Responsibility of Pharmacist towards Public Health

Ansuman Satapathy[1*] and Sandip Prasad Tiwari[1]

[1]Faculty of Pharmacy, Kalinga University, Naya Raipur, C.G., India

***Correspondence**

Ansuman Satapathy

Faculty of Pharmacy,

Kalinga University,

Naya Raipur, C.G., India

Abstract

Pharmacists play a crucial role in the healthcare system by ensuring that patients receive safe and effective medications. They are responsible for dispensing medication, advising patients on drug interactions and side effects, monitoring medication therapies, and collaborating with other healthcare professionals to optimize patient outcomes additionally, pharmacists provide patient education on disease management, medication compliance, and lifestyle modifications. They also serve as drug information experts, conducting drug utilization reviews and providing guidance on appropriate medication selection and dosing. The role of pharmacists is becoming increasingly important as healthcare systems strive to improve patient safety, reduce medication errors, and control healthcare costs. As medication experts, pharmacists are well-positioned to help address these challenges and improve the overall quality of care provided to patients. As a summary we can say that “Physician gives medicine to the patients but life to medicine given by pharmacist”

Keywords: Healthcare system; Effective medications; Medication compliance; Pharmacists; Patient safety

Introduction

Pharmacists play a vital and evolving role in modern healthcare systems, extending far beyond the traditional scope of dispensing medications. In the context of public health, pharmacists serve as accessible healthcare professionals who contribute significantly to disease prevention,health promotion, and patient education. Their position at the frontline of careallows them to influence community health outcomes, especially in underserved and rural areas

Pharmacist's Role in Public Health

With the rapid advancement of technology, the pharmacist's role has expanded to include digital health tools, electronic health records, telepharmacy, and artificial intelligence. These innovations not only improve the efficiency and safety of medication management but also enhance patient engagement and overall healthcare delivery. As healthcare continues to shift toward a more patient-centered and technology-driven model, pharmacists are uniquely positioned to bridge the gap between traditional healthcare practices and innovative digital solutions, playing a key role in improving both individual and public health outcomes. Pharmacists contribute significantly to public health by promoting wellness, preventing disease, and managing chronic conditions. As one of the most accessible healthcare professionals, pharmacists often serve as the first point of contact for patients seeking health advice. They play a crucial role in health education, offering guidance on smoking cessation, proper nutrition, vaccination, and medication adherence. Additionally, pharmacists conduct

community health screenings for conditions like hypertension, diabetes, and high cholesterol—helping to identify health risks early and refer patients to appropriate care. In times of public health emergencies, such as pandemics or natural disasters, pharmacists help manage medication distribution and ensure continuous patient support. By addressing healthcare gaps and promoting preventive care, pharmacists are essential players in improving population health and reducing the burden on the broader healthcare system.

Role of Pharmacist towards Public Health

Definition:

Pharmacists play a critical role in improving public health by ensuring the safe use of medications, promoting healthy lifestyles, preventing diseases, and enhancing healthcare accessibility. They act as healthcare providers who educate, guide, and support individuals and communities to achieve better health outcomes.

Key Points:

- **Medication Management:** Ensure proper dispensing, counselling, and monitoring of drug therapies.
- **Health Education:** Provide advice on disease prevention, healthy habits, and medication adherence.
- **Immunization Services:** Administer vaccines and promote vaccination programs.
- **Chronic Disease Management:** Support patients with conditions such as diabetes, hypertension, and asthma through counselling and monitoring.
- **Health Screenings:** Conduct screenings for blood pressure, cholesterol, blood glucose, etc.
- **Emergency Preparedness:** Contribute during public health crises such as pandemics or natural disasters.
- **Reducing Medication Errors:** Prevent adverse drug reactions and ensure patient safety.
- **Accessible Healthcare Provider:** Serve as a first point of contact for many community members

Technology Definition (in Pharmacy & Public Health)

Definition:

Technology in the context of pharmacy and public health refers to the application of digital tools, systems, and innovations to improve healthcare services, medication safety, disease prevention, and patient engagement.

Key Points:

- **Electronic Health Records (EHRs):** Maintain and access patient data for better decision-making.
- **Telepharmacy:** Provide pharmaceutical care and counseling remotely.
- **Mobile Health (mHealth) Apps:** Support patient self-care and medication reminders.
- **Automated Dispensing Systems:** Improve accuracy and efficiency in medication distribution.
- **Data Analytics:** Track medication usage, patient outcomes, and identify public health trends.
- **Artificial Intelligence (AI):** Assist in drug discovery, patient monitoring, and personalized therapy.
- **Barcoding and RFID:** Enhance drug safety and inventory management.
- **E-prescriptions:** Reduce errors and streamline prescription processes.

In 1981, the role of the pharmacist in public health is defined by the American Public Health Association (APHA). This association outlined that the role of the pharmacist is now escalating beyond the dispensation and distribution of medicines, and health supplies. Today, the administrative, and public health functions are also included in the services of pharmacists. Now, it becomes more patient-oriented. A pharmacist can provide many services to public health that may include pharmacotherapy, provide care, and prevention measures. A pharmacist has an available resource for health and medication information apart from dispensing medicine. Due to valuable placement of pharmacists in the clinical community, the integration of public health custom into pharmaceutical care, and pharmacological training is indispensable.

The public health services that an individual pharmacist performs will depend on the abilities, experience, training, and work methodology. APHA believes that all pharmacists can contribute to the promotion of public health by working alone or in cooperation with health care colleagues and administrators. The following are the other activities where pharmacists can play an important role to promote public health:

1. Population-based Care:

The Center for Advancement in Pharmaceutical Education (CAPE) Educational Outcomes suggested that pharmacists should involve in both patient-based and population-based care. In the past twenty years, the health-system pharmacists can support public health efforts using designing and providing disease management programs. The health-system pharmacists with their health care colleagues can contribute to population health care using tools such as medication-use evaluation, evidence-based disease management programs that are planned according to the needs of the served institutions and communities. Health-system pharmacists can involve in quality reviews by which they assure that evidence-based treatments are used for all patients to help assuage population health care.

2. Prevention of Disease and Medication Safety:

A pharmacist can be indulged in the prevention and control of disease in a many ways. They can help in the establishment of some screening programs to check out the status of immunization, and identification of some undiagnosed medical conditions.

The federal government's Healthy People 2010 initiative is also outlined the role of health-system pharmacists in medication safety and error prevention. These practices can reduce the number of hospital admissions due to reasons for drug therapy mismanagement and counterfeit

medications. Medication reconciliation programs are one of the vital tools with which pharmacists can achieve these goals.

3. Health Education:

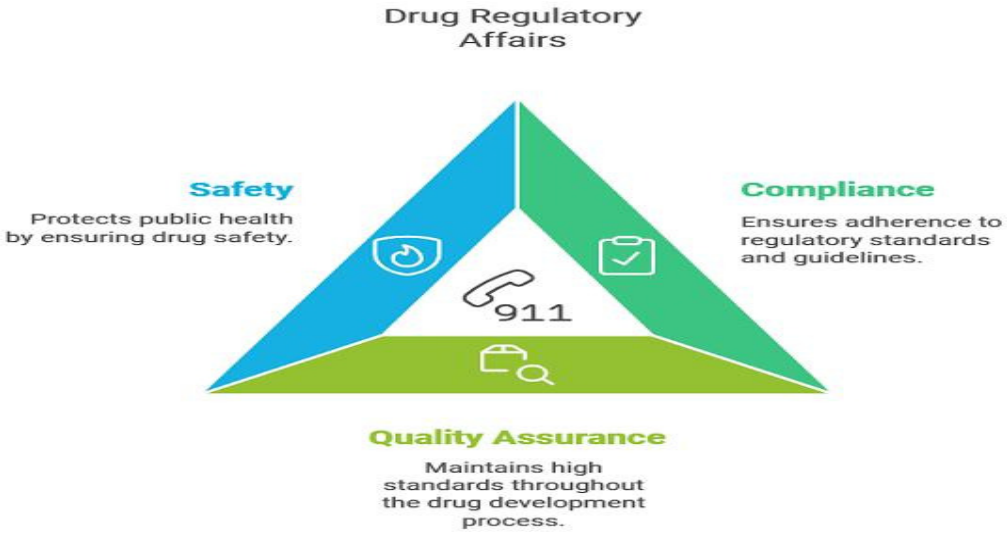
The development of programs on the safe and effective use of medication, and other public health-related topics, such as exercise, healthy nutrition and tobacco cessation, is also an important area where pharmacists play their role. The education and training programs are beneficial for public health care if they start on at an early age, such as school health programs, which help in the development of good health behaviors in children that can continue into adulthood also. Pharmacists should support these types of school health programs. Furthermore, health-system pharmacists can educate their health care colleagues about the safe and effective use of medication that further improves use of medications. The pharmacists can also educate community leaders like public office holders, legislators, school officials, regulators, and religious leaders who involve in public health customs.

4. Public Health Policy:

Health-system pharmacists can participate in the development of public health policy concerned with local boards of health as well as national programs. Drugs are the central part of health systems. Hence, the health policy, especially policy targeted for chronic disease, must be prepared with better consideration of drug therapy as well as factors affecting the disease outcomes. The role of Health-system pharmacists in emergency planning and service delivery of specialized pharmaceuticals like antidotes, vaccines, and antibiotics is critical. APHA also outlined the role of health system pharmacists as assistant in procuring, distributing and dispensing emergency supplies of pharmaceuticals, medications and immunization products and managing the drug therapy of individual victims with National Disaster Medical System assistance teams, the National Pharmacy Response Team or local units of the Medical Reserve Corps. Pharmacists, as medication-use experts, should also work in the assistance of health-system administrators to develop policies for the best management practices in the proper handling and disposal of hazardous drugs.

5. Research and Training:

A health-system pharmacist must get adequate education and training to carry out his responsibility in public health. Health-system pharmacists should be expertise in pharmacoepidemiology, research methodology, and biostatistics with their applications in decision related to public health. He should have an understanding of the design, conduct, and interpretation of clinical studies. Health-system pharmacists should participate in collaborative research and serve on data monitoring and safety committees, institutional review boards, and expert medication advisory committees. Moreover, the research fellows need exposure to research in public health policy, pharmacoeconomics, pharmacoepidemiology, and evidence-based medicine for experimental and instructive training. Health-system pharmacists should



also work in collaboration with public health policymakers, governmental agencies, medical centers, and academic institutions to promote optimal pharmacotherapy.

The Scope of Pharmacy and the Functions of Pharmacists

With the development of specific and potent synthetic drugs, the emphasis of the pharmacist's responsibility has moved substantially towards the utilization of scientific knowledge in the proper use of modern medicines and the protection of the public against dangers that are inherent in their use Pharmacists are employed in regulatory control and drug management, community pharmacy, hospital pharmacy, the pharmaceutical industry, academic activities, training of other health workers, and research. In all these fields, their aim is to ensure optimum drug therapy, both by contributing to the preparation, supply and control of medicines and associated products, and by providing information and advice to those who prescribe or use pharmaceutical products.

1. ***Regulatory control and drug management***

Health and drug policy:

Each ministry of health has a section dealing with pharmaceutical affairs. In view of the importance of drugs in government health services, and of the related expertise within the pharmaceutical section, it is important that the pharmaceutical affairs section should have equal prominence with other sections of the ministry. Pharmacists in administration participate in formulating health and drug policies, particularly those on the selection, procurement and distribution of drugs. They serve as sources of information for health care professionals and the public, and participate in the preparation of pharmacopoeias and other official documents. They co-operate with educators and the professional body of pharmacists in establishing and modifying the curricula of schools of pharmacy and continuing education programmes. In some

countries, pharmacists have roles in environmental health control and in control of the quality of food and of cosmetics and medical devices. Pharmacists do not perform these functions in all countries. A prerequisite to their widespread adoption is the involvement of pharmacists with the appropriate expertise in the determination and implementation of national health policy, which provides the context for policies related to drugs and pharmacy. In view of the special knowledge and expertise of pharmacists, they should be given the responsibility at a senior level for the determination and implementation of policy on drugs and pharmacy man-power and for the drafting and administration of legislation. Pharmacists in such senior positions should preferably have postgraduate training and a qualification in public health. In some countries, potent medicines and related products may be supplied or dispensed by non-pharmacists and without the supervision or control of pharmacists. For the safety of the public, such transactions should be per-formed or supervised by pharmacists, to ensure the supply of correct medicines of acceptable quality. In some countries the management of drug procurement and supply, and drug control, registration and enforcement, do not meet satisfactory standards. To achieve acceptable standards, pharmacists with suitable post-graduate training should be appointed to senior positions, and standards should be assured by comprehensive pharmaceutical legislation and its effective enforcement.

Management

Government-employed pharmacists are responsible for drug management, which includes the selection of essential drugs, the determination of drug requirements, the procurement and distribution of drugs and their rational use, as well as the design and use of information systems. Also, they collect and collate data required by their national government agencies and by international bodies, such as the International Narcotics Control Board.

Administration

In some countries, tenders for the import and supply of drugs are awarded to non-pharmaceutical businesses. The management of such businesses is not capable of applying professional standards and is influenced solely by commercial considerations. Procedures for inviting, accepting and award-ing tenders for the supply of pharmaceuticals should be separate from those for non-professional commercial tenders, and should be managed by pharmacists.

Educational policy

Pharmacists cooperate with educators in establishing and implementing policies with regard to undergraduate and continuing education, in-service training, and other aspects of manpower development.

Regulatory and enforcement agencies

Pharmacists are employed by regulatory agencies concerned with the approval, registration and quality control of drugs, cosmetics and medical devices, and with enforcement agencies,

including customs departments, that control the distribution of drugs through licit and illicit channels, and as inspectors of the manufacture, importation, distribution and sale of drugs.

Professional registration authorities

Pharmacists are prominently engaged in agencies, such as boards of pharmacy, that establish criteria for the registration of pharmacists or licensing requirements, register pharmacies and pharmacists, and monitor the way pharmacies are operated and the professional conduct of pharmacists.

International agencies and professional bodies Pharmacists employed in these bodies perform a variety of technical and administrative functions in professional bodies and in drug and health-related agencies, e.g., the World Health Organization, the International Narcotics Control Board, the United Nations Division of Narcotic Drugs, the United Nations Commission on Narcotic Drugs, the United Nations Fund for Drug Abuse Control, Interpol, national pharmacopoeia committees, and pharmaceutical societies.

Community pharmacy: Community pharmacists are the health professionals most accessible to the public. They supply medicines in accordance with a prescription or, when legally permitted, sell them without a prescription. In addition to ensuring an accurate supply of appropriate products, their professional activities also cover counselling of patients at the time of dispensing of prescription and non-prescription drugs, drug information to health professionals, patients and the general public, and participation in health-promotion programmes. They maintain links with other health professionals in primary health care.

Today, an increasingly wide range of new and analogous products are used in medicine, including high-technology biological products and radio-pharmaceuticals. There is also the heterogeneous group of medical devices, Which includes some products analogous to medicines, some of which demand special knowledge with regard to their uses and risks (e.g., dressings, wound management products, etc.).Pharmacists have progressively undertaken the additional task of ensuring the quality of the products they supply.

The main activities of community pharmacists are described below.

Processing of prescriptions

The pharmacist verifies the legality, safety and appropriateness of the prescription order, checks the patient medication record before dispensing the prescription (when such records are kept in the pharmacy), ensures that the quantities of medication are dispensed accurately, and decides whether the medication should be handed to the patient, with appropriate counsel-ling, by a pharmacist. In many countries, the community pharmacist is in a unique position to be fully aware of the patient's past and current drug history and, consequently, can provide essential advice to the prescriber.

Care of patients or clinical pharmacy

The pharmacist seeks to collect and integrate information about the patient's drug history, clarifies the patient's understanding of the intended dosage regimen and method of administration, and advises the patient of drug-related precautions, and in some countries, monitors and evaluates the therapeutic response.

Monitoring of drug utilization

The pharmacist can participate in arrangements for monitoring the utilization of drugs, such as practice research projects, and schemes to analyse prescriptions for the monitoring of adverse drug reactions.

Extemporaneous preparation and small-scale manufacture of medicines

Pharmacists everywhere continue to prepare medicines in the pharmacy. This enables them to adapt the formulation of a medicine to the needs of an individual patient. New developments in drugs and delivery systems may well extend the need for individually adapted medicines

and thus in-crease the pharmacist's need to continue with pharmacy formulation. In some countries, developed and developing, pharmacists engage in the small-scale manufacture of medicines, which must accord with good manufactur-ing and distribution practice guidelines.

Traditional and alternative medicines In some countries, pharmacists supply traditional medicines and dispense homoeopathic prescriptions.

Responding to symptoms of minor ailments

The pharmacist receives requests from members of the public for advice on a variety of symptoms and, when indicated, refers the inquiries to a medical practitioner. If the symptoms relate to a self-limiting minor ailment, the pharmacist can supply a non-prescription medicine, with advice to consult a medical practitioner if the symptoms persist for more than a few days. Alternatively, the pharmacist may give advice without supplying medicine.

Informing health care professionals and the public

The pharmacist can compile and maintain information on all medicines, and particularly on newly introduced medicines, provide this information as necessary to other health care professionals and to patients, and use it in promoting the rational use of drugs, by providing advice and explanations to physicians and to members of the public.

Health promotion

The pharmacist can take part in health promotion campaigns, locally and nationally, on a wide range of health-related topics, and particularly on drug-related topics (e.g., rational use of drugs, alcohol abuse, tobacco use, discouragement of drug use during pregnancy, organic solvent abuse, poison prevention) or topics concerned with other health problems (diarrhoeal diseases, tuberculosis, leprosy, HIV-infection/AIDS) and family planning. They may also take part in the education of local community groups in health promotion, and in campaigns on disease prevention, such as the Expanded Programme on Immunization, and malaria and blindness programmes.

Domiciliary services In a number of countries, the pharmacist provides an advisory as well as a supply service to residential homes for the elderly, and other long-term patients. In some countries, policies are being developed under which pharmacists will visit certain categories of house-bound patients to provide the counselling service that the patients would have received had they been able to visit the pharmacy.

2. *Hospital pharmacy*

Hospitals and other institutions and facilities, such as outpatient clinics, drug-dependency treatment facilities, poison control centres, drug infor-mation centres, and long-term care facilities, may be operated by the government or privately. While many of the pharmacist's activities in such facilities may be similar to those performed by community pharmacists, they differ in a number of ways. Additionally, the hospital or institu-tional pharmacist

- Has more opportunity to interact closely with the prescriber and, therefore, to promote the rational prescribing and use of drugs;
- In larger hospital and institutional pharmacies, is usually one of several pharmacists, and thus has a greater opportunity to interact with others, to specialize and to gain greater expertise;
- Having access to medical records, is in a position to influence the selection of drugs and dosage regimens, to monitor patient compliance and therapeutic response to drugs, and to recognize and report adverse drug reactions;

- Can more easily than the community pharmacist assess and monitor patterns of drug usage and thus recommend changes where necessary;
- Serves as a member of policy-making committees, including those concerned with drug selection, the use of antibiotics, and hospital infections (Drug and Therapeutics Committee) and thereby influences the preparation and composition of an essentialdrug list or formulary;
- Is in a better position to educate other health professionals about the rational use of drugs;
- More easily participates in studies to determine the beneficial or adverse effects of drugs, and is involved in the analysis of drugs in body fluids;
- Can control hospital manufacture and procurement of drugs to ensure the supply of high-quality products;
- Takes part in the planning and implementation of clinical trials.
-

3. Industrial pharmacy (the pharmaceutical industry)

Statutory provisions in some countries may require that certain positions be held by pharmacists. The main activities of industrial pharmacists are described below.

Research and development

Pharmacists contribute to research, and their expertise in formulation development is of particular relevance to the biological availability of ac-tive ingredients.

Manufacture and quality assurance

The pharmacist's broad knowledge of the pharmaceutical sciences ensures an integrated approach to quality assurance (including good manufacturing practice) through the validation of the various stages of production and the testing of products before release.

Drug information

The pharmacist has the knowledge and expertise to provide detailed information on medicines to members of the health professions and the public. Also, pharmacists provide an information service within the company.

Patent applications and drug registration

The pharmacist is ideally qualified to understand and collate the diverse in-formation required for patent and authorization submissions.

Clinical trials and post-marketing surveillance

The pharmacist has the knowledge of drugs and health care provision required to facilitate collaboration between companies, health professionals and governments in relation to clinical trials and surveillance.

Sales and marketing

The pharmacist, whose professional ethics demand a concern for the interest of patients, can make a contribution to proper marketing practices related to health care and to the provision of appropriate information to health professionals and the public.

Management

The inclusion of pharmacists in all levels of management promotes an ethical approach within management policies.

4. Academic activities

Academic pharmacists engage in education, pharmaceutical practice, and research in schools of pharmacy. These three aspects of academic activity are interrelated, and at the same time connected with manpower planning and management. Undergraduate, postgraduate and continuing education require the educators to have expertise in the various pharmaceutical sciences, but, in view of the professional and vocational goals of pharmacy education and the necessary interaction of education and research with service, the academic staff must also include a substantial component of pharmacists with appropriate postgraduate education.

5. Training of other health care workers: Training provided by pharmacists may include efforts to optimize drug therapy, by promoting the rational use and storage of drugs and methods of reducing drug abuse, and is directed to medical and other prescribers or suppliers of drugs, including community health workers who handle drugs. Pharmacists with training responsibilities should receive some training in the planning and management of training programmes in relation to the educational and health goals being served.

The role of pharmacists toward technology has evolved significantly, especially as healthcare systems become more digitized. Here's a concise overview of their role in relation to technology

Monitoring of Pharmacy Manpower Development

Any plan or programme for systematic and sustained improvement in a service should include a monitoring and evaluation component to measure progress.

National strategies for attaining health for all will normally provide for the monitoring of pharmacy manpower development and pharmacy services in the framework of health systems and manpower development (HSMD).

Among indicators of coverage by primary health care suggested by WHO are:

- The existence of a selected list of essential drugs;
- The availability of such drugs at the primary health care facility whenever they are needed throughout the year.

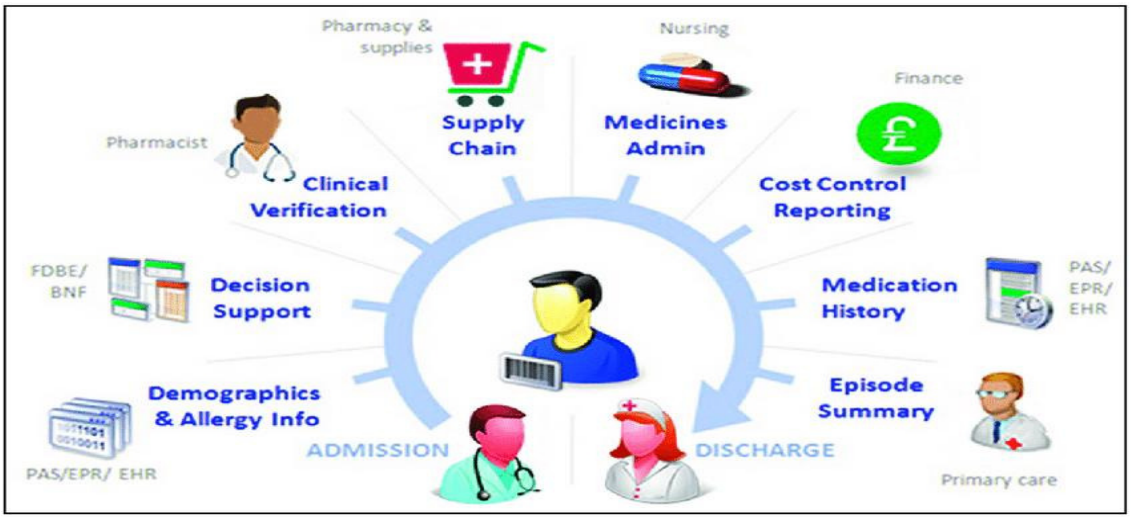
With regard to manpower, WHO has suggested as indicators:

- The population ratio to pharmacists;
- The ratio between various types of health worker, such as doctors to nurses or to other categories of health workers; and
- The number of schools that have revised or reformed their curricula to adapt them to the needs of health for all and primary health care.

Manpower planning includes the setting of targets, and the selection of indicators of achievement and progress. These are necessarily country-specific.

The pharmacy profession, through its regulatory bodies, should institute its own arrangements for monitoring its manpower development, either independently or in cooperation with national authorities. This would mean, first, stating the manpower goals and defining the targets to be reached by a given time. With regard to manpower development, monitoring would be applied to planning, production and management of manpower, and to the interaction of these three elements. It would be concerned with, for in-stance, whether there are national, systematic means of taking into consideration all the variables that affect, and are changing, the nature and scope of pharmacy. Monitoring should investigate whether educational planning reflects the

expanding role of pharmacists in health care teams-for example, their increasing community advisory and educational role. It should examine the use of continuing education to correct



manpower imbalances, e.g., to introduce or support changes in pharmacy practice, and also the possibilities of providing incentives to attract pharmacists to un-served or underserved communities or to undermanned specialties. It asks how the continuing-education needs of pharmacists are determined, and how the impact of continuing education on pharmacy practice and com-munity health is evaluated. In developing countries where pharmacists are in short supply the profession in cooperation with government can monitor the extent to which pharmacists at central and district levels accept responsibility for the training, supervision and guidance of non-pharmacist com-munity health workers with certain pharmacy tasks.

Role of Pharmacist towards Technology: Pharmacists play a vital role in integrating and utilizing technology to improve patient care, streamline pharmacy operations, and enhance healthcare outcomes. Their responsibilities in this area include:

Adopting Electronic Health Records (EHRs): Pharmacists access and contribute to EHRs to ensure accurate medication histories, identify potential drug interactions, and collaborate effectively with other healthcare professionals.

Utilizing Pharmacy Information Systems:

These systems help pharmacists manage prescriptions, automate dispensing processes, and maintain inventory efficiently, reducing errors and improving productivity.

Implementing Telepharmacy Services:

Especially in rural or underserved areas, pharmacists provide consultations and medication management services remotely, using video conferencing and digital tools.

Engaging in Clinical Decision Support Systems (CDSS): CDSS assists pharmacists in making evidence-based decisions regarding drug therapies, dosing, and contraindications, improving patient safety.

Promoting Digital Health Literacy: Pharmacists educate patients on the use of health apps, wearable devices, and online platforms to monitor their conditions and adhere to treatments.

Supporting E-Prescribing:

Electronic prescribing reduces prescription errors, enhances efficiency, and enables real-time communication between prescribers and pharmacists.

Participating in Pharmacogenomics and Data Analytics:

With access to large data sets and genetic information, pharmacists personalize medication therapy to match individual patient profiles, advancing precision medicine.

Advancing Automation and Robotics:

Automation in dispensing and medication packaging helps minimize human error and frees up pharmacists for more patient-centered services. The rapid advancement of technology has transformed nearly every aspect of healthcare, and pharmacy practice is no exception. Pharmacists today are not only medicine experts but also key players in leveraging technology to improve healthcare delivery and patient outcomes. Their involvement in various technological domains highlights the dynamic evolution of their role in modern healthcare systems.

Integration with Electronic Health Records (EHRs):

Pharmacists use EHRs to access comprehensive patient medical histories, medication lists, laboratory results, and clinical notes. This integration allows them to make informed decisions about drug therapy, identify potential drug-drug interactions, and ensure accurate documentation. It enhances inter-professional collaboration and continuity of care.

Use of Pharmacy Information Management Systems (PIMS): Modern pharmacies employ sophisticated information systems to manage prescriptions, process billing, track inventory,

and monitor medication adherence. These systems increase workflow efficiency, reduce medication errors, and support regulatory compliance.

Implementation of Telepharmacy: Telepharmacy enables pharmacists to provide care remotely, especially in rural or underserved regions. Through video consultations and digital communication tools, pharmacists can counsel patients, review prescriptions, and monitor therapy, ensuring accessibility to pharmaceutical care beyond traditional settings.

Adoption of Clinical Decision Support Systems (CDSS):

CDSS provides pharmacists with real-time, evidence-based alerts and recommendations. These tools assist in identifying inappropriate therapies, potential allergies, or adverse effects, and guide optimal drug selection and dosing. The use of CDSS significantly contributes to patient safety and therapeutic efficacy.

Promoting Digital Health and Patient Education:

Pharmacists play a role in increasing digital health literacy among patients by guiding them on how to use health apps, smart devices, and online platforms. These technologies help patients track their health parameters, manage chronic conditions, and improve medication adherence.

Automation and Robotics in Pharmacy Practice: Automation technologies, including robotic dispensers and pill counters, are increasingly used in pharmacies to ensure precise medication dispensing. This reduces manual workload and allows pharmacists to focus more on clinical services and direct patient care.

Support for E-Prescribing and Digital Communication:

Electronic prescribing (e-prescribing) systems enhance communication between prescribers and pharmacists, minimize errors due to illegible handwriting, and streamline the medication dispensing process. They also enable faster prescription refills and better record keeping.

Engagement in Pharmacogenomics and Big Data Analytics: With the growing field of pharmacogenomics, pharmacists analyze genetic data to customize drug therapies. Additionally, through big data analytics, pharmacists can identify population health trends, track outcomes, and contribute to research and public health initiatives. Utilizing and Managing Pharmacy Information Systems:

Medication Therapy Management (MTM) Platforms: Pharmacists employ specialized software to conduct comprehensive medication reviews, identify drug-related problems, and develop patient care plans.

Automated Dispensing Systems: They oversee and manage automated dispensing cabinets and robots to ensure accurate and efficient medication dispensing.

Leveraging Data Analytics and Artificial Intelligence (AI): Identifying Trends: Analyzing patient data to identify trends in medication use, adverse events, and adherence to improve patient outcomes and pharmacy practices.

Clinical Decision Support Systems: Utilizing AI-powered tools that provide real-time alerts and recommendations to optimize medication therapy.

Personalized Medicine: Applying pharmacogenomic data and AI to tailor medication regimens based on individual patient characteristics.

Block chain Technology: Exploring and implementing block chain for secure and transparent tracking of medications to prevent counterfeiting.

Data Privacy and Security: Ensuring compliance with regulations like HIPAA (in the US) or similar laws in India to protect patient data when using technology.

Combating Misinformation: Addressing the spread of inaccurate health information online. In essence, technology is no longer just a tool for pharmacists but an integral part of their professional role. It empowers them to enhance efficiency, improve accuracy, optimize patient care, and contribute to advancements in the pharmaceutical field. The future of pharmacy heavily relies on pharmacists' ability to embrace, adapt to, and ethically utilize technological innovations and to further elaborate on the role of pharmacists towards technology, particularly within the Indian context, we can add the following points:

Digital Health Initiatives: Pharmacists need to actively engage with and contribute to the growing digital health ecosystem in India, including government initiatives like the National Digital Health Mission (NDHM). This involves understanding and utilizing platforms for electronic prescriptions, health records, and telemedicine.

Accessibility and Affordability: Technology can play a crucial role in improving access to pharmaceutical care in remote and underserved areas of India through telepharmacy and online consultations. Pharmacists need to leverage these tools to bridge geographical barriers. Furthermore, technology can aid in optimizing supply chains to potentially reduce medication costs.

Combating Counterfeit Drugs: India faces a significant challenge with counterfeit medications. Pharmacists can utilize technologies like block chain and serialization to enhance the traceability and authenticity of drugs within the supply chain, protecting patients from substandard and falsified medicines.

Pharmacovigilance and Data Collection: Technology can facilitate the collection and analysis of adverse drug reaction (ADR) data across India, contributing to better pharmacovigilance and drug safety monitoring. Pharmacists play a vital role in reporting ADRs through digital platforms.

Language Diversity and Digital Literacy: When implementing technology, it's crucial to consider the linguistic diversity and varying levels of digital literacy among patients and healthcare professionals in India. User interfaces and patient-facing technologies need to be accessible and user-friendly in multiple languages where feasible. Pharmacists can act as intermediaries to help patients navigate these technologies.

Integration with Traditional Medicine Systems (AYUSH): While focusing on modern pharmaceuticals, there's a potential for technology to play a role in the documentation, standardization, and quality control of traditional Indian medicine systems. Pharmacists with relevant knowledge could contribute to this intersection.

Developing Indigenous Technological Solutions: Encouraging the development and adoption of pharmacy-specific technological solutions tailored to the unique needs and infrastructure of the Indian healthcare system is important. Indian pharmacists and technology developers can collaborate in this area.Skill Development and Training: Investing in the training and upskilling of pharmacists in India to effectively utilize new technologies is crucial for their successful adoption and integration into practice. Pharmacy education needs to incorporate digital health and technology-related competencies.

REFERENCES

1. CDC Foundation. What is Public Health? https://www.cdcfoundation.org/what-public-Health (accessed 2020 Jul 24).

2. American Public Health Association. What is Public Health? https://apha.org/what-is-Public-health (accessed 2020 Jul 24).

3. Pandve HT. Quaternary prevention: Need of the hour. J Family Med Prim Care. 2014; 3:309–10.

4. Office of Disease Prevention and Health Promotion, U.S. Department of Health andHuman Services. Determinants of Health.https://www.healthypeople.gov/2020/about/foundation-health-measures/Determinants-of-Health (accessed 2020 Jul 24).

5. McGinnis JM, Williams-Russo P, Knickman TR. The case for more active policy attention To health promotion. Health Aff (Millwood). 2002; 21:78-93 .

6.Shermock KM. Population health management: Challenges and opportunities for Pharmacy. Am J Health-Syst Pharm. 2017; 74:1398–9. https://doi.org/10.2146/ajhp170530

7.American Public Health Association. The role of the pharmacist in public health.

http://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-

database/2014/07/07/13/05/the-role-of-the-pharmacist-in-public-health (accessed

2020 Jul 24).

8.American Public Health Association. APHA policy 8024: the role of the pharmacist in Public health. Am J Public Health. 1981; 71:213–6.

9.Cain RM, Kahn JS. The pharmacist as a member of the health team. Am J Public Health. 1971; 61:2223–8.

10.Medina MS, Plaza CM, Stowe CD et al. Center for the Advancement of Pharmacy Education 2013 Educational Outcomes. Am J Pharm Educ. 2013; 77(8):1-10. Doi:10.5688/ajpe778162 (accessed 2019 Nov 24).

11.American Society of Health-System Pharmacists. ASHP statement on the pharmacist'sRole in antimicrobial stewardship and infection prevention and control. Am J Health-Syst Pharm.

1998; 55:1724–6. https://www.ashp.org/-/media/assets/policy-guidelines/docs/statements/pharmacists-role-substance-abuse-prevention-education-Assistance.ashx (accessed 2019 Jan 23).

13. American Society of Health-System Pharmacists. ASHP guidelines on preventingdiversion of controlled substances. Am J Health-Syst Pharm. 2017; 74:325-48.https://www.ashp.org/-/media/assets/policy-guidelines/docs/guidelines/preventing-diversion-of-controlled-substances.ashx (accessed 2019 Jan 23).

14. American Society of Health-System Pharmacists. ASHP guidelines on managing drug Product shortages. Am J Health-Syst Pharm. 2018; 75:e593-601. https://www.ashp.org/-/media/assets/policy-guidelines/docs/guidelines/managing-drug-productShortages.ashx (accessed 2019 Jan 23).

15. American Society of Health-System Pharmacists. ASHP guidelines on the pharmacist's Role in immunization. Am J Health-Syst Pharm. 2003; 60:1371–7.https://www.ashp.org/-/media/assets/policy-guidelines/docs/guidelines/pharmacists-role-immunization.ashx (accessed 2019 Jan 23).

16. American Society of Health-System Pharmacists. ASHP therapeutic position statement On smoking cessation. Am J Health-Syst Pharm. 1999; 56:460–4. https://www.ashp.org/-/media/assets/policy-guidelines/docs/therapeutic-position-statements/cessation-Tobacco-use.ashx (accessed 2019 Jan 23).

17. American Society of Health-System Pharmacists. ASHP statement on the role of healthSystem pharmacists in emergency preparedness. Am J Health-Syst Pharm. 2003; 60:1993–5. https://www.ashp.org/-/media/assets/policy-Guidelines/docs/statements/role-of-health-system-pharmacists-in-emergency-Preparedness.ashx (accessed 2019 Jan 23).

18. Benjamin GC. Ensuring population health: an important role for pharmacy. Am J Pharm Educ. 2016; 80(s) Article 19.

19. Goodman RA, Bunnell R, Posnera SF. What is "community health"? Examining the Meaning of an evolving field in public health. Prev Med. 2014; 67(Suppl. 1): S58–S61.Doi: 10.1016/j.ypmed.2014.07.028

20. Kindig D, Stoddart G. What is population health? Am J Public Health. 2003; 93:380-3.

21. Evans RG, Barer ML, Marmor TR. Why Are Some People Healthy and Others Not? TheDeterminants of Health Populations. New York: Transaction Publishers; 1994.

22. Swarthout M, Bishop MA. Population health management: Review of concepts andDefinitions. Am J Health-Syst Pharm. 2017; 74:1405–11. https://doi.org/10.2146/ajhp170025

23. Homsted FA, Magee CE, Nesin N. Population health management in a small health System: impact of controlled substance stewardship in a patient-centered medical Home. Am J Health-Syst Pharm. 2017; 74 :1468 –75 .

24. Rivo ML. It's Time to Start Practicing Population-Based Health Care: You don't have to be Part of an integrated delivery system to optimize care for populations of patients withCommon conditions. Fam PractManag. 1998; 5:37-46.

25. Sanborn MD. Population health management and the pharmacist's role. Am J Health-Syst Pharm. 2017; 74:1400-01. Doi:10.2146/ajhp170157

26. Knoer SJ, Swarthout MD, Sokn E et al. The Cleveland Clinic Pharmacy Population Health Management Summit. Am J Health-Syst Pharm. 2018; 75:1421–9.https://doi.org/10.2146/ajhp180081