Leveraging Consumer's Knowledge, Attitude, and Practices in the Management of Drug Counterfeiting

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ABSTRACT

WHO found that around 10.5% of the pharmaceutical products are fake in the developing countries. To overcome these issues pharmaceutical companies, have started using various anti-counterfeit packaging, typically, the QR Barcode (2D Data Matrix Barcode) and Barcode (UPC-A Barcode).Therefore, the Government and these Pharmaceutical companies need to create awareness among consumers, by empowering consumers to enquire, verify, identify the authenticity of pharmaceutical products. Accordingly, the study was conducted with 169 respondents to analyze the knowledge, attitude, and practices of consumers about the pharmaceutical products they consume or purchase. It has been found that 69.99% of respondents have the knowledge and 68.46% of respondents do observe and enquire about the pharmaceutical products that they purchase and consume. This implies that though respondents have less knowledge and follow fewer practices while purchasing pharmaceutical products, they show a concerned attitude. Besides, Pearson Correlation showed a strong correlation exists between Knowledge – Attitude (0.658), and Knowledge Practices (0.589). Whereas a moderate correlation is observed with Attitude – Practices (0.448).

Keywords: Counterfeit medicines; Knowledge; Practice; QR code; Bar code

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INTRODUCTION

In the world around, many businesses function illegally in all the spectrum of life. Counterfeiting of medicines is one such business where illegal medicines and other pharmaceutical products are supplied on national and international borders. According to WHO, "A counterfeit medicine is one which is deliberately and fraudulently mislabeled concerning the identity and/or source. Counterfeiting can apply to both branded and generic products and counterfeit products may include products with the correct ingredients or with the wrong ingredients, without active ingredients, with insufficient active ingredients or with fake packaging".

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The WHO has categorized counterfeit drugs as 'no active ingredients', 'incorrect amounts of active ingredients', 'incorrect ingredients', 'correct quantities of active ingredients but fake packaging', 'an original product that has been copied' and 'high levels of impurities and contaminants'. The occurrence of these categories were indicated as 32.1%, 20.2%, 21.4%, 15.6%, 1% and 8.5% respectively [1].

It is difficult to obtain the exact calculations on the lost sales and revenue, but according to the World Health Organization, counterfeiting costs the global pharma industry an estimate of US $75 billion a year. Percentage-wise, as per WHO the developed countries like the European union produce around 1% of counterfeit medicines, although in developing countries it is about 50%, there is a rise of 10% globally [2].

The Counterfeit Drug Market in India

According to United States Trade Representative (USTR), Special 301 Report' on intellectual property protection and review of 'notorious markets' for piracy and counterfeiting, 20% of all pharmaceutical goods sold in the Indian market are counterfeit. In July 2016, Cipla, IpcaLabs, Alkem Labs and Morepen Labs were found producing substandard drugs in the year 2015-2016 where 181 drug alerts were suspected in the same period as raised in a report by the Central Drugs Control Organization (CDSCO.) Most of the Indian drug enterprises, have summoned their affected batches, and are now facing an annual revenue loss of 4-5% due to drug counterfeiting. There are numerous cases of drugs found defective. One such case reported by Central Medicines Laboratory (CDL) in the Kannur district, Kerala 2002-03, where an anti-rabies vaccine used in government hospitals, was found adulterated. In 2013, around 8000 patients residing in the Himalayan region lost their lives in a remote hospital as a result of an antibiotic that was prescribed for preventing infection after surgery had no active ingredient present in it. The crucial areas that have contributed to the rise of forged and spurious medicines in India are the 'Bhagirath Palace' Chandni Chowk, found in New Delhi [3].

The Counterfeit Drug Market in the European Union

In the European Union organization in 2019, it was estimated that the pharma industry was the second largest industry to suffer losses, as their total loss of sales was €16.5 billion, amounting to 3.9% of the total losses. In December 2018 companies controlled by the online pharmacy, Canada Medicines were found guilty for selling counterfeit and misbranding pharmaceuticals in the United States and agreed to have forfeited $29 million, similar to their sales of illegal drug proceeds from 2009 to 2012 [4].

The Counterfeit Drug Market in Asia

The World Health Organization has made evaluations where about 30% of medications sold have been adulterated with low-quality substitutes that can be detrimental to human health. Most of them have been observed in some areas of Asia. As many as 67% considered replicated medicines were labeled disastrous out of those surveyed. About 75% of bogus drugs supplied to the world originate in India, followed by 7% and 6% in Egypt and China respectively. With this information, it can be said that the highest producer of drug counterfeiting is mainly in China, India, and other Southeast-Asian countries. Many Southeast-Asian countries, like China and India being developing nations, might have drug counterfeiting at these levels. In 2016, false yellow fever vaccination and two falsified Hepatitis C pharmaceuticals were discovered in Southeast-Asia, and those who issued a warning against them. The issue of drug counterfeiting is widespread in Asia as it is a populous region. In the year 2011, approximately 200 people died in Pakistan after taking contaminated heart medication [4,5].

The Counterfeit Drug Market in Africa

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Between 2013 and 2017, as per the details of fake medicines reported to WHO, a share of 42% of the total case reported was from the African region. In March 2019 alone, alerts for fake meningitis vaccines were raised by WHO in Niger and counterfeit hypertension medicines in Cameroon. In August, falsified versions of the antibiotic Augmentin were discovered in Uganda and Kenya. In Nigeria itself, recent research indicates that 12,300 deaths are reported annually due to fake malaria medication alone and in costs, it is around $893 million [6].

Report by WHO

In the year 2017, as a response to the global threat postured by counterfeit medicines WHO, has redefined the terms defined a substandard medicine and falsified medicines [7].

Substandard medicine is defined as "an authorized medical product that does not meet quality standards or specifications, produced by a known manufacturer". This definition is highlighting the occurrence of drug counterfeiting due to the failure of pharmaceutical companies to enforce good manufacturing practices (GMP) and Good Distribution Practices (GDP) [2]. It is important to foresee that such type of drug counterfeiting occurs during the manufacturing of medicinal products by the pharmaceutical company.

Further, WHO has defined a falsified medicine as "a medical product that is deliberately and fraudulently mislabeled or packed identical to the original medicine, making it difficult to identify". Such falsified medicine may contain inert ingredients or contaminants or even incorrect quantities of the active pharmaceutical ingredient (API) [8].

Country-Wise Medicines Act and Supply Chain Act

It is imperative that reducing the substandard medicine manufacturing and its tracking is achievable due to various laws such as schedule M of D & C act of India [9], The Federal Food Drug, and Cosmetic Act of USA [10], African Vaccines Regulatory Forum (AVAREF), Network of Official Medicines Control Laboratories (NOMCOL), African Medicines Regulatory Harmonization (AMRH) Initiative of Africa [11,12], European Medicines Agency of the European Union governed for the pharmaceutical companies.

But drug counterfeiting as falsified medicine is difficult to track and trace in absence of laws managing the supply chain and the dispensing of the drugs. To control the drug counterfeiting market, the USA and European Union have introduced a Supply Chain Act, such as Drug Supply Chain Security Act (DSCSA) [13] and Falsified Medicine Directive (FMD) [14] respectively. The regulations governed by this law the pharmaceutical manufacturers must apply safety features to medicine packs such as 2D Barcode and tamper-proof seal to ensure authenticity and supply chain traceability.

Various Kinds of Track and Trace Technologies Around the World

Accordingly, to manage the drug counterfeiting, pharmaceutical companies started using various track and trace technology such as serialization, UV printing, unique bar-coding, company hologram, RFID (Radio Frequency Identification), Barcode and 3D QR system or QR Barcode (2D Data Matrix Barcode) system.

Though various track and trace technologies are used by pharma companies, still as per OECD/EUIPO (2019) study, the value of global trade in counterfeit pharmaceuticals was up to USD 4.4 billion in 2016. This represents 0.84% of total worldwide imports in pharmaceutical products. In addition to this due to the advent of the COVID pandemic, the counterfeiters have found a new business of selling counterfeited hand-washes, sanitizers, fever tablets, and cough syrups [12].

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The aforementioned analysis clearly illustrates counterfeit drugs are a major cause of morbidity, mortality, and loss of public confidence in medicines and health structures. Despite various stringent laws regulating the Pharmaceutical industries and supply chain management, close cooperation between Pharma industries, government regulatory bodies, and international organizations the prevalence of counterfeit drugs is rising by 10% globally. So the present study is designed to evaluate the possibility of empowering the consumers in the management of drug counterfeiting. COVID 19 has flourished in the counterfeiting market but it has as well-motivated and imbibed the practice of QR code scanning, typically for paying the bills. Accordingly, the present study is focused on the possibility of imbibing similar QR code scanning practices in consumers while purchasing pharmaceutical products to empower them in the drug counterfeiting management of falsified medicine.

The focus of the present paper is to analyze the knowledge, attitude, and practices of consumers about the pharmaceutical products they consume or purchase. It is hypothesized that the positive link between the consumer's knowledge attitude and practices would suggest that empowering customers/consumers to verify a prescription product or a non-prescription product would allow pharmaceutical firms to handle counterfeit medicines.

METHODOLOGY

Study Area and Sampling

A cross-sectional quantitative survey was conducted amongst the general population. A random sample is taken for this study. The Question Pro Link having the questionnaire is to evaluate the Knowledge, Attitude, and Practice that was circulated amongst the respondents. A total of 169 responses aged 18 and over have been received from consumers/customers across India.

Validation Tool

The questionnaire was framed by the authors after a review of the study regarding the market of drug counterfeiting. An expert panel evaluated the face validity and content validity of the tool during and after development to ensure that the respondents had a complete outlook of the tool used in the study.

Panel of three experts, one educationist, one statistician, and one pharmacist were chosen to evaluate the face validity and content validity of the questionnaire. Each reviewer independently rated the relevance, clarity, and essentiality of each item in the questionnaire on the basis of 3-point Likert scale as per the Table 1.

Table 1: 3-point Likert scale to evaluate the face validity and content validity of the questionnaire

Degree of relevancy scale	Degree of clarity scale	Degree of essentiality
Not relevant	Not clear	Not essential
Somewhat relevant	Questions need revision	Useful but not essential
Very relevant	Very clear	Essential

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The Content Validity Index (CVI) was used to estimate the validity of the items. As per the CVI index, a rating of 2 or 3 indicates the content is valid and consistent with the structural framework.

CVI for essentiality is 0.795, CVI for relevancy is 0.795 whereas CVI for clarity is 0.812. Indicating high essentiality, relevancy, and very high clarity in the questionnaire. This validated self-administered Knowledge, Attitude, and Practice questionnaire was used for the survey which consists of 4 sections: 1) Demographic information of the respondent; 2) Consumers/customers knowledge and behavior while purchasing medicine and pharmaceutical products. 3) The attitude of the consumers/customers while purchasing medicine and pharmaceutical products. Practices followed by the consumers/customers, doctors, and pharmacists while purchasing, prescribing, and selling medicines and pharmaceutical products respectively.

Scoring of the Tool and Analysis

In the demographic section, the participants were asked to provide information about age, gender, city (that the respondents reside in), educational status, work profile. The knowledge section consists of 7 questions to access the respondent's level of knowledge and purchasing behavior for the medicines they purchase. A score of '0' was given for the wrong answer, '1' was given for the least right/important answer, '2' was given for the correct/important answer and '3' was given for correct/appropriate/very important answer. The attitude section consists of six statements to assess the Attitude of the respondents while purchasing medicine and pharmaceutical products. A score of '0' was given for the wrong answer, '1' was given for the least right/important answer, '2' was given for the correct/important answer and '3' was given for appropriate/very important answer. The practices section consists of 4 questions to Practices followed by the consumers, doctors, and pharmacists while purchasing, prescribing, and selling medicines and pharmaceutical products respectively. A score of '0' was given for the wrong answer, '1' was given for the least right/important answer, '2' was given for the correct/important answer and '3' was given for appropriate/very important answer.

The Raw Scores were Calculated for all the Sections of Knowledge, Attitude, and Practices

At the discretion of the investigators, the scores <=49% were considered as low concerning Knowledge, Attitude, and Practices, the scores between 50% to 70% were considered as averag*e* concerning Knowledge, Attitude, and Practice, and the scores=>71% were considered as high concerning Knowledge, Attitude and Practice. The quantitative data obtained from the respondents were entered into Microsoft Office Excel 365.

The significance level (α) was set at 0.05 for all statistical tests and further analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0 and the statistical distribution related to demographic characteristics, and for Knowledge and Attitude was calculated for the overall sample and the subsamples. Pearson's rank-order correlation coefficient was used to describe the strength and direction of the relationship between responses to the knowledge, attitudes, and practice questions.

RESULTS

A total of 169 study participants voluntarily participated in the study out of the total respondents, 49.70% (84 out of 169) were male, and 50.30% (85 out of 169) were female, and the majority age group 47.33%(80) were between 18 to 24 years. 52.07% (88 out of 169) of the respondents were employed/businessperson/retired/homemaker and 47.93% (81 out of 169) were students. The highest numbers of the study participants were from the non-healthcare sector 60.36% (102 out of 169), as they were the main target audience. Secondarily the healthcare professionals 39.64% (67 out of 169) were considered. Responses by each of the respondents' socio-demographic characteristics concerning gender are presented in Table 2. There is a significant difference between the gender and age, healthcare, and non-healthcare sector of respondents.

Table 2: Demographic study

Gender	Male	Frequency (%)	Female	Frequency (%)	Total	Total frequency (%)	p-Value
Frequency	84	49.7	85	50.3	169	100	
Age							
18-24	24	30	56	70	80	47.34	p-Value=0.00004, Chi Square=27.369, Degree of freedom-5
25-34	17	70.83	7	29.17	24	14.2	
35-44	6	60	4	40	10	5.92	
45-54	19	59.38	13	40.63	32	18.93	
55-64	12	70.59	5	29.41	17	10.06	
Above 64	6	100	0	0	6	3.55	
Total Sum	84		85		169		
Occupation							
Employed/Business/Retired/Home-maker	58	65.91	30	34.09	88	52.07	p-Value=0.00001125, Chi Square=19.287, Degree of freedom=1
Student	26	32.1	55	67.9	81	47.93	
Total Sum	84		85		169		
Employed/Business/Retired/Home-maker and students							
Healthcare	22	32.84	45	67.16	67	39.64	p-Value=0.00037859, Chi Square=12.635, Degree of freedom-1
Non-Healthcare	62	60.78	40	39.22	102	60.36	
Total Sum	84		85		169		

Knowledge Analysis of the Respondents

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In the management of healthcare delivery, it is apparent that Medicines can treat illnesses, relieve symptoms, and alleviate patient suffering provided they are prescribed, dispensed, and administered appropriately. Therefore, Doctors, Pharmacists, and consumers are the main stakeholders of the healthcare system.

As the present study is focused on the leveraging of consumer's knowledge in the management of drug counterfeiting, the present section was specifically coined to understand the consumer's preference while purchasing various pharma products such as Prescription drugs, over the counter (OTC) products, and Knowledge about the label printed on the packaging of the medicines and the pharma products.

Most of the respondents i.e. 86.98% (147 out of 169 respondents) visit pharmacy shop to purchase the drugs prescribed by their physician, 63.31% (107 out of 169 respondents) respondents visit the pharmacy to purchase an over the counter drug and 22.48%(38 out of 169 respondents) respondents visit to purchase a non – pharmaceutical product. Though the reasons to visit the pharmacies are different it indicates that the respondents have knowledge that they have to purchase medicines and pharmaceutical products from the pharmacy shop.

94.67% (160 out of 169 respondents) do check the expiration date, 83.43% (141 out of 169 respondents) check the seal of the product, 66.86% (113 out of 169 respondents) directions for use, 46.74% (79 out of 169 respondents) cost of the product. Along with checking the cost, expiration date, authenticity, etc., consumers must also check for a red label behind the drug and must not purchase these red label drugs without a prescription. Only 71.01% (120 out of 169) of respondents could explain the very purpose of 'red label' on medicines.

Prior art indicates that the counterfeiting of mentioned label details such as product tradename, expiry date, cost, and the red label is easily possible, so pharma companies started with the use of anti-counterfeit packaging such as QR Barcode (2D Data Matrix Barcode), Barcode (UPC-A Barcode). Accordingly, it was observed that 39.05% (66 out of 169 respondents) have not observed a QR Barcode (2D Data Matrix Barcode) or any QR code per se nor a Barcode (UPC-A Barcode) behind the packaging of the drugs and other pharmaceutical products. Only 4.14% (7 out of 169 of respondents)) of the respondents have observed a QR Barcode (2D Data Matrix Barcode), 21.89% (37 out of 169 respondents) respondents have observed a Barcode and 34.91% (59 out of 169 respondents) have observed both.

It is evident from the aforementioned, particulars that the respondents have knowledge about various labeling details printed on the pharma product packaging, but respondents have limited knowledge about anti-counterfeit packaging.

There is no significant difference between the respondent's gender and their knowledge of purchasing the medicine to the understanding of medicines and other pharmaceutical products. But there is a significant difference between the healthcare and non-healthcare professionals and their curiosity to observe the QR Barcode (2D Data Matrix Barcode) or any QR code per se nor a Barcode (UPC-A Barcode) behind the packing of the medicines and other pharmaceutical products. Responses by each of the respondents' knowledge characteristics are presented in Figure 1.
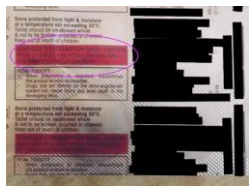
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Gender	Male	Frequency(%)	Female	Frequency(%)	Total	Total Frequecy (%)	p- Value
Frequency	84	49.70	85	50.30	169	100	
From the following what have you observed behind the packaging of your medicine or any pharmaceutical product?							
QR code	5	71.43	2	28.57	7	4.14	p-Value=0.25, Chi Square Test= 4.032, Degree of freedom= 3
Barcode	14	37.84	23	62.16	37	21.89	
Both	29	49.15	30	50.85	59	34.91	
No I have never observed a QR code/Barcode	36	54.55	30	45.45	66	39.05	
TOTAL SUM	84		85		169		
From the following which QR code you have observed on medicine/ pharmaceutical product?							
Image-1	12	63.16	7	36.84	19	11.24	p-Value= 0.05, Chi Square Test= 5.898, Degree of freedom= 2
Image-2	23	44.23	29	55.77	52	30.77	
Image-3	4	100.00	0	0.00	4	2.37	
TOTAL SUM	39		36		75		
Have you observed this type of barcode on the medicine or any pharmaceutical product?							
Yes	37	45.12	45	54.88	82	48.52	p-Value=0.75, Chi Square Test= 0.095, Degree of freedom= 1
No	4	40	6	60	10	5.92	
TOTAL SUM	41		51		92		
In the image given below, have you ever observed the Red color label (circled) on the medicine?							
Yes	52	43.33	68	56.67	120	71.01	p-Value=0.0095, Chi Square Test=6.719, Degree of freedom= 1
No	32	65.31	17	34.69	49	28.99	
TOTAL SUM	84		85		169		
Do you know the fact that certain medicines cannot be purchased without a prescription?							p-Value=0.0823, Chi Square Test=3.018, Degree of freedom=1
Yes	84	50.60	82	49.40	166	98.22	
No	0	0	3	100	3	1.78	
TOTAL SUM	84		85		169		

Figure 1: Consumer knowledge about the pharmaceutical products

The Attitude Analysis of the Respondents

In the knowledge section, it was observed that the respondents prefer purchasing the pharmacy shop for purchasing pharma products. So it is now important to check that do they have some curiosity about the authenticity of the pharma products and do they enquire with the pharmacist and the doctors about the same.

In depitcs that 94.08% (159 out of 169 respondents) trust the pharma products but during this pandemic, they are doubting on quality and the authenticity of the Over The Counter (OTC) products such as sanitizer 63.31%(107 out of 169 respondents), masks 47.33%(80 out of 169 respondents) and Hand wash 20.11%(34 out of 169 respondents). Typically, due to the flushing of the market with new brands. Further, 28.40%(48 out of 169 respondents) respondents trust the doctors,1.18% (2 out of 169 respondents) report the pharmaceutical companies and 7.69% (13 out of 169 respondents) approach the pharmacist if they face any unusual side-effects (side-effects other than the ones mentioned by the doctor or by the pharmaceutical company) from the medicines or any pharmaceutical products they consume. There is no significant difference between gender and their attitude of taking the opinion of consuming a particular medicine.

Practices Analysis of the Respondents

Knowledge section showed various reasons for respondent's visits to the pharmacy shop and the attitude section of the present indicates that 94.08% (159 out of 169 respondents) trust pharma products, so now it is important to understand what practices they follow while purchasing and administering the pharma products typically, medicines.

Figure 2 depicts, that 93.49% (158 out of 169 respondents) follow the practices of purchasing medicines from the local pharmacy, followed by a hospital pharmacy 26.62% (45 out of 169 respondents) and E-Pharmacy 11.24% (19 out of 169 respondents). However, when the practices of enquiring about the pharma products are analyzed, it was observed that 69.80% (118 out of 169 respondents) do interact with the pharmacist but typically for asking the cost, alternative medicines, but fail to practice enquiring about the authenticity of the pharma products.

Gender	Male	Frequency(%)	Female	Frequency(%)	Total	Total Frequecy (%)	p- Value
Frequency	84	49.70	85	50.30	169	100	
Do you read the printed literature (information on the medicine)available inside the box of the medicine or pharmaceutical product?							p-Value= 0.00009423, Chi Square Test= 15.249, Degree of freedom= 1
Yes	47	39.83	71	60.17	118	69.82	
No	37	72.55	14	27.45	51	30.18	
TOTAL SUM	84		85		169		
Have you scanned the QR code that you have observed?							p-Value= 0.22, Chi Square Test= 1.448, Degree of freedom= 1
Yes	12	63.16	7	36.84	19	11.24	
No	22	46.81	24	51.06	47	27.81	
TOTAL SUM	22		24		66		
Have you scanned the barcode that you have observed?							p-Value=0.32, Chi Square Test= 0.98, Degree of freedom= 1
Yes	8	57.14	6	42.86	14	8.28	
No	29	42.65	39	57.35	68	40.24	
TOTAL	37		45		82		

Figure 2: Consumer practices while purchasing the pharmaceutical products

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On the backdrop of lack of communication between Pharmacist and the respondents, the practices of using anti-counterfeiting packaging material by the respondents were analyzed, which indicated that details of scanning the QR Barcode (2D Data Matrix Barcode) and Barcode (UPC-A Barcode) were analyzed that 34.91% (59 out of 169 respondents) have the knowledge of QR Barcode (2D Data Matrix Barcode) and Barcode (UPC-A Barcode) but only 11. 24% (19 out of 169 respondents) practiced it by scanning the QR Barcode (2D Data Matrix Barcode) and 27.81% (47 out of 169 respondents) have not scanned the QR Barcode (2D Data Matrix Barcode) provided on the drug and other pharmaceutical products. Also, the consumers must read the information on the medicine given on the carton or the leaflet provided inside the carton. But there is 30.18% (51 out of 169 respondents) of respondents do not read a leaflet provided inside the carton. Indicating a lack of awareness about the importance of reading and understanding the labeling and product information. Therefore, there is a significant difference between gender and their practice of reading the printed literature available inside the box of medicine or pharmaceutical product.

Analysis of Correlations between Knowledge, Attitudes, and Practices of Consumers

As per Pearson correlation analysis, Correlation coefficient between ± 0.50 and ± 1, ± 0.30 and ± 0.49 and below +0.29 represents strong, medium and weak correlation respectively. According to Table 3, there is a strong correlation between Knowledge-Attitude (0.658), and Knowledge-Practices (0.589). Whereas a moderate correlation is observed with Attitude Practices (0.448).

Table 3: Pearson correlation

Variables	Correlation coefficient
Knowledge and attitude	0.658
Knowledge and practice	0.589
Attitude and practices	0.448

DISCUSSION

The present study is focused on analyzing the knowledge, attitude, and practices, of respondents is necessary to identify the falsified medicine that is deliberately and fraudulently mislabeled or packed identical to the original medicine. In the first step, the responses of the respondents were analyzed to determine their reason to visit the pharmacy, what type of pharmacy respondents prefer while purchasing the medicine.

86.98% of respondents visit the pharmacy shop to purchase a prescription drug, 63.31% of respondents visit the pharmacy to purchase an over the counter drug, and 22.48% of respondents visit to purchase a non – pharmaceutical

product. 51.47% of respondents were confident about the quality and the authenticity of the medicines and other pharmaceutical products that they purchase and consume.

In the next step respondent's responses were analyzed to evaluate their preference in selection among local pharmacy, hospital pharmacy, and E-Pharmacy. The analysis indicates that the majority of 93.49%, respondents purchase their medicines from the local pharmacy, followed by 26.6% prefer the hospital pharmacy and 11.24% of respondents prefer online platforms i.e., the E-Pharmacy.

The aforementioned particulars indicate that the respondents visit the pharmacy shop to purchase the drugs prescribed by the physicians and prefer local pharmacies for purchasing pharmaceutical products over hospital pharmacy and E-Pharmacy.

Though respondents showed confidence in the quality and the authenticity of pharmaceutical products that they purchase and consume, only 0.59% interacts with pharmacists and 7.6% interact with pharmacists in case of side effects. In accordance with the knowledge when the practices of respondents were evaluated while purchasing the pharma products, 79.80% of responses showed that pharmacists inquired about doctor's prescription but more than 50% showed that pharmacists ask for alternate medicine for the prescribed one.

The aforementioned analysis indicates that the respondents trust the pharma products and purchase them without even due diligence.

In the next step, the knowledge, attitude, and practices of respondents about the packaging of the pharmaceutical product were analyzed. As per standard Guidelines of regulatory agencies such as CDSCO (India), FDA (US) and the like the packaging and labeling of the pharmaceutical products should have, name of the drug product, a list of the active ingredients, showing the amount of each present, and a statement of the net contents, e.g. number of dosage units, weight or volume; the batch number assigned by the manufacturer; the expiry date, storage conditions or handling precautions; directions for use, and the name, address of the manufacturer [13]

Among these details, it is evident that the consumer can easily check the expiry date, cost of the product, special storage conditions or handling precautions, condition of the packaging material to purchase falsified counterfeit drugs. Results indicate that 94.67% do check the expiration date, 83.43% check the seal of the product, 66.86% directions for use. 71.01% of respondents could recognize the 'red label' on the drug. These responses indicate that respondents have knowledge about the details mentioned on the packaging of the pharmaceutical products and they have the attitude as well to practice it while purchasing the pharmaceutical products.

The above-mentioned details indicate that there is a positive correlation between the knowledge, attitude, and practices of the respondents. However, the counterfeit drug or falsified drug market analysis indicates coping with the packaging material of the original pharma product showcasing identical label details is easily achievable except the Barcode (UPC-A Barcode) and QR Barcode (2D Data Matrix Barcode). So though the respondents showed a

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positive correlation between knowledge, attitude, and practices while purchasing the pharmaceutical product, the management of the drug counterfeiting market is not completely achievable unless consumers are empowered with the knowledge of QR Barcode (2D Data Matrix Barcode) and imbibed the attitude and practices of scanning the same [14].

Accordingly, when responses related to QR Barcode (2D Data Matrix Barcode) and Barcode (UPC-A Barcode) printed on the packaging were analyzed only 4.14% have knowledge about the QR Barcode (2D Data Matrix Barcode), 21.89% knows Barcode (UPC-A Barcode), 34.91% has the knowledge about both, the QR Barcode (2D Data Matrix Barcode) and Barcode (UPC-A Barcode), whereas 39.05% have never observed QR Barcode (2D Data Matrix Barcode) or Barcode (UPC-A Barcode) on the pharmaceutical packaging. Among the 34.91% who have observed the QR code and Barcode, only 8.28% were able to scan the Barcode (UPC-A Barcode) and 11.24% were able to scan the QR Barcode (2D Data Matrix Barcode) currently used by the pharma companies. This analysis indicates that respondents don't have knowledge about the use and thereby the importance of QR Barcode (2D Data Matrix Barcode) in the management of counterfeit or falsified drugs.

Through this discussion, it can be stated that the customers/consumers more rely on pharmacists and doctors. It is also observed that the customers/consumers lack general awareness about these tracks and trace technologies by pharmaceutical companies. This is due to the barriers in communication between the government, pharmaceutical companies, and customers/consumers. To avoid these barriers, the government and pharmaceutical companies must come together along with the customers/consumers to fight drug counterfeiting.

CONCLUSION

Drug counterfeiting is an enormous business, and despite regulatory measures taken by the government and pharma industries, it is rising 10% globally. The pharma companies are typically relied on anti-counterfeit packaging, to avoid counterfeiting. However, the present study showed that the use of QR Barcode (2D Data Matrix Barcode system) and Barcode (UPC-A Barcode) is limited to tracking and tracing the medicines during transit. QR Barcode (2D Data Matrix Barcode system) is underutilized by pharma companies as well as by the consumers as a tool in the management of drug counterfeiting.

In the wake of COVID-19, awareness and utilization of the QR codes and Barcodes have increased in all sections of society. Consequently, the present study depicts that 34.91% of respondents are aware of the QR code and Barcodes in general, but only, 11.24% were able to identify the type of QR code i.e., QR Barcode (2D Data Matrix Barcode system) currently used by Pharma Industry. This indicates that the Government of India and the pharmaceutical companies should develop strategies in implementing and creating awareness about the usage of the QR Barcode by consumers to empower consumers in the management of counterfeit drugs.

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