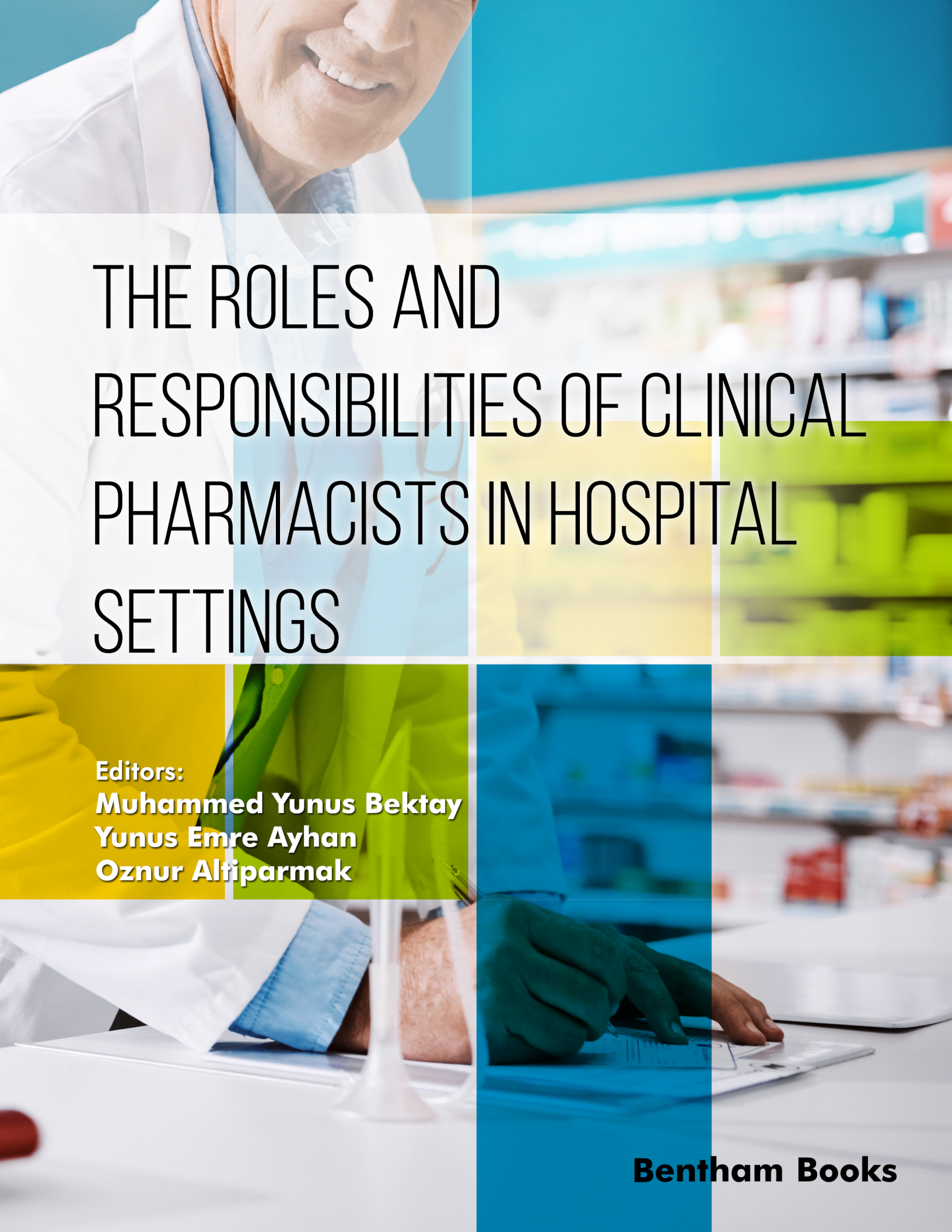




THE ROLES AND RESPONSIBILITIES OF CLINICAL PHARMACISTS IN HOSPITAL SETTINGS

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The Roles and Responsibilities of Clinical Pharmacists in Hospital Settings

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FOREWORD

It is with great pleasure and anticipation that I introduce this comprehensive book on the pivotal roles and definitions of clinical pharmacists in the hospital setting. In the ever-evolving landscape of healthcare, the responsibilities of clinical pharmacists have expanded far beyond traditional roles. They are now essential members of the healthcare team, collaborating with physicians, nurses, and other professionals to optimize medication therapy, monitor patient outcomes, and ensure the highest standards of pharmaceutical care. This book takes a deep dive into these multifaceted responsibilities, shedding light on the nuanced yet pivotal contributions that clinical pharmacists make on a daily basis.

Through meticulous research, insightful analyses, and compelling patient case examples this book offers readers a comprehensive understanding of the diverse hospital services where clinical pharmacists operate. From the demanding and high-stress environment of intensive care units to the compassionate care provided in pediatric services, each chapter delves into the unique challenges and opportunities faced by clinical pharmacists in these settings. Moreover, this book underlines the human aspect of clinical pharmacy. It emphasizes the importance of patient education, medication safety, and the ethical considerations that guide every decision made by clinical pharmacists. By focusing not only on the technical aspects but also on the compassionate and empathetic dimensions of their work, this book truly captures the essence of clinical pharmacy in the hospital setting.

I commend the authors for their dedication to compiling this invaluable resource. It is my sincere hope that this book will serve as an enlightening and inspiring companion for healthcare professionals, students, and anyone interested in the intricate and profoundly meaningful world of clinical pharmacy within the hospital environment.

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PREFACE

Hospitals serve as pivotal institutions within the healthcare sector, dedicated to the treatment, healing, and compassionate care of patients. Among the multifaceted and dynamic components that constitute these healthcare establishments, clinical pharmacists stand out as indispensable healthcare professionals. This book aims to delve into the responsibilities and roles of clinical pharmacists in a hospital setting, highlighting the intricacies and significance of this vital profession.

By examining different hospital services, each with its unique requirements, this book illustrates how clinical pharmacists contribute in various areas. From intensive care units to cardiology departments and internal medicine wards to pediatric services, clinical pharmacists are dedicated to the health and well-being of patients. This book serves as a resource to help us understand the day-to-day tasks, responsibilities, and impacts of clinical pharmacists in these diverse service settings. The roles of clinical pharmacists in hospital wards extend beyond mere medication distribution. They also include medication therapy monitoring, assessment of drug interactions, addressing patients' medication-related questions, and collaboration with the healthcare team. This book provides detailed explanations of each of these responsibilities and underscores the positive influence of clinical pharmacists on patients' healthcare outcomes. Clinical pharmacists not only ensure the safe and effective use of medications in a hospital environment but also contribute to patient satisfaction. By providing education about medication therapies and assisting patients in correctly using their medications, clinical pharmacists empower patients to have a better understanding and management of their treatment processes.

This book is prepared to emphasize the critical role of clinical pharmacists in hospital services. These professionals work with dedication to preserve the health and well-being of patients, and this book aims to help us better appreciate their efforts. We hope that this book will assist in a deeper understanding of the significant contributions of clinical pharmacists in a hospital setting and inspire future practitioners of this profession.

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CHAPTER 1

Introduction to the Role of Clinical Pharmacists in Hospital Settings

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Abstract: Clinical pharmacists (CPs) play a crucial role in hospital settings by providing patient-centered care and improving medication outcomes. CPs use various tools such as medication reviews, medicine reconciliation, patient counseling, and drug monitoring to identify and resolve drug-related problems. CPs are also involved in the implementation of evidence-based guidelines and standards to improve the quality of care and patient outcomes. These competencies required by CP in hospital settings include knowledge of all pharmaceutical sciences. They must also have excellent communication skills, be able to work as part of a multidisciplinary team, and possess the ability to critically evaluate and apply research findings. CPs assess the effectiveness of interventions with quality of life, health-related quality of life, medication adherence, clinical outcome, drug utilization, readmission rate, quality-adjusted life year, cost-effectiveness, hospital length of stay, patient satisfaction, and incidence of adverse drug events. In conclusion, the role of CP in hospital settings is essential for improving patient outcomes and ensuring safe and effective medication use. They play a critical role in the healthcare team by providing pharmaceutical care, utilizing evidence-based practices, and advocating for patients. CPs are well-positioned to make a significant impact on the quality of care and patient outcomes in hospital settings.

Keywords: Adverse drug events, Adherence, Clinical pharmacy, Cognitive pharmacy services, Concordance, Compliance, Drug-related problems, Medication therapy management, Patient-oriented pharmacy practice, Pharmaceutical care, Rationale drug use.

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INTRODUCTION

Definitions and Related Concepts

Clinical pharmacy is a specialized health science that aims to optimize patient care. It is an approach to pharmacy practice that emphasizes the use of evidence-based medicine, patient-centered care and interdisciplinary collaboration. Clinical pharmacists (CPs) work closely with doctors, nurses and other healthcare providers to ensure that patients receive safe and effective drug therapy [1 - 5]. According to the European Society of Clinical Pharmacy, “*Clinical pharmacy aims to optimize the utilization of medicines through practice and research in order to achieve person-centered and public health goals*” [1, 4, 5].

Clinical pharmacy aims to improve the quality of patient care by providing rational drug use. This is achieved through various activities such as reviewing and verifying medication orders, reconciling medication regimens, providing medication education to patients and healthcare professionals, monitoring patients for potential adverse effects or drug interactions, and identifying, preventing, and managing drug-related problems. CPs also play a key role in the development and implementation of medication-related policies and procedures within healthcare organizations [1, 4, 6].

Clinical pharmacy practice can be divided into different areas of focus, such as critical care, geriatric care, oncology, pediatrics, ambulatory care, psychiatry, *etc.* CPs work in a variety of settings, including hospitals, clinics, long-term care facilities, and community pharmacies. They are an integral part of the healthcare team, and their expertise in medication therapy can lead to improved patient outcomes, reduced healthcare costs, and enhanced patient satisfaction [1, 5].

Within the healthcare system, a clinical pharmacist (CP) plays an important role. CP services may improve patient outcomes, reduce costs, and ensure the appropriate and safe use of medications. Through these services and good communication among other healthcare professionals, CPs significantly contribute to the management of diseases [7 - 10].

Pharmaceutical care (PC) is an approach to the practice of pharmacy that focuses on the patient as an individual and emphasizes the provision of personalized, patient-centered care. A holistic approach of PC aims to the use of medication that takes into account the patient's unique needs and circumstances, and it is a patient-centered approach to the use of medication [6, 10]. The main goal of PC is to improve treatment outcomes by optimizing medication use. This is achieved through the provision of personalized care that is tailored to the individual needs of the patient. PC involves the identification, prevention, and management of

drug-related problems, and the provision of medication education and counseling to patients and other healthcare providers. Pharmaceutical care can only be provided by pharmacists who have the knowledge, skills, and required competencies [10].

ROLE OF CLINICAL PHARMACISTS IN HOSPITAL SETTINGS

In a hospital setting, CPs ensure that patients receive safe and effective medication therapy by working closely with healthcare teams. The main activities of CP include reviewing patient charts and medication orders, monitoring drug therapy for potential adverse effects, and making recommendations for adjustments or changes to medication regimens. CPs also work with physicians and nurses to increase knowledge levels by educating patients about their medications. CPs may also participate in daily rounds to provide expertise on drug therapy. In addition, a CP is responsible for managing the hospital's formulary and drug inventory. Conducting scientific research to improve patient outcomes is another important role of CP [11, 12]. CPs should also conduct research to improve patient outcomes and develop new treatment protocols. They may also participate in clinical trials to evaluate the safety and effectiveness of new medications. Besides the above-mentioned roles, many different cognitive services are provided by CPs in hospital settings around the world.

Medication therapy management, or MTM, is a patient-centered service that is based on the philosophy of "Pharmaceutical Care". The MTM approach focuses on optimizing medication use and improving patient outcomes through personalized and proactive management of medication therapy. MTM is led by the idea that pharmacists should be actively involved in the care of patients and should work closely with other healthcare providers to ensure that medications are being used safely, effectively, and cost-efficiently. MTM service aims to improve the quality of care provided to patients by identifying and resolving medication-related issues, promoting better communication among healthcare teams, and providing patient education and counseling [13, 14].

Patient education and counseling are widely accepted tasks of a CP. It is a natural outcome of their responsibility to assist people who use medication by providing advice on how to use and manage those products. CPs work together with physicians and nurses to educate patients about their medications, including how to take the drugs, possible side effects, and what to do in case of an adverse event. Patient counseling is defined as an interaction between a professional and a patient, aimed at helping to inform the patient and having them make appropriate decisions. This is a proactive and individualized exchange of knowledge built on a trusting relationship between the pharmacist and the patient. To provide

counseling, the pharmacist should possess the necessary skills to access those resources and support the client, providing the right information and promoting positive behavior [10, 15].

Clinical rounds and consultations are one of the important roles of clinical pharmacists in hospital settings. CP should take daily clinical rounds together with physicians and other healthcare providers to provide expertise on drug therapy. They may also consult with healthcare providers on specific cases about medication management [16, 17]. In hospital settings, in addition to clinical rounds and consultations, formulary management and drug inventory management are also under the scope of CPs' responsibilities. CPs are responsible for managing the hospitals' formulary [18]. CP may also work with other healthcare providers to evaluate new medications and make recommendations for inclusion in the hospitals' formulary [18].

In summary, CPs are essential healthcare professionals in hospital settings. They are responsible for ensuring that patients receive safe and effective medication therapy, and they work closely with physicians and nurses to provide expert advice and guidance on medication management.

PHARMACEUTICAL CARE PROCESS AND RESOURCES

Clinical practice of pharmaceutical care requires reliable and validated systems to be able to assess patients' conditions. Maintaining clinical responsibilities, a CP uses different approaches to drug-related problems. Drug-related problems (DRPs) are any issues that arise as a result of the use of medications. They can include things like adverse effects, drug interactions, and medication errors. DRPs can occur at any stage of the medication use process, from prescribing and dispensing to administration and monitoring. They can also occur in any healthcare setting, including hospitals, long-term care facilities, and community pharmacies [19].

DRPs can be classified into different categories depending on their cause and effect. Some common classifications of DRPs include adverse drug reactions (ADRs), drug interactions, medication errors, non-compliance, underdosing, overdosing, misadventure, therapeutic failure, and disease-drug interactions [20].

Adverse drug reactions (ADRs) are unintended and undesirable effects of a medication that occur at therapeutic doses. According to Aronson *et al.*, ADR is defined as "*An appreciably harmful or unpleasant reaction resulting from an intervention related to the use of a medicinal product; adverse effects usually predict hazard from future administration and warrant prevention, or specific treatment, or alteration of the dosage regimen, or withdrawal of the product*"

[20]. ADRs can range from mild side effects, such as a rash or headache, to more severe reactions, such as anaphylaxis or organ failure [20 - 22].

Drug-drug interactions occur when two or more medications interact with each other, leading to a change in the effectiveness or toxicity of one or more of the medications. Drug interactions can occur when medications are taken together or when medications are metabolized by the same enzymes in the liver. Medication errors are preventable mistakes that occur during any stage of the medication use process. Medication errors can include things like prescribing the wrong medication, dispensing the wrong dosage, or administering the medication to the wrong patient [20, 22].

Non-compliance is a common behavior of patients, which refers to not following the medication regimen as prescribed. The common examples of non-compliance can be not taking medication as directed or stopping taking medication prematurely. In the presence of non-compliance, underdosing or overdosing can occur. This either leads to treatment failure or increased risk of toxicity. Therapeutic failure is when the medication is not achieving the desired therapeutic effect. Many interactions, either between disease and drug, drug and drug or food and drug, may affect the pharmacokinetics or pharmacodynamics of the medication, leading to adverse effects or lack of efficacy [19, 20].

CPs should identify, prevent, and manage DRPs. CPs should review patients' medication regimens, identify potential DRPs, and make recommendations for adjustments to solve or prevent DRPs, and should help to improve patient outcomes and enhance the quality of healthcare services. CP must educate patients about the medications, including potential adverse effects and what to do if a problem arises [23].

Many scientists have classified DRPs throughout history. The Hepler and Strand classification was developed by Hepler and Strand in 1990. This classification categorizes DRPs based on where they occur in the medication use process. The categories are prescribing, dispensing, administration, and monitoring [6]. The Westerlund classification, developed by Westerlund, categorizes DRPs based on the stage of the medication use process at which they occur and the type of problem. The categories are prescribing errors, dispensing errors, administration errors, drug-disease interactions, drug-drug interactions, and patient-related factors [24].

The Pharmaceutical Care Network Europe (PCNE) classification, developed by the PCNE in the late 1990s, categorizes DRPs based on their cause and effect. The categories are adverse drug reactions, drug interactions, non-compliance, underdosing, and disease-drug interactions [23]. The PCNE classification is a

widely used tool for identifying and classifying DRPs. This classification system is very useful for identifying and characterizing drug-related problems. It helps the CP to understand the cause, the origin of the DRPs, and the effect of the problem, as well as to suggest appropriate interventions to resolve it. For example, if the problem is caused by an adverse drug reaction, the pharmacist may suggest a change in the medication regimen or dosage, or if the problem is caused by non-compliance, the pharmacist may suggest patient education and counseling [23]. Besides the above-mentioned classifications, there are other systems proposed to classify the DRPs. All of these classifications have their strengths and weaknesses, and each provides a different perspective on the nature and causes of DRPs. These classifications are used by CP and other healthcare professionals to identify and classify DRPs so that appropriate interventions can be made to prevent and resolve them [10].

To detect DRPs, a CP should assess the suitability of prescribed drugs and patient characteristics. A thorough examination of all the drugs a patient is taking is typically referred to as a medication review. A consensus has been established by the PCNE working groups, and the definition of medication review agreed upon is *“Medication review is a structured evaluation of a patient’s medicines with the aim of optimizing medicines use and improving health outcomes. This entails detecting drug-related problems and recommending interventions”* [25].

Medication review is an essential part of the clinical pharmacist's role in ensuring that patients receive safe and effective medication therapy [26]. CPs review patient charts and medication orders to identify any potential mistakes and discrepancies such as wrong dose, drug interactions, contraindications, *etc.* CPs should use drug reference resources, such as guidelines, online databases, and textbooks to stay up-to-date on the latest information about medications. The use of clinical decision support systems (CDSS) to identify potential problems and to suggest alternative treatment options is also a popular approach [25 - 27].

Medicine reconciliation is the process of ensuring that a patient's medication regimen is accurate and up-to-date [28 - 30]. Basically, medicine reconciliation is a methodical approach for creating a comprehensive and accurate list of a patient's current medications and comparing it to their medical records or medication orders to prevent errors such as duplications and omissions. It is especially important when a patient is transferred between different healthcare facilities or is discharged from the hospital, which is called transition of care (ToC) in literature [31, 32].

ToC refers to the movement of a patient from one healthcare provider or setting to another, with the goal of ensuring the continuity and quality of their care. These

facilities might be hospitals, primary care providers, specialty care providers, long-term care facilities, or even between different stages of care within the same facility (*e.g.*, from an ICU to a general medical-surgical unit). A coordinated approach is required for an effective ToC that includes communication and collaboration between healthcare providers, the patient and their caregivers in the process. ToC also involves sharing medical information, creating a comprehensive care plan, arranging follow-up appointments, and ensuring that necessary medications, equipment, and support services are in place to support the patient's ongoing care. The ultimate goal is to minimize the risk of medical errors, improve patient outcomes, and promote a smooth and safe transfer of care [31, 32]. CPs play an important role in ToC. They can contribute to the development and implementation of cognitive pharmacy services in daily work routines. Pharmacists must be involved in the transition of care in a variety of healthcare settings, including hospitals, ambulatory care clinics, long-term care facilities, and community pharmacies. CPs' expertise in medication management may bridge the gap between different healthcare providers and ensure continuity of care for patients [33 - 37].

Discharge consultation is a process by which healthcare providers, particularly clinical pharmacists, provide information and education to patients and their caregivers prior to leaving the hospital or other healthcare facility. The consultation should be designed to ensure that patients and their caregivers understand the patient's condition, the medications they are taking, and the recommended post-discharge care plan. The benefits of discharge consultation have been pointed out in the literature in different settings [37 - 39].

CPs work with physicians and nurses to educate patients about their medications, including how to take them, possible side effects, and what to do if a problem arises. They also provide written information and verbal instructions for patients and caregivers, if needed. This helps to ensure that patients have a clear understanding of their medication regimen and how to use the medications safely and effectively, which can improve patient outcomes and reduce the risk of adverse effects [26, 27].

Drug monitoring is the process of monitoring patients for potential adverse effects and making recommendations for adjustments or changes to medication regimens as needed [40]. CPs use medication administration records (MARs) to monitor patients for potential adverse effects and to ensure that medications are being administered correctly [41 - 43]. They also use CDSS to identify potential drug interactions or contraindications and to suggest alternative treatment options. By monitoring patients and their medication regimens, CPs can identify and address

any issues that arise, which can help to prevent adverse effects and improve patient outcomes [42].

Therapeutic drug monitoring (TDM) is a process by which healthcare providers measure the concentration of a drug to determine whether the drug is at an effective level or adjustments are needed to the dose or dosing frequency. TDM is commonly used for drugs with a narrow therapeutic index, meaning that the difference between a safe and toxic dose is small. Pharmacists play an important role in TDM by interpreting drug concentration data and providing recommendations to healthcare providers. Pharmacists can assist in designing and implementing TDM programs, analyzing drug concentration data, and making recommendations for medication dosage adjustments to optimize patient outcomes. In the context of TDM, pharmacists may also be involved in monitoring for potential drug interactions or adverse effects and providing patient education on the importance of medication adherence and monitoring. Overall, the pharmacist's role in TDM is to help ensure that patients are receiving the right medication at the right dose, monitor for potential medication-related problems, and optimize medication therapy to improve patient outcomes [43 - 47].

CPs in hospital settings need reliable and trusted resources to provide PC services. CP uses a variety of tools to manage and monitor medication therapy for patients. Electronic health records (EHRs), MARs, drug reference resources, CDSS, medication order entry systems, medication dispensing systems, formulary management systems, drug inventory management systems, and clinical decision support systems could be the most important resources for CPs to provide patient-oriented services within the hospital settings.

Electronic health records are computer-based systems that store patient information, including medical history, lab results, and medication orders. EHRs allow CP to easily access and review patient information and to communicate with other healthcare providers. EHRs enable CPs to document their interventions and recommendations made to the patient's care team. MARs are documents that provide information about the medications a patient is receiving, including the dose, frequency, and route of administration. CPs use MARs to monitor patients for potential adverse effects and to ensure that medications are being administered correctly. Medication order entry systems are computer-based systems that have been developed for ordering medication electronically. Medication dispensing systems are automated systems that are used to dispense medications. These systems can help to reduce medication errors and improve patient safety by ensuring that the correct medication is dispensed to the correct patient. Formulary management systems are also computer-based systems that contain information about the medications that are approved for use in the hospital. CPs use these

systems to evaluate new medications for inclusion in the formulary. Drug inventory management systems help to ensure that the hospital has an adequate supply of medications on hand and can also track the usage of specific medications. Clinical decision support systems (CDSS) are computer-based systems that provide alerts and recommendations for medication management based on the patient's specific condition and medications. They can help to identify potential drug interactions or contraindications and suggest alternative treatment options. CPs use a variety of drug reference resources/databases and textbooks to stay up-to-date on the latest information about medications and their potential interactions. Some examples of online resources include Micromedex, Epocrates, Lexicomp, clinical guidelines, *etc.* Overall, these tools allow the clinical pharmacist to provide efficient and safe care to patients by helping them to make well-informed decisions, monitoring the patient's medication therapy, and complying with the regulations and best practices.

The role of CPs in hospital settings is essential, and they are responsible for ensuring that patients receive safe and effective medication therapy by reviewing, reconciling, counseling, and monitoring their medication regimens. CPs work closely with physicians and nurses to provide expert advice and guidance on medication management and use various tools and resources to stay up-to-date with the latest information about medications and their potential interactions. They use their knowledge and skills to improve patient outcomes, reduce the risk of adverse effects, and enhance the quality of healthcare services.

In addition to tools used to provide patient-oriented services within the hospital, there are other lists, criteria and guidelines to promote rational drug use. The efficacy and reliability of all these tools have been scientifically proven and updated recently by scientists. Beers criteria [48], STOPP-START criteria [49, 50], TIME-to-STOP/TIME-to-START criteria [51], the EU(7)-PIM list [52], the FORTA (Fit fOR The Aged) List [53], and potentially inappropriate medications in the elderly (the PRISCUS list) [54] are clinical tools that are used to identify potentially inappropriate medications (PIMs) in older adults. These tools are designed to help healthcare professionals evaluate the safety and effectiveness of medications for older patients and to identify medication-related problems that may contribute to adverse events or poor outcomes.

The Beers criteria is a list of medications that have been identified as potentially inappropriate for older adults. The criteria were first developed in 1991 by Dr. Mark Beers and have been updated several times since then. The criteria are based on a review of the literature and expert consensus [48]. The criteria include a list of medications that are contraindicated in older adults, medications that should be

used with caution, and medications that should be avoided in older adults with certain medical conditions [48].

The STOPP-START criteria are a tool for identifying potentially inappropriate prescriptions (PIPs) in older adults. The criteria are divided into two sections: STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tool to Alert to Right Treatment) [49]. STOPP contains a list of criteria to identify PIPs, such as unnecessary drugs, high-risk drugs, and drugs that may interact with other medications. START contains a list of criteria to identify missing drugs, drugs that may be omitted or under-used, such as drugs for hypertension, diabetes, and osteoporosis [49, 50].

Both criteria are intended to be used as a guide for healthcare providers, and they should be used in conjunction with other clinical information to make decisions about medication therapy. The use of these criteria can help to improve the safety and effectiveness of medication therapy for older adults by identifying and addressing medication-related problems, such as adverse drug events, drug interactions, and unnecessary medications. By identifying PIMs, healthcare providers can reduce the risk of adverse events, improve patients' quality of life and reduce healthcare costs [55]. Both Beers and STOPP-START criteria are widely used in clinical practice and are effective in reducing the number of PIMs and improving patient outcomes. However, it is important to note that these criteria are not exhaustive and do not cover all potential drug-related problems. Also, they are not intended to be used as a substitute for professional judgment. Therefore, healthcare providers must use their clinical expertise, along with these criteria, to make decisions about medication therapy for older adults [55].

Another commonly used index is used in drugs affecting the central nervous system. Cholinergic burden indexes are tools used to evaluate the potential for anticholinergic drug interactions in older adults. The use of these drugs in older adults can be particularly problematic as older adults are more susceptible to anticholinergic side effects [56]. There are different cholinergic burden indexes that are commonly used in practice. The anticholinergic cognitive burden (ACB) scale is a 10-point scale that assigns a score to medications based on their potential to cause cognitive impairment. Medications are scored on a scale of 0 to 3, with a score of 3 indicating the highest potential for cognitive impairment. The anticholinergic risk scale (ARS) is a 9-point scale that assigns a score to medications based on their potential to cause anticholinergic side effects. Medications are scored on a scale of 0 to 3, with a score of 3 indicating the highest potential for anticholinergic side effects. The anticholinergic drug scale (ADS) is a 7-point scale that assigns a score to medications based on their potential to cause anticholinergic side effects. Medications are scored on a scale

of 0 to 3, with a score of 3 indicating the highest potential for anticholinergic side effects. It is important to note that these indexes are not always accurate and should be used in conjunction with other clinical information and professional judgment when assessing the risk of anticholinergic drug interactions in older adults [56].

The Naranjo algorithm is a tool used to assess the causality of adverse drug reactions (ADRs). It is designed to help healthcare professionals determine whether an ADR is likely to be caused by a particular medication [57]. The Naranjo algorithm is a 10-question questionnaire that assigns a probability score to the likelihood of a causal relationship between a medication and an ADR. The questions are based on the temporal relationship, dose-response relationship, rechallenge, dechallenge, other possible causes, and specificity of the reaction. The score is then used to classify the ADR as definitely, probably, possibly, probably not, or definitely not caused by the medication in question. The algorithm is simple and easy to use, and it can help make decisions about medication therapy. However, it is important to note that the Naranjo algorithm is not a definitive test for causality and that other factors, such as the patient's medical history and the presence of other medications, should also be considered when assessing the causality of an ADR [57].

COMPETENCIES REQUIRED BY CLINICAL PHARMACISTS WORKING IN HOSPITAL SETTINGS

CPs working in a hospital setting are responsible for ensuring that patients receive safe and effective medication therapy. To perform this role, a CP must possess a range of competencies.

CPs play a critical role in antimicrobial stewardship programs, which are designed to optimize the use of antibiotics and reduce the risk of antimicrobial resistance. The clinical pharmacist's role in antimicrobial stewardship programs is to promote the appropriate use of antibiotics, optimize antimicrobial therapy, and reduce the risk of antimicrobial resistance. CPs are essential team members in antimicrobial stewardship programs and contribute to ensuring the appropriate use of antimicrobial medications. They are involved in prospective audits and interventions, feedback, education, tracking of metrics, implementation of rapid diagnostic testing, and the establishment of policies and protocols related to antimicrobial use and infectious diseases. CPs have a critical role in achieving the objectives of antimicrobial stewardship programs across different settings of care, including inpatient, outpatient, and long-term care sectors. By collaborating with other healthcare providers and leveraging their expertise, pharmacists can improve patient outcomes and public health in diverse care settings [58 - 61]

CPs are also trained to manage the use of anticoagulant medications in patients. Many studies pointed out that CP-provided services related to anticoagulants were beneficial in terms of different aspects [62 - 65]. CPs possess expert knowledge and skills in the pharmacology, clinical use, and monitoring of anticoagulant medications. The primary role of a CP is to ensure that patients receiving anticoagulant therapy are managed safely and effectively and that the medication is used appropriately to prevent or treat thromboembolic disorders. CP should collaborate closely with other healthcare providers to ensure safe and effective use of anticoagulant medications, which includes providing medication management recommendations, communicating with other healthcare providers, and participating in patient care rounds. Additionally, clinical pharmacists participate in quality assurance activities. This may involve developing and implementing protocols and guidelines, conducting medication safety assessments and monitoring for adverse events [62 - 65].

The role of a CP in transplantation is crucial for ensuring optimal medication therapy, minimizing medication-related adverse events, and promoting long-term graft and patient survival [66 - 71]. Pharmacists are an integral part of the interdisciplinary transplant team and play a vital role in medication management and patient care. CPs' role in transplantation is critical for ensuring optimal medication therapy and promoting long-term graft and patient survival.

CPs play a key role in the application of clinical pharmacokinetics to optimize medication therapy and improve patient outcomes. The role of a CP in clinical pharmacokinetics involves the interpretation of pharmacokinetic parameters to ensure safe and effective medication therapy. This includes assessing patient-specific factors, such as age, weight, renal function, and drug interactions, and using this information to individualize medication dosing. Many studies proved that the involvement of CP in clinical pharmacokinetics has favorable outcomes [72 - 78].

Another important role of CPs is promoting optimal nutrition and ensuring the safe and effective use of nutritional supplements in patient care. Nutrition is an essential component of healthcare, and pharmacists can use their expertise to help patients achieve their nutritional goals. It is a crucial duty of a CP to promote optimal nutrition and ensure the safe and effective use of nutritional supplements in patient care, which has been pointed out by many scientists [79 - 81].

In addition to the above-mentioned services, the core competencies that CPs should possess are given in Table 1.

Table 1. Core competencies of clinical pharmacists.

Core Competencies	Definition
Drug information and literature evaluation	CP must have a deep understanding of the medications used in the hospital, including their indications, contraindications, potential interactions, and side effects. They must also be able to interpret and use drug reference resources, such as online databases and textbooks. CP must be able to access, critically evaluate, and apply current drug information to patient care. This includes understanding how to use drug reference resources, such as online databases and textbooks, and how to evaluate the quality and relevance of research studies.
Patient assessment skills	CP must be able to assess patients' medication needs, including reviewing patients' medical history, current medications, and laboratory results. They must also be able to monitor patients for potential adverse effects and make recommendations for adjustments or changes to medication regimens as needed. CP must have the knowledge and skills to evaluate patients' medication regimens, identify potential drug-related problems (DRPs), and make recommendations for adjustments or changes to medication regimens as needed. This includes understanding the pharmacokinetics and pharmacodynamics of drugs and how they are affected by disease state and patient characteristics.
Patient-centered care	CP must be able to provide care that is responsive to individual patient needs and preferences. This includes understanding how to communicate effectively with patients, how to provide patient education, and how to involve patients in decision-making about their medication therapy.
Medication management skills	CP must be able to manage patients' medication therapy, including monitoring medication regimens, identifying potential drug interactions and contraindications, and making recommendations for adjustments or changes to medication regimens as needed.
Communication and collaboration skills	CP must be able to communicate effectively with patients, physicians, nurses, and other healthcare providers. They must also be able to work collaboratively with other healthcare providers to ensure that patients receive safe and effective medication therapy. CP must be able to communicate effectively with patients and other healthcare providers and to work effectively as part of a healthcare team. This includes understanding how to communicate effectively with patients, how to provide patient education, and how to involve patients in decision-making about their medication therapy.
Problem-solving and critical thinking skills	CP must be able to identify and solve problems related to medication therapy, including identifying potential drug interactions and contraindications and making recommendations for adjustments or changes to medication regimens as needed.
Knowledge of regulations and guidelines	CP must know the regulations and guidelines related to medication management in a hospital setting and must be able to comply with them.
Informatics and technology skills	CP must be able to use various tools and technologies, such as electronic health records (EHRs), medication order entry systems, and clinical decision support systems (CDSS), to manage and monitor medication therapy.
Leadership and management skills	CP must have the ability to lead and manage the medication.