



## Review Article

# The pursuit of rational drug use: Understanding factors and interventions

Iti Chauhan<sup>1\*</sup>, Mohd Yasir<sup>2</sup>, Madhu Kumari<sup>1</sup>, Madhu Verma<sup>1</sup>

<sup>1</sup>Department of Pharmaceutics, ITS College of Pharmacy, Muradnagar, Ghaziabad, Uttar Pradesh, India, <sup>2</sup>Department of Pharmacy, College of Health Science, Arsi University, Asella, Oromia Region, Ethiopia

### Correspondence:

Iti Chauhan, Department of Pharmaceutics, I.T.S College of Pharmacy, Muradnagar, Ghaziabad - 201 206, Uttar Pradesh, India. Phone: 91-8860988988. E-mail: iti.pharma@gmail.com

### How to cite this article:

Chauhan I, Yasir M, Kumari M, Verma M. The pursuit of rational drug use: Understanding factors and interventions. *Pharmaspire* 2018;7:48-54.

**Source of Support:** Nil,

**Conflicts of Interest:** None declared.

### ABSTRACT

Health is a fundamental human right and the attainment of the highest possible level of health is the most important worldwide social goal. Medicines are important component of health care. Advances in medications have enabled doctors to cure many diseases and save lives. The selection of essential medicines is only one step toward the improvement of the quality of health care; selection needs to be followed by appropriate use. However, unfortunately, because of inappropriate use, the effective medicines of yesterday become ineffective today. The situation is alarming. In this article, the author is focusing on the concept of rational drug use, factors responsible for irrational use, and the strategies to improve rational use of medicines. The intention is to provide an enlightening perspective for health professionals, patients, policymakers, and the public.

**Keywords:** Drug, essential medicine, rational

## INTRODUCTION

Irrational use of medicines is in a state of perplexity worldwide. The World Health Organization (WHO) estimates that more than half of all medicines are prescribed, dispensed, or sold inappropriately. The overuse, underuse, or misuse of medicines results in wastage of scarce resources and widespread health hazards.<sup>[1]</sup>

In 1984, the World Health Assembly requested the Director-General of the WHO to arrange a meeting of experts to discuss approaches to ensure the rational use of drugs, in particular through improved knowledge and flow of information, and to figure out the role of marketing practices in this respect. On this point a meeting, named “Conference of Experts on the Rational Use of Drugs,” was held in Nairobi, Kenya, from 25 to 29 November 1985.<sup>[2]</sup>

As stated by the WHO, rational use of drug requires that patients receive medication appropriate to their clinical needs, in doses that

meet their own individual requirements for an adequate period and at the lowest cost to them and their community.<sup>[3]</sup>

## RATIONAL ALSO MEANS APPROPRIATE

Oxford English Dictionary defines “rational” as that which is based on reason, which is sensible, same, or moderate. Rational drug therapy may be used interchangeably with the concept of prescribing appropriate drug for the appropriate indication by appropriate (route of) administration for the appropriate patient in appropriate dose and duration, with due cogitation of appropriate cost.<sup>[4]</sup>

The definition implies that rational use of drugs, especially rational prescribing, should meet certain criteria as follows:

### Appropriate indication

The decision to prescribe drug(s) is entirely based on medical rationale and the drug therapy is an effective and safe treatment.

### Appropriate drug

The selection of drugs is based on efficacy, safety, suitability, and cost considerations.

### Access this article online

<b>Website:</b> www.isfcppharmaspire.com	<b>P-ISSN:</b> 2321-4732 <b>E-ISSN:</b> XXXX-XXXX
--	--

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

## Appropriate patient

No contraindications exist, the likelihood of adverse reactions is minimal and the drug is acceptable to the patient.

## Appropriate patient information

Relevant, accurate, important, and clear information is given to patients regarding their conditions and the medication(s) that are prescribed.

## Appropriate evaluation

The anticipated and unexpected effects of medications are appropriately monitored and interpreted.<sup>[5]</sup>

## FACTORS UNDERLYING IRRATIONAL USE OF DRUGS

Big question is who is responsible for allowing irrational drug therapy and irrational prescriptions? The major forces affecting use of drug can be categorized as those deriving from patients, prescribers, the workplace, the supply system including industry influences, regulation, drug information and misinformation, and combinations of these factors.<sup>[5]</sup>

## PATIENTS

### Belief of a pill for every ill

Sometimes patient's approach doctor for minor illness expecting that there exists a pill for every illness. They create a high presumption for a prescription in every consultation.<sup>[6]</sup>

### Misleading beliefs

Some cultural practices and environmental beliefs, fear of becoming drug dependent, lack of appropriate health literacy, and ignorance toward health lead to non-compliance which in turn causes irrational therapy.<sup>[5]</sup>

1. Patient demands/expectations - Sometimes under pressure of patients or their relatives doctors may have to prescribe the drugs or dosage forms which may not be necessary for the patient. For example insisting to give injections in place of oral dosage form.<sup>[7]</sup>
2. Self-medication - Taking the drug without doctor's prescription, not having adequate knowledge of drugs, and drugs dispensed by pharmacists without prescription of doctor are important determinants of irrational use of drug.<sup>[3]</sup>

## PRESCRIBERS/DISPENSER

### Lack of education and inadequate training

One of the important determinants of irrational drug prescribing is lack of updated drug information. There must be provision to provide unbiased, updated, and independent information about the drug. Moreover, deprived elementary training in pharmacotherapy

for undergraduate medical and paramedical students is also increasing this menace.<sup>[8]</sup>

## Extravagant prescribing

Some doctors prescribe the drug with notion that effectiveness of drug is directly proportional to the cost of drug. A low priced drug will provide comparable efficacy and safety. This is not always genuine. Moreover, on the basis of promotional activities by companies, doctors prefer to prescribe brand name drugs even when cheaper alternatives are available, for example, use of a third generation, broad-spectrum antimicrobial when a first-line, narrow spectrum, agent is indicated.<sup>[3,8]</sup>

## Irrational prescribing

Under, over, incorrect, or multiple prescribing are assorted facets of irrational prescribing. Irrational prescribing may be manifested by the following examples:

- a. Prescribing of medicines when no medicine therapy is indicated, for example, antibiotics for viral upper respiratory infections.
- b. The use of correct medicines with incorrect administration, dosages, and duration, for example, use of IV metronidazole when suppositories or oral formulations would be appropriate.
- c. The use of the wrong medicine for a specific condition requiring medication therapy, for example, antibacterial in childhood diarrhea instead of oral rehydration salts.
- d. The use of medicines with doubtful/unproven efficacy, for example, use of antimotility agents in acute diarrhea.
- e. Failure of dosage adjustments for coexisting medical, genetics, environmental, or other factors.
- f. Failure to provide available, safe, effective, and affordable medications.
- g. Two or more medications are used when fewer would achieve same effect.
- h. Prescribing unnecessary fixed-dose combinations (one ingredient not needed for the patient).
- i. Polypharmacy: Using many medicines concomitantly is known as polypharmacy. Prescribing drug for several related conditions or every symptom of disease even when treatment for primary condition could improve or cure the secondary issues. Unjustified polypharmacy can increase the incidence of ADRs, drug interaction, and cost of treatment.<sup>[3,8,9]</sup>

## Faulty dispensing

Irrational therapy may be expected because of following:

- a. Incorrect interpretation of prescription.
- b. Retrieval of wrong ingredients.
- c. Inaccurate counting, compounding or pouring.
- d. Inadequate labeling.
- e. Unsanitary procedures.
- f. Packaging: Poor-quality packaging materials, odd package size, which may require repackaging, unappealing.<sup>[10]</sup>

## Busy doctor

Many times due to excess patient load, physicians are not able to provide appropriate counseling about the disease or drugs to the patients.<sup>[3]</sup>

## Prescribing by non-allopathic doctors

Sometimes allopathic drugs are prescribed by practitioners of traditional system of medicine (Ayurveda, Unani, Homeopathy, and Siddha practitioners) who are not well aware about efficacy and safety of allopathic drugs.<sup>[3]</sup>

## WORKPLACE

### Heavy patient load

Because of increased workload, doctor becomes too busy to imply his or her knowledge and discretion in selection of the drug.<sup>[3,11]</sup>

### Lack of diagnostic facilities

On account of poor diagnostic facilities, proper examination of patient suffers which may lead to wrong diagnosis. Uncertain diagnosis induces mistaken choice of drug.<sup>[7]</sup>

### Insufficient staff

Inadequate human resources at each level of health-care system leads to poor pharmaceutical care.<sup>[5]</sup>

## DRUG SUPPLY SYSTEM

Market is flooded with large number of “Me too” drugs. Availability of too many not needed doubtful medicines in market leads to lack of consistent supply of needed drugs and variation of individual prescribing preferences and inconsistent prescribing leading to numerous prescribing and dispensing errors.<sup>[3,7]</sup>

### Legal and regulatory framework

Absence of well-organized and effective regulatory system leads to irrational drug therapy. Lack of national health policy, erroneous implementation of laws, dearth of prescribing and dispensing guidelines, and flaccid control over advertising exercises are some of the drawbacks in system causing irrational medicine use.<sup>[7,12]</sup>

### Promotion of drug

Pharmaceutical industries may trigger the doctor to prescribe their brand medicines on the basis of attributes other than efficacy and safety. Many times unethical and crooked approach is practiced by marketing personnel to promote the sale of their product.<sup>[3,7,12]</sup>

### Repercussions of irrational utilization of drugs

Irrational use of medicines on a wide scale may have detrimental consequences on community and health-care delivery system. Impact can be seen in following ways:

- i. Minimized quality drug therapy leading to increased morbidity and mortality.
- ii. Ineffective treatment leading to prolongation of illness hence increased cost of medical care.
- iii. Iatrogenic disease: Relating to illness caused by medical examination or treatment. Irrational choice of drugs or

polypharmacy will elevate risk of side/adverse effects, therefore, causing more distress and harm to patient.

- iv. Inappropriate use and overuse of medicines in the general public facility where the government provides the resources leads to wastage and less funds for other essential drugs.
- v. Overuse and misuse may cause the development of drug resistance and probability of non-compliance and self-medication in patients.
- vi. Overprescribing promotes the opinion of “pill for each and every symptom” in patients leading to dependency and harmful side effects.
- vii. Availability of plethoric drug combinations and non-essential pharmaceutical products in market leads to lack in persistent supply of essential and vital drugs. This also makes grounds for diversified prescribing leading to numerous prescribing and dispensing errors.<sup>[3,5,7,11,13]</sup>

## Strategies to improve rational use of medicines

Strategies to boost rational drug use can be educational, managerial, economic, or regulatory. Whichever strategy is used, interventions should be based on the particular problem behavior and should hit the bull’s eye. It is necessary to investigate the origin of problem for successful development and practice of any approach. To tackle the menace of irrational drug use interventions should be designed to focus on every factor, that is, patients, health-care practitioners, facilities, and regulatory framework.

All health-care professionals involved need to be educated and encouraged to use drugs rationally. Managerial course of action may help to ensure implementation; and strict regulations may be needed to execute them, especially for the private health sector.<sup>[14]</sup>

## MANAGERIAL INTERVENTION

### Essential drug concept

Essential medicines are those that satisfy the priority health-care needs of the population. Using an essential medicines list (EML) makes medicine management easier in all respects; procurement, storage, and distribution are easier with fewer items, and prescribing and dispensing are easier for professionals if they have to know about fewer items. Selection of essential drug is done on the basis of public health relevance, evidence-based efficacy and safety, and comparative cost-effectiveness. Essential drugs lists, formularies, and standard treatment guidelines are complementary to each other. This is the reason a model list of essential drug is important in developing countries for the following reasons:

- a. Development of treatment guidelines.
- b. Development of national formulary.
- c. Measures to improve drug use information for patients.<sup>[13,15,16]</sup>

### Standard clinical guidelines

Clinical guidelines define the desired prescribing behavior and represent the core of all educational, regulatory, and managerial interventions. Clinical guidelines alias standard treatment guidelines or prescribing policies unfold the most cost-effective therapeutic

approach, on the basis of specific clinical condition. The impact of these guidelines would be more intense if the prescriber will be closely involved in the development. Guidelines should be tailored according to each level of health care (ranging from paramedical staff in primary health-care clinics to specialist doctors in tertiary referral hospitals), based on widespread common diseases and the skills and facilities available.

Evidence-based treatment guidelines and regular updating help to ensure credibility and acceptance of the same by practitioners. Ministry of Health and Welfare, Government of India, has constituted a task force on developing and updating standard treatment guidelines. Printed material in the form of information leaflets can be circulated to provide summarized, independent, and up-to-date drug information to prescribers.<sup>[12,13,16,17]</sup>

### Pharmacy and therapeutics committees (PTC) in districts and hospitals

A PTC is a policy forming and recommending body of all the relevant people to work together to improve health-care delivery, whether in hospitals or other health facilities. PTC evaluates clinical use of drugs and develops policies for managing drug use and drug administration. Such committees establish programs and procedures that help to ensure safe and cost-effective drug therapy. These committees play dual role of advisory council as well as educational body.<sup>[18]</sup>

A couple of key responsibilities of PTC are enlisted below:

- Developing and adapting the standard clinical guidelines and essential drugs list for health institution.
- Perform drug utilization studies and prescription reviews.
- Develop and compile a hospital formulary of drugs.
- Recommends written policies and procedure for selection, procurement, storage, distribution, and use of drugs.
- Develop educational strategies for health-care staff members to improve rational drug use.
- Monitoring and taking action to prevent adverse drug reactions and medication errors.
- Providing advice about other drug management issues, such as quality and expenditure.<sup>[13,16]</sup>

### Monitoring, supervising, and feedback

Monitoring is extremely important to warrant the good quality of care. A supportive and educational control will be more effective and better accepted by prescribers than simple inspection and punishment. Targeted face-to-face supervision along with audit, feedback, and drug use evaluation can be implemented. Prescription audit and feedback consist of analyzing prescription appropriateness and then giving feedback. Inspecting consistency in between prescribing and dispensing habits with standard treatment guidelines should be practiced. The WHO indicators can be used to quickly assess critical aspects in following areas related to the rational use of drugs in primary care:

- Pharmaceutical prescribing practices by health professionals.
- Key elements of patient care, covering both clinical consultation and pharmaceutical dispensing.

- Availability of health facility-specific factors which support rational use.<sup>[12,13,16]</sup>

## INDICATORS OF RATIONAL USE OF DRUGS

The standard WHO prescribing indicators are as follows:

- Mean number of drugs per prescription.
- Percentage of drugs prescribed by generic name.
- Percentage of antibiotics prescribed per prescription.
- Percentage of antibiotics prescribed from all prescribed drugs.
- Percentage of injectable drugs prescribed per prescription.
- Percentage of prescriptions containing vitamin/tonic preparations.
- Percentage of drugs prescribed from EML of the hospital/institution.<sup>[19,20]</sup>

## PATIENT CARE INDICATORS

- Average consultation time.
- Average dispensing time.
- Percentage of drugs actually dispensed.
- Percentage of drugs adequately labeled.
- Patient's knowledge of correct dosage.<sup>[21]</sup>

## HEALTH FACILITY INDICATORS

- Availability of copy of essential drug list or formulary.
- Availability of key drugs for treatment of common health problems.<sup>[22]</sup>

## Selection, procurement, and drug distribution

An effective medicine management cycle comprises of selection, procurement, storage, and distribution of drugs. Procurement procedures need to be reinforced to assure regular supply and in compliance with EMLs and standard prescribing behavior. Misuse of medicines can be prevented by use of approved hospital formulary or structured order forms. Selection for acquiring drugs is critical so as to rationalize the scanty resources for vital products that must always be available at all level of health care. A competent drug distribution system should focus to maintain a constant supply of medicines, storing medicines in good condition, minimize medicines loss due to spoilage and expiry, maintain accurate inventory records, rationalize medicines storage points, use available transportation resources efficiently, and reduce pilferage.<sup>[23]</sup>

## EDUCATIONAL INTERVENTION

Education, with its various approaches, has a significant role to play in nurturing the rational use of medicines. Educational strategies for health-care practitioners and consumers both are essential, but little attention is paid on this facet. In the case of medical and paramedical education, there is often a focus on the transfer of narrow, time-limited pharmacological knowledge, rather than on the development of problem-based training in pharmacotherapy and the ability to assess drug information critically.

## Basic training of health-care practitioners

Quality education in pharmacotherapy for students can significantly influence future prescribing. Rational pharmacotherapy training, linked to standard clinical guidelines and EMLs, can help to establish good prescribing habits. The role of nurses in prescribing and dispensing and in communicating with patients should also be recognized, and therefore be included in training programs.<sup>[13,24]</sup>

## Continuing in-service education (CME) of health-care practitioners

CME, symposium, lectures, conferences, and workshops can be effective in increasing knowledge and learn about changing behaviors. CME need not be restricted not only to professional medical or paramedical personnel but may also include people from pharmaceutical market such as medicine retailers and drug store managers.

Training should emphasize on rational drug prescribing and dispensing and boost the concept of essential drug list among health professionals. Workshop on effective inventory and store management can be organized for pharmacist. Several training courses for health professionals should be organized by government organizations to strengthen the technical knowledge and capacity of a large number of experts in government, academia, and NGOs in various areas such as drug policies, standard treatment guidelines, formularies, quality assurance, and essential drug concept.<sup>[13,16,17]</sup>

## Drug information centers (DIC)

A veiled factor in many facets of irrational drug use is the lack of access to independent drug information. Hence, DIC can play a prime role to oblige the need for independent drug information. DIC refer to facility specially set aside for, and specializing in the provision of drug information and related issues. DIC can be established and maintained by the government, state pharmacy councils, or linked to a teaching hospital. The DIC caters authentic individualized, relevant, accurate, and unbiased drug and poison information to wide strata of people, from health-care professional to patients.<sup>[12,13]</sup>

## Drug bulletins

Drug bulletins are specialized periodicals providing comparative information and advice on the prescribing skills and rational use of medicines. These are a useful means to disseminate practical, unbiased, and updated drug information to health-care professionals and consumers. Bulletins can be published cyclically which covers updated news about national drug policy, essential drug list, aspects of clinical pharmacotherapy, pharmaceutical treatment and prevention guidelines, medication errors, drug interactions, adverse drug reactions, etc. Along with providing technical information, bulletin can also deal with patient-oriented literature. Bulletins readers cover a variety of readers including prescribers, pharmacist, nurses, community health workers, and general public.<sup>[12,17]</sup>

## Other printed source of information

Health-care professionals have various sources of drug information to help them understand efficient use of medicines. The aim of these printed materials is to provide reliable information about medicines and promote more rational, informed decisions about their use.

Textbooks, medical journals, clinical literature and newsletters, national formularies, treatment guidelines, leaflets, data sheets, flyers, and promotional posters are some of the resource material that can be used to streamline information and improve prescribing and dispensing decisions.<sup>[17,24]</sup>

## Public education

General public education is an important sector to be taken care while developing and implementing national drug policy. Most health-care programs tend to site more significance on the supply of essential drug list and the training of practitioners to prescribe properly than on promoting rational use of drugs by consumers. However, drug usage pattern reveals that people commonly use medicines without practitioners' guidance. In general, patient either self-medicate or their drug management is influenced by their cultural, habitual, and lifestyle beliefs. Given this situation, more attention should be paid to public education in the appropriate use of medicines. Public education in the rational use of medicines includes instruction at the time of treatment for proper use of prescribed or dispensed medicines and counseling of a large gathering or specific target groups. This will enhance medication adherence and achieve the maximum benefit from the treatment. Various modes for spreading awareness and imparting knowledge can be: Patient information leaflet, posters, flip charts, talk shows, street plays, public lectures, radio/TV shows, documentaries, newspapers, magazines, special days, walks, health education courses, and social media campaigns.<sup>[13,16,24]</sup>

## Economic intervention

These strategies should be drafted in such a way that prescribers get motivated due to positive financial incentives such as price setting, changes in reimbursement methods, and quality-based performance contracts.

## DODGING OF PERVERSE FINANCIAL INCENTIVES

Monetary incentives that instigate irrational use of medicines should be avoided. Pharmaceutical companies bribe or favor gifts to doctors to prescribe their brands. Restrictions on these kinds of incentives can result in physicians suggesting lower-cost generic drugs instead. Some kind of strict policy should be made to avert these monetary benefits during detailing procedure. Flat prescription fees (covering all medicines in any amount) trigger overprescribing by charging the same amount irrespective of number of drug items or quantity of each item. Charges for consumers should therefore be made per medicine, not per prescription. The price setting can often encourage rational use of pharmaceuticals. Insurance policies should provide reimbursement only for essential medicines, not non-essential ones.<sup>[16,17,25]</sup>



## REGULATORY INTERVENTION

### Stringent regulatory system

An effective and uncompromising regulatory system that safeguards the efficacy, safety, and quality of drugs marketed is a necessity for policies to promote rational use. Regulatory policies and guidelines uplift prescribers to prescribe generic medicines, banning unsafe drugs, and restriction on unfair prescribing and dispensing practices. Rigorous monitoring and surveillance by regulatory agency are also needed for the successful implementation of above-said practices.

### Evaluation of drugs for market approval

Critical assessment and rational choice of safe drugs for marketing in the country is pivotal for curbing the menace of availability and irrational use of drugs in health-care sector. A robust master plan should be enforced about the categorization of drug as over-the-counter and prescription only. It will lead to safe and judicious utilization of drugs. Government should also focus to synchronize the pharmaceutical promotional activities which influence the prescribing habit of health-care professionals.

### Medicine registration

Regulations should be made for registration of medicines to ensure availability of safe, high quality, and cost-effective medicines in the market. Regulatory agency should enforce legislation against the irrational fixed drug combinations and non-efficacious medicines.

### Licensing and certification

Certification of health professionals such as doctors, nurses, and paramedical staff to ensure that all practitioners have the necessary proficiency regarding diagnosis, prescribing, and dispensing practices. Rules for licensing and regular inspection of retail and wholesale drug stores should be implemented to certain the compliance of necessary stocking and dispensing standards.<sup>[13,16,17]</sup>

## CONCLUSION

A major weakness of intervention activities in developing countries is that they are rarely based on baseline data on existing drug prescribing and use. Knowing and understanding the context of the drug use situation is crucial to be able to evaluate the impact of an intervention. Several studies have stressed the need to primarily research local drug use practices among prescribers and consumers, before embarking on an intervention study. Medicines cannot be used rationally unless everyone involved in the pharmaceutical supply chain has access to objective information about the drug they buy and use. Knowledge and ideas about drugs are constantly changing and a clinician is expected to know about the new development in drug therapy. The essential drug list is prepared by a committee comprising of experts in the field of medicine, pharmacology, pharmacy, public health, drug management, and peripheral health workers. The non-proprietary names should be used in the list. Selection of

essential drugs is a continuing process taking into consideration the changing health priorities, epidemiological situation, progress in the pharmacological and pharmaceutical knowledge. There should be an effort to provide information about the essential drugs. There should be provision to assure the quality of essential drugs. The concept of essential drugs will help in the promotion of rational use of drugs. If the drug is judiciously used, then it will offer hope of saving life, reestablishing the health, and alleviating the suffering while injudicious use of drug causes more harm than benefit to the patient and exposes the prescriber to a risk.

*“In nothing do men more nearly approach the gods than in giving health to men through appropriate medication.”*

## REFERENCES

1. World Health Organisation. A Major Global Problem. Available from: [http://www.who.int/medicines/areas/rational\\_use/en/](http://www.who.int/medicines/areas/rational_use/en/). [Last cited on 2018 Feb 25].
2. The Rational use of Drugs, Report of the Conference of Experts, Nairobi, WHO, Geneva. 1985. p. 25-29. Available from: <http://www.apps.who.int/medicinedocs/documents/s17054e/s17054e.pdf>.
3. Suryaprakash D. Rational drug therapy. *J Rational Pharmacother Res* 2014;2:67-72.
4. All India Drug Action Network. Rational Drugs Available from: <https://www.aidanindia.wordpress.com/2008/09/01/rational-drugs/>. [Last updated on 2008 Sep 01]; [Last cited on 2018 Feb 24].
5. Problems of Irrational Drug Use, Session Guide. Available from: [http://www.archives.who.int/PRDUC2004/RDUCD/Session\\_Guides/problems\\_of\\_irrational\\_drug\\_use.htm](http://www.archives.who.int/PRDUC2004/RDUCD/Session_Guides/problems_of_irrational_drug_use.htm). [Last cited on 2018 Feb 24].
6. Chaturvedi VP, Mathur AG, Anand AC. Rational drug use—as common as common sense? *Med J Armed Forces India* 2012;68:206-8.
7. Sneha A, Mathur AK. Chapter 2, rational drug use. *Health Administ* 2006;19:5-7.
8. Chapter-3, Rationality of Drugs. Available from: [http://www.locostindia.com/CHAPTER\\_3/Rationality%20of%20Drugs.htm](http://www.locostindia.com/CHAPTER_3/Rationality%20of%20Drugs.htm). [cited 2018 Feb 24].
9. Irrational Prescribing. National Medicine Information Center and Reference Library (NMIICRL); Directorate General of Pharmacy; Federal Ministry of Health, SJRUM; 2014. p. 5-7.
10. Rational Drug Use: Prescribing, Dispensing, Counseling and Adherence in ART Programs. Available from: [http://www.who.int/hiv/amds/capacity/ken\\_msh\\_rational.pdf](http://www.who.int/hiv/amds/capacity/ken_msh_rational.pdf). [Last cited on 2018 Feb 26].
11. Chapter-27, Managing for Rational Medicine Use, MDS-3, Managing Access to Medicines and Health Technologies; 2012. Available from: <https://www.msh.org/sites/msh.org/files/mds3-ch27-rationaluse-mar2012.pdf>. [Last cited on 2018 Feb 26].
12. le Grand A, Hogerzeil HV, Haaijer-Ruskamp FM. Intervention research in rational use of drugs: A review. *Health Policy Plan* 1999;14:89-102.
13. Promoting Rational Drug Use: The Need for a National Rational Drug Use Sub-Mission. Available from: [http://www.nhsrindia.org/sites/default/files/Promoting\\_Rational\\_Drug\\_Use.pdf](http://www.nhsrindia.org/sites/default/files/Promoting_Rational_Drug_Use.pdf). [Last cited on 2018 Feb 26].
14. Core Strategies to Improve Drug use. Available from: <http://www.apps.who.int/medicinedocs/en/d/Js2283e/5.6.4.html>. [Last cited on 2018 Feb 26].
15. Essential Medicines List Based on Treatments of Choice. Available from: <http://www.apps.who.int/medicinedocs/en/d/Jh3011e/5.3.html>. [Last cited on 2018 Feb 26].
16. Policies and Structures to Ensure Rational use of Medicines. *Contact*; 2006; No. 183. Available from: <https://www.oikoumene.org/en/what-we-do/health-and-healing/contact-magazine>. [Last cited on 2018 Feb 26].
17. Strategies to Improve Medicine Use—Overview, Session 9, Drug and

- Therapeutics Committee Training Course- Participants' Guide, Management Sciences for Health and World Health Organization. Arlington, USA: Submitted to the U.S. Agency for International Development by the Rational Pharmaceutical Management Plus Program; 2007. Available from: [http://www.who.int/medicines/technical\\_briefing/tbs/09-PG\\_Strategiest-Improve-Drug\\_final-08.pdf](http://www.who.int/medicines/technical_briefing/tbs/09-PG_Strategiest-Improve-Drug_final-08.pdf). [Last cited on 2018 Feb 26].
18. Nand P, Khar RK. A Textbook of Hospital and Clinical Pharmacy. New Delhi: Birla Publications Pvt. Ltd.; 2008. p. 19-21.
  19. Types of Indicators. Available from: <http://www.apps.who.int/medicinedocs/en/d/Js2289e/2.html>. [Last cited on 2018 Feb 26].
  20. Bashrahil KA. Indicators of rational drug use and health services in Hadramout, Yemen. *EMHJ* 2010;16:151-5.
  21. How to Investigate Drug Use in Health Facilities: Selected Drug Use Indicators-EDM Research Series No. 007, Chapter 2, Patient Care Indicators. Available from: <http://www.apps.who.int/medicinedocs/en/d/Js2289e/3.2.html>. [Last cited on 2018 Feb 26].
  22. How to Investigate Drug Use in Health Facilities: Selected Drug Use Indicators-EDM Research Series No. 007, Chapter 2, Health Facility Indicators. Available from: <http://www.apps.who.int/medicinedocs/en/d/Js2289e/3.3.html>. [Last cited on 2018 Feb 26].
  23. Medicines Supply, Essential Medicines and Health Products. Available from: <http://www.who.int/medicines/areas/access/supply/en/index5.html>. [Last cited on 2018 Feb 26].
  24. The Role of Education in the Rational use of Medicines. SEARO Technical Publication Series, No. 45. Regional Office for South-East Asia, New Delhi: World Health Organization; 2006.
  25. WHO. Policy Perspectives on Medicines—Promoting Rational use of Medicines: Core Components. Geneva: World Health Organization; 2002. Available from: <http://www.archives.who.int/tbs/rational/h3011e.pdf>. [Last cited on 2018 Feb 26].