "excessively high." According to this survey, pharmacists in community pharmacy settings devoted 64%–75% of their time to patient care services associated with medication dispensing (administering medication products, providing patient counseling on prescription and OTC products, and interacting with other professionals during the medication dispensing process).[84] Dispensing of medications is only a fragment of the community pharmacist's workload. The breadth of provided services continues expanding to include medication therapy management services, medication synchronization, CMM, medication reconciliation, opioid de-prescribing, and point-of-care testing. All considered, prescription volume may not be the best estimation of a pharmacist's workload in the community setting. Efforts to provide adequate time, sufficient pharmacist and technician staffing, improved workload-to-staff ratios, and reduced pressure to meet metrics may improve community pharmacists' perception of the work environment factors that influence patient safety.[85]

5 | DISCUSSION

Clinical pharmacist ratios can serve as important structural measures to compare process and outcome measures across institutions, in an effort to standardize and create a reliable health care system.[86,87] Clinical pharmacists should share appropriate resource ratios to improve the health care system and help consumers, health care professionals, and policymakers make informed health decisions.[88] Many factors affect the capacity of clinical pharmacists to achieve the patient care and non-patient care responsibilities expected of them. Table 5 shows examples of variables that can alleviate or burden pharmacist responsibilities, thereby modifying the pharmacist ratios either positively or negatively. As clinical pharmacist roles and responsibilities expand, the potential burden on practice will invariably also change and require continuous consideration of additional variables and modification of established ratios. Because of the current lack of medication optimization and underuse of comprehensive clinical pharmacy services across all practice settings, we estimate the need for clinical pharmacists to increase despite the use of advanced technology and pharmacy support personnel.

5.1 | Recommendations

- Efforts to establish clinical pharmacist ratios should continue and expand because decision-making on staffing ratios should be more objective. Ratios should be applied to both establishing new care services and reassessing existing services. When developing clinical pharmacist–to-patient ratios, established, evidence-based ratios should be considered that support quality care from a safety and efficacy standpoint.
- Clinical pharmacist ratios are best compared when accounting for the impact of confounders. For example, when 1.0 FTE clinical pharmacists are assigned to one care area with 20 patients and also have non-clinical responsibilities that account for 25% of their time, that can be proportionally subtracted from 1.0, effectively increasing the patient load from 1:20 to 1:25 if the competing responsibility is removed. Similarly, appropriately educated and trained pharmacy support personnel such as certified and trained technicians and students (i.e., "pharmacist extenders") can improve patient loads.

TABLE 5 Variables affecting pharmacist ratios.

Variable	Example (if applicable)	Comments	General tendency to alleviate or burden the clinical pharmacist[a,b]
Pharmacy learners (students and residents)		Depending on where in their learning journey, they may increase or decrease workload. Typical progressions to consider: beginning, middle, or end of rotation; EPPE, IPPE, APPE, residents	↑ or ↓
Medication profile generation features	• Computerized physician order entry • Technician order entry • Auto-verification (e.g., acetaminophen)	• Many emerging technologies do not necessarily decrease workload; rather, they introduce additional safety checks • Auto-verification may decrease workload	No effect, maybe ↑ with auto-verification
Patient triage and surveillance	• Surveillance programming • Customizable reports • Automated reporting		↑
Access to providers	• Call or paging and waiting for callback • On-site providers available for questions or clarification		↑ or ↓
Time to develop and pass	• Pharmacist-led protocols	Can make more effective use of time	↑ or ↓
More acute Patient with more specialized conditions (e.g., burn, pediatrics)	• Patient acuity	• General medical-surgical • Stable chronically ill	↓

Abbreviations: APPE, advanced pharmacy practice experience; EPPE, early pharmacy practice experience; IPPE, introductory pharmacy practice experience.

[a]Alleviates (↑): permits a higher pharmacist-to-patient ratio when present.

[b]Burdens (↓): Requires a lower pharmacist-to-patient ratio when present.

- Clinical pharmacist ratios should be banded to discrete—as opposed to continuous—integers to improve communication, both internal and external. Streamlined ratios for specialty areas might include examples such as 1:12 for critical care, 1:30 for medical areas, 1:20 for pediatrics, and so on. Although very specific ratios for each specialty practice may be elicited through ongoing research, the usefulness of such precision and accuracy could be lost in the extensive noise created by the many confounders outlined earlier and in Table 5.
- Clinical practice models should include resources for daily service, with back-up and relief to preserve the ratio indefinitely (i.e., clinical pharmacist ratios should be preserved to offer reliable patient care 365 days per year). As clinical pharmacy services have shifted from beneficial to essential, continuous daily patient care services have become essential. As such, patients who are admitted during pharmacist vacation or sick leave should not receive lesser care than those admitted while the pharmacist is on duty.
- For acute care services, clinical pharmacist-to-bed ratios—compared with clinical pharmacist-to-patient ratios—are less subject to fluctuations in system capacity and are therefore more easily standardized.
- For ambulatory services, clinical pharmacist–to-patient ratios according to panel size are more practical and feasible for standardization.
- Key stakeholder national (e.g., the ACCP, the ASHP, American Pharmacists Association) and international pharmacy organizations should endorse pharmacist ratios as a priority charge.
- Professional advocacy should be carried out to achieve recognition from governmental agencies and health system leadership, much like for the nursing field in California and Massachusetts. Messaging should indicate that there are ideal pharmacist numbers for optimal patient outcomes and safety that should be targeted in all health care settings.
- Other health care providers and practitioner organizations should offer support by advocating for reasonable and responsible clinical pharmacist ratios to support the health care system.
- Key performance indicators/metrics, such as those for acute care, should be broadly adopted across the profession to measure and confirm the value of adequate resource allocation and be further refined (e.g., targeted to the specific areas of practice).

5.2 | Future considerations

Moving forward, identifying a unifying clinical pharmacist–to-patient or pharmacist-to-bed ratio will continue to be challenging. Although there are core expectations among all pharmacy practice areas, the degree of expertise and specialization in each area varies widely. Recommendations may change for specific ratios as practice shifts. As the scope of practice shifts away from targeted disease state management and more toward CMM services in the ambulatory care setting, this may incentivize different practice models that require vastly different pharmacist ratios than current models. Although the CMM example is specific to the ambulatory care setting, this is an example for any service that may become incentivized (e.g., financially beneficial) in any care setting. The purpose of this task force was to identify an ideal ratio and factors that modify this ratio. Although some areas of practice such as critical care pharmacy have more robust evidence for specific ratios, others such as pediatrics are far less clear. To establish a more consistent ratio in multiple settings, pharmacy advocacy is needed to target this as a key goal, both nationally and locally.

ACKNOWLEDGMENTS

The authors thank Kathy Pham, Pharm.D. for guidance with this manuscript.

FUNDING INFORMATION

There was no external funding for this work.

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

ORCID

Jay L. Martello https://orcid.org/0000-0001-9564-4818
Zack Dumont https://orcid.org/0000-0001-5296-2488
Mitchell S. Buckley https://orcid.org/0000-0002-3385-8105
Christopher T. Buckley https://orcid.org/0000-0003-2398-2273
Nicolette Centanni https://orcid.org/0000-0003-1946-2849
Elizabeth A. Chester https://orcid.org/0009-0007-8255-8436
Jeffrey Gonzales https://orcid.org/0009-0004-5573-8157
Gina Harper https://orcid.org/0009-0008-5416-9879
Miranda Howland https://orcid.org/0000-0001-7838-548X
David Gutenschwager https://orcid.org/0000-0003-1724-4987
Rachel Meyers https://orcid.org/0009-0009-2343-282X
Russel J. Roberts https://orcid.org/0000-0003-1436-0368
Ashley R. Selby https://orcid.org/0000-0001-8528-7589
Emily Shin https://orcid.org/0000-0003-0943-7375
Kristen Szempruch https://orcid.org/0000-0001-7649-4404
Elizabeth Van Dril https://orcid.org/0000-0002-6138-1113
Sharon Wu https://orcid.org/0000-0002-8391-7249

REFERENCES

1. American College of Clinical Pharmacy. The definition of clinical pharmacy. *Pharmacotherapy*. 2008;28(6):816–817.
2. Saseen JJ, Ripley TL, Bondi D, Burke JM, Cohen LJ, McBane S, et al. ACCP clinical pharmacist competencies. *Pharmacotherapy*. 2017;37(5):630–636.
3. Bond CA, Raehl CL, Pitterle ME, Franke T. Health care professional staffing, hospital characteristics, and hospital mortality rates. *Pharmacotherapy*. 1999;19(2):130–138.
4. Bond CA, Raehl CL, Franke T. Interrelationships among mortality rates, drug costs, total cost of care, and length of stay in United States hospitals: summary and recommendations for clinical pharmacy services and staffing. *Pharmacotherapy*. 2001;21(2):129–141.
5. Rech MA, Gurnani PK, Peppard WJ, Smetana KS, Van Berkel MA, Hammond DA, et al. PHarmacist avoidance or reductions in medical costs in CRITically ill adults: PHARM-CRIT study. *Crit Care Explor*. 2021;3(12):e0594.
6. Rech MA, Adams W, Smetana KS, Gurnani PK, Van Berkel Patel MA, Peppard WJ, et al. PHarmacist avoidance or reductions in medical costs in patients presenting the EMergency department: PHARM-EM study. *Crit Care Explor*. 2021;3(4):e0406.
7. Chant C. How critical are critical care pharmacists? *Can J Hosp Pharm*. 2012;65(1):5–6.
8. Lat I, Paciullo C, Daley MJ, MacLaren R, Bolesta S, McCann J, et al. Position paper on critical care pharmacy services: 2020 update. *Crit Care Med*. 2020;48(9):e813–e834.
9. SHPA Committee of Specialty Practice in Clinical Pharmacy. SHPA standards of practice for clinical pharmacy. *J Pharm Pract Res*. 2005;35:122–146.
10. Faculty of Intensive Care Medicine, Intensive Care Society. Core standards for intensive care units. 1st ed. 2013 Available from: www.ficm.ac.uk/sites/default/files/Core%20Standards%20for%20ICUs%20Ed.1%20(2013).pdf
11. Sikora A, Ayyala D, Rech MA, Blackwell SB, Campbell J, Caylor MM, et al. Impact of pharmacists to improve patient care in the critically ill: a large multicenter analysis using meaningful metrics with the medication regimen complexity-ICU (MRC-ICU) score. *Crit Care Med*. 2022;50(9):1318–1328.
12. Anderegg SV, Wilkinson ST, Couldry RJ, Grauer DW, Howser E. Effects of a hospital-wide pharmacy practice model change on readmission and return to emergency department rates. *Am J Health-Syst Pharm*. 2014;71(17):1469–1479.
13. Newsome AS, Smith SE, Jones TW, Taylor A, Van Berkel MA, Rabinovich M. A survey of critical care pharmacists to patient ratios and practice characteristics in intensive care units. *J Am Coll Clin Pharm*. 2020;3(1):68–74.
14. Bond CA, Raehl CL. Clinical pharmacy services, pharmacy staffing, and hospital mortality rates. *Pharmacotherapy*. 2007;27(4):481–493.
15. Malone DC, Abarca J, Skrepnek GH, Murphy JE, Armstrong EP, Grizzle AJ, et al. Pharmacist workload and pharmacy characteristics associated with the dispensing of potentially clinically important drug-drug interactions. *Med Care*. 2007;45(5):456–462.
16. Patel MS, Arron MJ, Sinsky TA, Green EH, Baker DW, Bowen JL, et al. Estimating the staffing infrastructure for a patient-centered medical home. *Am J Manag Care*. 2013;19(6):509–516.
17. Goroll A, Bagley B, Harbrecht M, Kirschner N, Kenkeremath N. Payment reform to support high-performing practice: report of the payment reform task force. *Patient-Centered Primary Care Collaborative*. 2010:1–28. Available from: https://www.pcpcc.org/sites/default/files/media/paymentreformpub.pdf
18. Meyers D, LeRoy L, Bailit M, Schaefer J, Wagner E, Zhan C. Workforce configurations to provide high-quality, comprehensive primary care: a mixed-method exploration of staffing for four types of primary care practices. *J Gen Intern Med*. 2018;33(10):1774–1779.
19. McFarland MS, Groppi J, Jorgenson T, Moore T, Ourth H, Searle A, et al. Role of the US veterans health administration clinical pharmacy

specialist provider: shaping the future of comprehensive medication management. *Can J Hosp Pharm*. 2020;73(2):152–158.
20. Smith MA. Primary care teams and pharmacist staffing ratios: is there a magic number? *Ann Pharmacother*. 2018;52(3):290–294.
21. Ozbay N, King BS, Gothard MD, King CA. Assessing appropriate panel size and optimization of quality metrics for ambulatory care pharmacists in the primary care setting. *Am J Health-Syst Pharm*. 2023;80:e23–e28.
22. Kapu AN, McComiskey CA, Buckler L, Derkazarian J, Goda T, Lofgren MA, et al. Advanced practice providers' perceptions of patient workload: results of a multi-institutional survey. *J Nurs Adm*. 2016;46(10):521–529.
23. Ward NS, Howell MD. Intensivist-to-patient ratios in ICUs: is there a number? *Curr Opin Anaesthesiol*. 2015;28(2):172–179.
24. Tu JV, Austin PC, Chan BTB. Relationship between annual volume of patients treated by admitting physician and mortality after acute myocardial infarction. *Jama*. 2001;285(24):3116–3122.
25. Harvey PR, Trudgill NG. The association between physician staff numbers and mortality in English hospitals. *EClinicalMedicine*. 2021;32:1–5.
26. Bhatla A, Ryskina KL. Hospital and ICU patient volume per physician at peak of COVID pandemic: state-level estimates. *Healthcare*. 2020;8(4):100489.
27. Kleinpell R, Ward NS, Kelso LA, Mollenkopf FP Jr, Houghton D. Provider to patient ratios for nurse practitioners and physician assistants in critical care units. *Am J Crit Care*. 2015;24(3):e16–e21.
28. Dugdale DC, Epstein R, Pantilat SZ. Time and the patient-physician relationship. *JGIM*. 1999;14:S34–S40.
29. U.S. Government Publishing Office: electronic code of federal regulations. Condition of participation: nursing services. 42CFR 482.23(b). Available from: https://www.ecfr.gov/current/title-42/chapter-IV/subchapter-G/part-482/subpart-C/section-482.23
30. American Nurses Association. Advocating for safe staffing. Available from: https://www.nursingworld.org/practice-policy/nurse-staffing/nurse-staffing-advocacy/
31. Bartmess M, Myers CR, Thomas SP. Nurse staffing legislation: empirical evidence and policy analysis. *Nurs Forum*. 2021;56:660–675.
32. California Department of Public Health. Changes to the minimum licensed nurse-to-patient ratios effective January 1. 2008 Available from: https://www.cdph.ca.gov/Programs/CHCQ/LCP/Pages/AFL-07-26.aspx
33. Commonwealth of Massachusetts. HPC regulation 958 CMR 8.00 to implement the ICU nurse staffing law. Available from: https://www.mass.gov/service-details/hpc-regulation-958-cmr-800-to-implement-the-icu-nurse-staffing-law
34. Aitken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *Jama*. 2002;288:1987–1993.
35. Driscoll A, Grant MJ, Carroll D, Dalton S, Deaton C, Jones I, et al. The effect of nurse-to-patient ratios on nurse-sensitive patient outcomes in acute specialist units: a systematic review and meta-analysis. *Eur J Cardiovasc Nurs*. 2018;17:6–22.
36. Bae S. Intensive care nurse staffing and nurse outcomes: a systematic review. *Nurs Crit Care*. 2021;26:457–466.
37. Lo E, Rainkie D, Semchuk WM, Dalton S, Deaton C, Jones I, et al. Measurement of clinical pharmacy key performance indicators to focus and improve your hospital pharmacy practice. *Can J Hosp Pharm*. 2016;69(2):149–155.
38. Urick BY, Ferreri SP, Shasky C, Pfeiffenberger T, Trygstad T, Farley JF. Lessons learned from using global outcome measures to assess community pharmacy performance. *J Manag Care Spec Pharm*. 2018;24(12):1278–1283.
39. King PK, Burkhardt C, Rafferty A, Wooster J, Walkerly A, Took R, et al. Quality measures of clinical pharmacy services during transitions of care. *J Am Coll Clin Pharm*. 2021;4(7):883–907.
40. Clements JN, Emmons RP, Anderson SL, Chow M, Coon SA, Irwin AN, et al. Current and future state of quality metrics and performance indicators in comprehensive medication management for ambulatory care pharmacy practice. *J Am Coll Clin Pharm*. 2021;4:390–405.
41. Acquisto NM, Beavers CJ, Bolesta S, Buckley MS, Dobbins KF, Finch CK, et al. Development and application of quality measures of clinical pharmacist services provided in inpatient/acute care settings. *J Am Coll Clin Pharm*. 2021;4(12):1601–1617.
42. Morgan SR, Acquisto NM, Coralic Z, Basalyga V, Campbell M, Kelly JJ, et al. Clinical pharmacy services in the emergency department. *Am J Emerg Med*. 2018;36(10):1727–1732.
43. Schmidt L, Klink C, Iglar A, Sharpe N. Implementation of performance metrics to assess pharmacists' activities in ambulatory care clinics. *Am J Health-Syst Pharm*. 2017;74(1):e76–e82.
44. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion, division of nutrition, physical activity, and obesity. *Adult Obesity Prevalence Maps*. Updated September 21. 2023; Available from: https://www.cdc.gov/obesity/data/prevalence-maps.html
45. Carmichael J, Jassar G, Nguyen PA. Healthcare metrics: where do pharmacists add value? *Am J Health-Syst Pharm*. 2016;73(19):1537–1547.
46. Hagemann TM, Reed BN, Bradley BA, Clements JN, Cohen LJ, Coon SA, et al. Burnout among clinical pharmacists: causes, interventions, and a call to action. *J Am Coll Clin Pharm*. 2020;3(4):832–842.
47. Jones GM, Roe NA, Louden L, Tubbs CR. Factors associated with burnout among US hospital clinical pharmacy practitioners: results of a nationwide pilot survey. *Hosp Pharm*. 2017;52(11):742–751.
48. Gaither CA, Nadkarni A. Interpersonal interactions, job demands and work-related outcomes in pharmacy. *Int J Pharm Pract*. 2012;20(2):80–89.
49. Newsome AS, Murray B, Smith SE, Brothers T, Al-Mamun MA, Chase AM, et al. Optimization of critical care pharmacy clinical services: a gap analysis approach. *Am J Health-Syst Pharm*. 2021;78(22):2077–2085.
50. The core elements of hospital antibiotic stewardship programs. 2019 Available from: https://www.cdc.gov/antibiotic-use/healthcare/pdfs/hospital-core-elements-H.pdf
51. McInnis T, The patient-centered medical home: integrating comprehensive medication management to optimize patient outcomes, resource guide. 2nd ed. 2012 Available from: https://www.pcpcc.org/sites/default/files/media/medmanagement.pdf
52. CMS Manual System Pub. 100–07 state operations provider certification. 2019 Available from: https://www.cms.gov/Regulations-and-Guidance/Guidance/Transmittals/2019Downloads/R187SOMA.pdf
53. The Joint Commission. Sentinel event alert 39: preventing pediatric medication errors. Available from: https://www.jointcommission.org/resources/sentinel-event/sentinel-event-alert-newsletters/sentinel-event-alert-issue-39-preventing-pediatric-medication-errors/#.ZBW5i2cbyJ
54. Burgess L, Fletcher S, Cooper MK, Wiggins E, Horton SS, Kramer JS. Characteristics contributing to a pharmacy services excellence model in a large health system. *HCA Health J Med*. 2021;2:367–378.
55. Simmons A, Vest TA, Cicci J, Clarke M, Morbitzer KA, Valgus JM, et al. Formation and validation of an acute care clinical pharmacist productivity model: part 2. *Am J Health-Syst Pharm*. 2021;78(15):1410–1416.
56. Gibson GA. *Pharmacy practice model transformation from medication focus to patient-centered care*. Philadelphia: University of Pennsylvania Health System; 2013.
57. Joint Faculty of Intensive Care Medicine of Ireland. National standards for adult critical care services 2011. Available from: https://www.anaesthesia.ie/attachments/article/57/JFICMI_Minimum_Standards%20Rev-01.pdf

58. SHPA Committee of Specialty Practice in Critical Care. SHPA standards of practice for critical care pharmacy practice. *J Pharm Pract Res*. 2008;38(1):58–60.
59. Horn E, Jacobi J. The critical care clinical pharmacist: evolution of an essential team member. *Crit Care Med*. 2006;34(3 Suppl):S46–S51.
60. Allied health professionals (AHP) and healthcare scientists (HCS) critical care staffing guidance. *National AHP and HCS critical care advisory group: critical care programme*. London: NHS Modernisation Agency; 2003. p. 6–8.
61. Mabasa VH, Malyuk DL, Tung A, Balen RM, Nicolls TR, Rahiman NL. Using clinical pharmacy support technicians to optimize pharmaceutical care in the intensive care unit. *Can J Hosp Pharm*. 2010;63(1):41–45.
62. Kaushal R, Bates DW, Landrigan C, McKenna KJ, Clapp MD, Federico F, et al. Medication errors and adverse drug events in pediatric inpatients. *Jama*. 2001;285:2114–2120.
63. Ernst KD. Committee on hospital care, American Academy of Pediatrics. Resources recommended for the care of pediatric patients in hospitals. *Pediatrics*. 2020;145(4):e20200204.
64. Mueller BU, Neuspiel DR, Fisher ERS. Council on quality improvement and patient safety, committee on hospital care. Principles of pediatric patient safety: reducing harm due to medical care. *Pediatrics*. 2019;143(2):e20183649.
65. Eiland LS, Benner K, Gumpper KF, Heigham MK, Meyers R, Pham K, et al. ASHP-PPAG guidelines for providing pediatric pharmacy services in hospitals and health systems. *Am J Health-Syst Pharm*. 2018;75(15):1151–1165.
66. The Joint Commission. Sentinel event alert: preventing pediatric medication errors. Available from: https://www.jointcommission.org/resources/sentinel-event/sentinel-event-alert-newsletters/sentinel-event-alert-issue-39-preventing-pediatric-medication-errors#.ZBhnnbMK5c
67. Magill SS, Edwards JR, Beldavs ZG, Dumyati G, Janelle SJ, Kainer MA, et al. Prevalence of antimicrobial use in US acute care hospitals, May-September 2011. *Jama*. 2014;312(14):1438–1446.
68. Fridkin S, Baggs J, Fagan R, Magill S, Pollack LA, Malpiedi P, et al. Centers for Disease Control and Prevention. Vital signs: improving antibiotic use among hospitalized patients. *Morb Mortal Wkly Rep*. 2014;63:194–200.
69. Magill SS, O'Leary E, Ray SM, Kainer MA, Evans C, Bamberg WM, et al. Emerging infections program hospital prevalence survey team. Assessment of the appropriateness of antimicrobial use in US hospitals. *JAMA Netw Open*. 2021;4(3):e212007.
70. Core elements of hospital antibiotic stewardship programs. Centers for Disease Control and Prevention. Last reviewed: April 7. 2021 Available from: https://www.cdc.gov/antibiotic-use/core-elements/hospital.html
71. Core elements of antibiotic stewardship. Centers for Disease Control and Prevention. Last reviewed: April 7. 2021 Available from: https://www.cdc.gov/antibiotic-use/core-elements/index.html
72. Doernberg SB, Abbo LM, Burdette SD, Fishman NO, Goodman EL, Kravitz GR, et al. Essential resources and strategies for antibiotic stewardship programs in the acute care setting. *Clin Infect Dis*. 2018;67(8):1168–1174.
73. Echevarria K, Groppi J, Kelly AA, Morreale AP, Neuhauser MM, Roselle GA. Development and application of an objective staffing calculator for antimicrobial stewardship programs in the veterans health administration. *Am J Health-Syst Pharm*. 2017;74(21):1785–1790.
74. Pulcini C, Morel CM, Tacconelli E, Beovic B, de With K, Goossens H, et al. Human resources estimates and funding for antibiotic stewardship teams are urgently needed. *Clin Microbiol Infect*. 2017;23(11):785–787.
75. Steen A, Bovio FJ. Improving clinic utilization and workload capture for clinical pharmacy specialists. *Am J Health-Syst Pharm*. 2020;77(7):552–559.
76. Van Dril E, Schumacher C, Kliethermes MA, Borchert JS, Buros SA. Workload evaluation of clinical pharmacists in the ambulatory care setting. *J Am Coll Clin Pharm*. 2020;3(6):1015–1027.
77. Fernandes O, Gorman SK, Slavik RS, Semchuk WM, Shalansky S, Bussières JF, et al. Development of clinical pharmacy key performance indicators for hospital pharmacists using a modified Delphi approach. *Ann Pharmacother*. 2015;49:656–669.
78. Schumacher C, Van Dril E. Planning and steps to building the ambulatory patient care practice model. In: Kliethermes MA, Brown TR, editors. *Building a successful ambulatory care practice: advancing patient care*. 2nd ed. Bethesda (MD): American Society of Health-System Pharmacists; 2019. p. 41–79.
79. Walker D, Hartkopf KJ, Hager DR. Primary care pharmacy technicians: effect on pharmacist workload and patient access to clinical pharmacy services. *Am J Health-Syst Pharm*. 2020;77(Supplement_4):S93–S99.
80. Evans JL, Gladd EM, Gonzalez AC, Tranam S, Larrabee JM, Lipphardt SE, et al. Establishing a clinical pharmacy technician at a United States Army military treatment facility. *J Am Pharm Assoc (2003)*. 2016;56(5):573-9.e1.
81. Kuhn H, Park A, Kim B, Lukesh W, Rose A. Proportion of work appropriate for pharmacy technicians in anticoagulation clinics. *Am J Health-Syst Pharm*. 2016;73(5):322–327.
82. Ourth HL, Folstad J, Mambourg SE, Hopwood G, Marchiando C, Combs C, et al. Evaluation of the potential impact of pharmacy technician performance of anticoagulation clinic tasks on operational efficiency. *Am J Health-Syst Pharm*. 2019;76(16):1248–1253.
83. Chui MA, Mott DA. Community pharmacists' subjective workload and perceived task performance: a human factors approach. *J Am Pharm Assoc (2003)*. 2012;52(6):e153–e160.
84. American Association of Colleges of Pharmacy. National pharmacist workforce study final report. Available from: https://www.aacp.org/article/national-pharmacist-workforce-studies
85. Francis SG. Pharmacists' perceptions about the effect of work environment factors on patient safety in large-chain retail pharmacies. *J Pharm Technol*. 2022;38(6):376–378.
86. Agency for Healthcare Research and Quality. Types of health care quality measures. Available from: https://www.ahrq.gov/talkingquality/measures/types.html
87. Chassin MR, Loeb JM. High-reliability health care: getting there from here. *Milbank Q*. 2013;91:459–490.
88. Agency for Healthcare Research and Quality. A profile. Available from: https://www.ahrq.gov/cpi/about/profile/index.html

How to cite this article: Martello JL, Dumont Z, Bruck W, et al. Identifying ideal pharmacist-to-patient ratios for the successful provision of clinical pharmacy services. *J Am Coll Clin Pharm*. 2024;1-12. doi:10.1002/jac5.1951