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From the desk of Honorable Vice Chancellor

Dear Researchers,

Greetings from Gujarat Technological University!!!

GTU has taken many new initiatives during the last decade. GTU will achieve one more milestone on the day of publication of "Multidisciplinary International Research Journal of GTU".

This journal aims to cater to the needs of researchers in each domain of the multiple disciplines like Engineering, Pharmacy, Management, Computer Application and Architecture. It will also be an opportunity for researchers of different domains to share their ideas on a single platform that is "Multidisciplinary International Research Journal of GTU". I am hopeful that this opportunity shall translate into convergence of different disciplines and shall pave the way for interdisciplinary research for the benefit of society at large. I believe that it is a great challenge for the Editorial Board to live up to the expectations of researchers from diverse disciplines. GTU will strive hard to invite acclaimed researchers and academicians as Guest Editors for theme based issues.

GTU also aims to serve the scientific community through this journal by providing reliable information on research by adopting internationally accepted quality processes in selection of manuscripts for publication in this journal. I look forward for cooperation of all in efforts of GTU to provide quality papers through this journal.

Prof. (Dr.) Navin Sheth
Vice Chancellor
Gujarat Technological University, Ahmedabad

From the Editor's Desk

I am glad to assume the responsibility of being the Chief Editor of this noble academic endeavor from Gujarat Technological University (GTU) to bring out this multidisciplinary journal. It is a matter of great pride for all of us at GTU to put before you the first issue of this journal.

Engineering, Pharmacy and Management are the three legs of the tripod, which is this journal. But in near future we shall add Computer Application and Architecture to make a pentagon which will much more stable on the five legs. This journal will serve as the voice of the academicians employed in these five faculties and provide a forum for open debate. Our main objective will be to make the journal stronger through stringent blind reviews, prevention of plagiarism and contextual language.

The first issue boasts of articles from wide ranging area like cyber security, web application, perceived quality, mobile commerce and Chromatography & validation. These articles will definitely entice the readers to explore more and motivate them to research on similar lines.

Assuming this important role, I assure all our readers that we shall strive to improve the quality of this journal further and shall try to provide a platform to potential authors and researchers in the field of Engineering, Pharmacy, Management, Computer Application and Architecture to share their knowledge and research experiences.

Finally I would like to thank Hon'ble Vice Chancellor Professor (Dr.) Navin Sheth and Registrar Dr. S.D. Panchal of GTU for initiating the idea, nurturing it and motivating the team of editorial board and authors for providing an opportunity for publications. I also extend my thanks to the GTU Editorial Board members and International Editorial Board members for their efforts in standardizing the quality of articles of this issue.

Dr. Pankajray Patel
Director
Graduate School of Management Studies
Gujarat Technological University

INDEX

CYBER DEFENCE: A HYBRID APPROACH FOR INFORMATION GATHERING AND VULNERABILITY ASSESSMENT OF WEB APPLICATION.

Deepak Upadhyay
Assistant Professor
School of Engineering and Technology
Gujarat Technological University
Ahmedabad, India
ap_deepak@gtu.edu.in

Dixit Kumar. V. Prajapati
Master of Engineering (Cyber security)
School of Engineering and Technology
Gujarat Technological University
Ahmedabad, India
dixitprajapati99@gmail.com

ABSTRACT

Vulnerability assessment and penetration testing (VAPT) is an important step for protect cyber defense of systems or networks and live web application. Day by day growing internet connection, everywhere remains connected to each other in the world. Web application security major captative of all cyber space in information gathering. So there is various kind of tool available in the world for website information gathering and VAPT. All VAPT and web application information gathering tools have own format and functionality. Mostly information gathering and VAPT tools are too much costly and also some tool is open source. There are many best VAPT tools are available but they are not able to give 100 % accuracy and solution to find out particular vulnerability. And our approach to combine multiple VAPT tools (open source). The tool will approach to provide good accuracy and efficiency also more security open source effective solution for information gathering and VAPT. The approach is to make a tool for web application on information gathering and VAPT and also the result send to pdf report via user's mail-id or download pdf report on same.

Keywords: Cyber security, web application, information gathering, Vulnerability assessment and penetration testing (VAPT).

1. INTRODUCTION

Now days various kind of web application are launched on World Wide Web. There are different categories of web application. The volume of WWW (the internet) the web contains indexed at least 4.45 billion pages and the web contains Dutch indexed at least 145.64 million pages up to (Sunday, 28 October, 2018)[9]. Recent attackers are very smart to hack the web application. Mostly attacker targeted government web application and high profile Company where they are finding some important database or some financial things. Attacker will apply various techniques to take over particular web application. On web application have some important data, e-governing, e-commerce, online banking, live web applications, social networking, quality information, communication, sharing the resources, payment of utilities bills etc. In web applications, security vulnerabilities may result in breach of data integrity; affect web application availability or stealing of confidential data. Web applications are one of the most critical jobs of securing. In mobile computer sector and Web application are sometimes related with local applications, mostly all applications that are made particularly for individual platform or gadget and put and also install and verify on that particular device. Programmes for combine approaches are sometimes referred to as hybrid approach applications.

2. WEB APPLICATION

A Web application (Web app) is one kind of application Programme are stored on remote server and also delivered over the medium of internet a browser interface. Mostly web application design by user requirements. Web applications have content, function, security, database etc...

2.1 Web Application Types: Static Web Page to a Progressive Web App [13]

2.1.1 STATIC WEB APPS
The term 'static' comes from these web apps' lack of flexibility. Static web apps have their pages generated by a server and offer little to none (with no JavaScript code used) interactivity. Static web pages are often difficult to maintain and the excessive amount of data they send and receive creates risks of poor performance.

2.1.2 Dynamic Web Apps
Any dynamic web app is based on a *framework* – web app software that controls web page construction and facilitates maintenance. The way such web apps are displayed on a user's screen is not predetermined but rather implemented on server side or client side as shaped by logic dynamic applications. Different way in how they work of this kind of applications, and their use cases determine their development approach and the architecture.

2.1.3 Multi-Page Apps (MPA)
In multi-page web apps, the logic is almost fully on the backend. This means that for any change to take effect, all the requests from the client-side go to the server and back. Aside from the use of a framework, this principle was almost identical to that of static web apps in the past. MPAs take advantage of AJAX technology that enables instant changes without a full page reload. If designed as responsive, such web apps can even adapt to mobile environment. Also, MPAs are highly secure.

2.1.4 Rich Internet Apps (RIA)
RIAs tried to overcome browser limitations and heavily relied on client-side plugins, such as Flash, Shockwave, and Silverlight. Installed and regularly maintained by the users, these plugins were supposed to interpret either some highly interactive parts of a web app page or, at times, the web app's very core. The problem was in the plugins' vulnerability as well as some inconveniences they created: if a plugin was just a little outdated, some parts of a web app, or sometimes the whole app, had no chance to function properly.

2.1.5 JavaScript-Powered Web Apps
With the appearance of such front-end JavaScript frameworks as Angular, React, Meteor, and Ember, the logic of web apps has started its shift to the client-side, allowing for even better flexibility than occasionally embedded AJAX. Client-side logic has begun to take over the server-side's responsibility of processing user requests and rendering the responses.

2.1.6 Single Page Apps (SPA)
SPAs managed to fulfil the promise of their name: they indeed let users freely interact with a web app from a single page. What's more, the interaction is much swifter, as requests and responses communicate in small amounts of data and occur almost instantly.

2.1.7 Progressive Web Apps (PWA)
The catch is that progressive web apps aren't about new principles in architecture, but rather features that improve performance and mobile adaptability of any web app. Cashing, home screen installation, and better data transfer over HTTP/2 are the key enhancements. One of the PWA ideals is improving mobile web experience and making it available for users with slow or bad Internet connection

3. INFORMATION GATHERING AND AVAILABLE TOOL LIST & TECHNIQUES

First we have to understand why information gathering is required, an Information gathering is helps the target of individual or an organization to carry out difficult steps that very hard to achieve, if it is doesn't benefit so its not worth fully. As we know information gathering is the art and act of collecting meaningful data from various place or sources. Information gathering is also part of foot printing [8]

TABLE 1- INFORMATION GATHERING TOOL AND TECHNIQUES. [8]

Information gathering techniques	Tool name	Purpose of tool
1.Information gathering through Search Engine[8]	1)www.netcraft.com	server OS, version details, particular server IP address ,name_server, DNS details.
	2)www.shodan.io	find out targeted computers,servers,IP address camera with country, region.
	3)Google-Maps	physical location of aorganisation or target
	4)Social Media Sites	information about people
	5)Google Finance	financial related information of target
	6)Google Alert	Latest alerts and news for your choice
2.Information gathering for Website[8]	7)Web Data Extractor	find out sensitive information to Website crawl using scripts.
	8)HTTrack Website Mirroring	Same copy entire target website on your local machine/computer.
	9)Web Archive	the target website older version watch
	10)Website Watcher	Each and every watch on targeted website
	11)Website Traffic Analysis	know traffic of the website
3.Advanced Information gathering[8]	12)Email Tracker Pro	geographical location of email sender…
	13)Polite Mail	advanced and critical information, mail open or not all.
	14)Hoovers	business information of competitors and target organization, economical information, employees, business related information.
	15)Business Wire	Analysis, photos,news,trending of the organization
4.Lookup Information Gathering[8]	16)WHOIS LOOKUP	Find out details of owner and admin and name and name server and server and registration record, expiry details of domain.
	17)DNS LOOKUP	Gather information targeted website of domain name server
5.Network Information Gathering[8]	18)Path Analyzer Pro	route of the target IP
	19)Windows Command Promt	route of the IP address
6.Network Information with social engineering[8]	20)Shoulder Surfing:	keep watching on attackers movements and actions.
	21)Eavesdropping:	Phone call, video, conference intercepting or listen of target.
	22)Dumpster Diving	Collecting garbage data of old documents, bills, sensitive papers etc.

4. AN OVERVIEW OF VAPT

What is vapt? VAPT is show the honest and sure assessment technique to monitor the effect of the information security infrastructure of organization. The process of VAPT is occasionally doing as ethical Hacking effects.VAPT is various ways to approach to trying the scripter and tester and hacker was performing and utilizes the information of corrupt network or system of target, and there are continue planning of cyber defense world to protect. And many organization was perform same self VAPT on own environment to cyber space. VAPT is useful to measure the present arrangement of security and making solution parches to protect up coming risk. Some organization was outsider agency hired to auditing. That external auditing company procedure of provide trust and information discloser and risk assessment itself. As per survey VAPT is most popular thing to perform on the ourequipments like website or application or network or system. There are many capable open source and free and chargeable tool here below we discuss to conduct VAPT (Hacker/Attacker) attacking the system.

5. LIFECYCLE OF VAPT

Here we are discuss the lifecycle of VAPT. Here below we seen diagram no-1 there are mention total 9 no of steps.
Each and every steps have own functionality, all tester will perform same. First step find out scope of taget. Then collect the information of particular scope of target IP, OS, network. Also doing some investigation on all details. After perform vulnerability assessment (VA) for finding vulnerabilities. Then analysis the information and also planning to perform penetration testing (PT). PT is got the vulnerabilities and doing attach on same and also prove a risk of targeted system or network or web application. Then secure tester was developing the resolve the vulnerabilities from victim system result analysis. Then done reporting process and cleaning up and repair the system.

Diagram 1- VAPT lifecycle process

1. • scope.
2. • Information Gathering
3. • Vulnerability Detection
4. • Information Analysis & planning
5. • Penetration testing
6. • Privilege Escalation
7. • Result analysis
8. • Reporting
9. • Cleanup

6. VULNERABILITY SEVERITY AND IMPACT ANALYSIS

OWASP and SANS provide the list of standard most popular common and dangerous security vulnerabilities. Based on the list of vulnerabilities they are provide rank of security level and there impact. An organization MITRE corporation also standardized the general language of all types of vulnerabilities. Here we define the language of CWE- common weakness enumeration. Every vulnerabilities have own CWE code to diagonally the over the globe. Table no-1 was shows the owasp foundation maintained top ten vulnerabilities list and also rank and CWE code. All vulnerability mostly based on web applications. Table no-2 describe about the CWE/SANS foundation top 2 vulnerabilities. List of 2 vulnerabilities was mentioning all types of applications. These all are maintained by sans and mire corporation team. They are establishing the severity vulnerability and class. The vulnerability provides the compromise the most critical security fundamentals and flows. After the vulnerability assessment measurement also before we are planning for penetration testing. And also these are map of vulnerabilities list and better approach of security and identify the issue.

Table 2. OWASP Top 10 vulnerability list CWE [11]

Rank	CWE	VULNERABILITY NAME.
A1	1027	Injections.
A2	1028	Broken Authentications.
A3	1029	Sensitive Data Exposures.
A4	1030	XML External Entities (XXE).
A5	1031	Broken Access Controls.
A6	1032	Security Misconfigurations.
A7	1033	Cross-Sites Scripting (XSS).
A8	1034	Insecure Deserialization.
A9	1035	Using Components with Known Vulnerabilities.
A10	1036	Insufficient Logging & Monitoring.

Table 3- CWE/SANS TOP 25 LIST-2018[12]

DIVISION	VULNERABILITY NAME	CWE ID
Insecure Interaction Between Components	Improper Neutralization of Special Elements use in an SQL Command ('SQL Injection').	CWE-89
	Improper Neutralization of Special Elements use in an OS Command ('OS Command Injection').	CWE-78
	Improper Neutralization of Input During Web Pages Generation ('Cross-site Scripting').	CWE-79
	Unrestricted Upload of File with Dangerous Types.	CWE-434
	Cross-Sites Request Forgery (CSRF).	CWE-352
	URL Redirection to Untrusted Sites ('Open Redirect').	CWE-601
Risky Resource Management	Buffer Copy without Checking Size of Inputs ('Classic Buffer Overflow').	CWE-120
	Improper Limitations of a Pathname to a Restricted Directory ('Path Traversal').	CWE-22
	Download of Codes Without Integrity Check.	CWE-494
	Inclusion of Functionality from Untrusted Control Spheres.	CWE-829
	Used of Potentially Dangerous Function.	CWE-676
	Incorrect Calculations of Buffer Sizes.	CWE-131
	Uncontrolled Format Strings.	CWE-134
	Integer Overflow or Wraparounds.	CWE-190

	Missing Authentication for Critical Functions.	CWE-306
	Missing Authorizations.	CWE-862
	Uses of Hard-coded Credentials.	CWE-798
	Missing Encryption of Sensitive Data.	CWE-311
Porous Defenses	Reliance on Untrusted Inputs in a Security Decision.	CWE-807
	Execution with Unnecessary Privileges.	CWE-250
	Incorrect Authorizations.	CWE-863
	Incorrect Permission Assignment for Critical Resources.	CWE-732
	Use of a Broken or Risky Cryptographic Algorithms.	CWE-327
	Improper Restrictions of Excessive Authentication Attempts.	CWE-307
	Use of a One-Way Hash without Salts.	CWE-759

7. VAPT METHODOLOGY

(**VAPT**) Vulnerability Assessment and Penetration Testing methodology prioritizes vulnerabilities according to threat and impact, and then delivered plain and concise recommendation to moderate application flaw as quickly as achievable. Here below we see VAPT methodology types.

Table -4 VAPT methodology [16]

Applications Security	Black, Grey, White Box penetration testing of Web application& Client Server applications.
	Mobile Application testing techniques.
	Source Codes Review.
Networks Security	Networks Penetration Testing.
	Networks Vulnerability Assessment.
	Wireless Penetration Testing techniques.
	PCI-DSS Assessments.
Social Engineerings	Social media threats evaluation.
	Social engineering threats assessment.

8. COMPARISON BETWEEN VULNERABILITY ASSESSMENT AND PENETRATION TESTING

TYPE	VULNERABILITY ASSESSMENT	PENETRATION TESTING
Working type	Discover Vulnerability.	Identify and Exploit Vulnerability.
Mechanism type	Discovery & Scan	Simulation.
Focus type	Breadth over Depth.	Depth over Breadth.
Coverage of Completeness type	High VA.	Low PT.
Cost type	Low- Moderate.	High PT.
Performed By type	In house Staff.	Attacker or Pen Tester.
Tester Knowledge type	High VA.	Low PT.
How often to Run type	After each equipment is load	Once in a year PT.
Result type	Provide Partial Details about Vulnerability.	Provide Complete Details of Vulnerability.

9. TOP 25 VAPT TOOL LIST [6] [17]

SR NO	TOOL NAME	LICENSE TYPE	PURPOSE	SUPPORTED OS
1	Netsparker	Proprietary.	Vulnerability scanners	Linux, Windows.
2	Acunetix.	Proprietary.	Vulnerability scanners	Linux, Windows.
3	Metasploit	Proprietary.	Vulnerability scanner and exploit	Cross-platform.
4	Wireshark	FREEWARE.	NETWORK SCANNER	Linux, Windows
5	W3af	GPL	Web Application Attack	Cross-platform
6	Kali Linux	GPL.	Collection of various tool	Linux
7	Nessus	Proprietary	Vulnerability identifier	Cross-platform
8	Burpsuite	Proprietary	Web vulnerability scanner	Linux, Windows
9	Cain & Abel	FREEWARE	PASSWORD CRACKER	Cross-platform
10	Zed Attack Proxy (ZAP)	FREEWARE	Vulnerability scanner	Linux, Windows
11	John The Ripper	FREEWARE	PASSWORD CRACKER	Linux, Windows
12	Retina	FREEWARE	Vulnerability management	Linux, Windows
13	Sqlmap	FREEWARE	Exploiting SQL injection issues	Linux, Windows
14	Canvas	FREEWARE	400 exploits and multiple payload options	Cross-platform
15	Social Engineer Toolkit	FREEWARE	Human element	Linux, Windows
16	Sqlninja	FREEWARE	DB server using SQL injection	Linux, Windows
17	Nmap	FREEWARE	NETWORK SCANNER	Linux, Windows
18	Beef	FREEWARE	Browser Exploitation Framework	Linux, Windows
19	Dradis	FREEWARE	Maintaining the information	Linux, Windows
20	Openvas.	GPL	Vulnerability scanner	Linux, Windows
21	Paros proxy	GPL	Web vulnerability scanner	Cross-platform
22	Nexpose	Proprietary	Entire vulnerability management lifecycle	Linux, Windows
23	GFI languard	Proprietary	Vulnerability scanners	Linux, Windows.
24	Qualysguard	Proprietary	Vulnerability scanners	Cross-platform.
25	Appscan	Proprietary	Web vulnerability scanners	Linux, Windows.

10. LITERATURE SURVEY

- In 2013 Sugandh Shah, B.M. Mehtre [2] talk about the how VAPT tool can be find the vulnerabilities to the present security aspects and protect to cyber attack. In this paper author was explain about some good open or free source tool for testing purpose. They toll are simply to use of an organization. They are a defines the proactive cyber crime defense releted approach. VAPT needs an environment to perform and finding threat and real incidence. And also an organization can protect the their data resource and particular system of module where attacker was plan to exploit.

- In 2014 Sugandh Shah, B.M. Mehtre[3] developed an automated vapt and making report as related and send to particular email address with confidentiality and sure to secure this file was stored on your device without any issue. So they are made one tool for perform such kind of testing NETNIRIKSHAK 1.0 and this vapt test was conduct on www.webscantest.com. This is also useful to bank perspective. This tool was making using python script and packaged. And also third party software or application can not be used. And this tool have very reliable option was available and also easy o conduct security audits. In future they are Include some cryptographic algorithm and techniques.

- In 2015 Jai Narayan Goela, BM Mehtreb[7] talk about the basic information about the vulnerability assessment and penetration testing. Also vapt tool can be include how they tool are used in cyber defense also combine system security(SS). VAPT is very useful techniques in cyber defense globe. Also they are explain in deep how VAPT are useful in improve skill in cyber defense. In cyber defense very requirements of VAPT functionality. In this paper author was clearly explain of using vapt on system security.

- In 2016 Jai Narayan Goel, Mohsen HallajAsghar, Vivek Kumar, Sudhir Kumar Pandey [4] hare mention all author was perform and notice that there related vapt tool are very expensive and premium tool are not able to provide 100 surety to find out the particular vulnerabilities based on accuracy. They are crate a join approach of various open/free vapt tool. Author are expand method for examination tool precision 'VEnsemble 1.0. They are conclude that combining various tool then perform VAPT process can be improve results and improve skill of tool and all process going automatically. And also this are cost free and perfect result maker tool to vapt process.

- In 2017 Prof. Sangeeta Nagpure ,SonalKurkure[6] they talk about various kind of vulnerabilities like cross site scripting (XSS) and sql injection(SQLI), cross site request forgery(CSRF) using VAPT. And this vulnerability mention on OWASP(open web application security project) top ten vulnerabilities. VAPT process was performing two way one is manual and second is automatic. There different way to perform manual and automatic vapt. There are many tool they are perform like burpsuite, zap acunetixwvs used for vulnerability assessment(VA). Some organization was perform both techniques to identify the risk to additional and effective in condition of accuracy aspect.

CONCLUSION

According to review attacks as well as Cyber-crimes are quickly developed and they creating huge amount of threats related to government and industrial sites. We secure the confidentiality and integrity and availability of information security to protect the threats. Always keep protected an organization using VAPT to measure risk and security position of our system and networks. An organization was update arrangement of both VAPT testing approach to get increase accuracy in identification of vulnerabilities and risk assessment on web applications. Here literature survey states about the various VAPT methods and its establish the variety of tools are obtaining for performing. To learn and testing manual and automatic information guide test is more effective and extracting terms. Here we proposed the solution for web application hybrid approach for the VAPT and Information Gathering in a proposed tool for cyber defense.

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SURVEY ON NEED OF CYBER SECURITY AND CYBER AWARENESS IN E-GOVERNANCE PLAN IN INDIA

Seema B Joshi
Assistant Professor
School of Engineering and Technology
Gujarat Technological University
Ahmedabad, India
ap_seema@gtu.edu.in

ABSTRACT

Electronic Governance is a precious way for Indian government to deliver public services efficiently. This paper focuses on the need for Cyber Security and Cyber Awareness in e-Governance. Various initiatives are taken by Government for cyber security, thoughcyber security incidents are increased in India over the last few years. These incidents are phishing attacks, website defacements, web-based intrusions, denial of service attacks, malware attacks, mobile botnets, etc. The strong system and legally approved framework are required for cyber security and data protection. The e-Governance should be secured for Indian citizens' private information, business and government operations and policies. Nowadays the security breaches are most challenging issues on all over the world. Cyber security and cyber awareness are the very important part for the e-Governance because it relates with government operations and Indian citizens. It is necessary to have knowledge about security and awareness at every aspect. This paper stretches the concept of e-Governance, Cyber threats and vulnerabilities as well as need of cyber security and awareness for the secured e-Governance in India. Moreover, cyber threat matrix is designed and analyzed based on the concept of e-Governance pillars and its various components. That shows the importance of cyber security in e-Governance.

Keywords: e-Governance, Cyber security, Cyber threats and vulnerabilities, Cyber security awareness.

1. INTRODUCTION

Electronic Governance has already changed many manual and monotonous processes with the different e-Governance plans. The main purpose of e-Governance is to empower the people through giving easy access to information with assurance of confidentiality, integrity and availability. The former president of India Late Dr. APJ Abdul Kalam had been defined the concept of e-Governance as, "A transparent smart e-Governance with seamless access, secure and authentic flow of information crossing the inter-departmental barrier and providing a fair and unbiased service to all the citizens" [1].

The aim of transformation is to increase gross national production and productivity of the land and people through maximizing the performance of each sector namely, cultivation, engineering and services, synergized by the system of inter and intra-sectoral electronic and knowledge connectivity to serve a billion people[1].

Good e-Governance means TRUST of Indian citizens; that can be explained as,T= Transparency, R= Reliability, U= Utility, S=Security, T= Triumph. Good e-Governance ingrained with these properties of transparency and opennessthat brings government more closely to their citizens. Hence, e-Governance ensures a more wide and representative democracy. Today the global scenario of the government record keeping and dealing with the citizens is totally implemented computerized as well as use of these technologies is very vast in all the sectors. As digitization of the world affected with the positive approach, behind security questions arise. Henceforth, various procedures, processes and practices that

involve protecting networks, computers, online devices and data from attack, damage or unauthorized access, that is cyber security becomes very essential.

Moreover, cyber awareness is also very essential because everyone is dealing with the various e-Governance applications and processes. Many individual users are being targeted to attack the Government, bankingand other infrastructure in India. The application or system is easily compromised because lack of knowledge and awareness of individual users. It is required to create awareness among various stake holders including Indian citizens, public and private sectors, student communities, etc., as their interests has to be secured.

The rest of the paper is organized as follows: Section II discusses pillars of e-Governance and cyber threats. Section III discusses need of cyber security in e-Governance. Section IV is about need of cyber awareness in India. Section V contains the conclusion part of the study.

2. PILLARS OF E-GOVERNANCE AND CYBER THREATS

The e-Governance providesgreatest possible use of Internet technology to communicate and provide information to common peoples and businessman. Anyone can pay different types of bills such as electricity, water, phone, etc. over the internet in the era of digitization. It is essential to understand the four pillars upon which e-Governance is dependent. The success of electronic governance widely depends upon political strength, citizens' support and cooperation of various departments amongst each other. There are four pillars of e-Governance as shown in Figure 1 [2].

Figure 1 Pillars of e-Governance
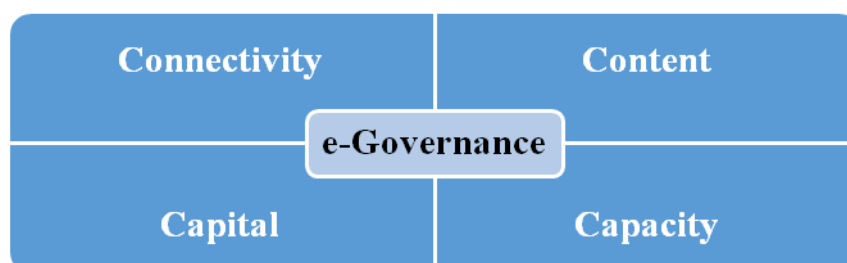
2.1 Connectivity: -

The main objective of e-Governance is to connect the people to the Governance services. The strong connectivity should be required for an effective e-governance.

2.2 Content: -

There should be data content to share with citizens. This database should be available in all regional language so that everyone can connect and use e-Governance services. It is helpful to create transparency in services between different e-Governance components such as G2C (Government to Customer), G2E (Government to Employee), G2B (Government to Business), G2G (Government to Government).

2.3 Capacity: -
Capacity is the ability to plan and implement government work in synergy with people, identifying and solving their problems so that actual benefits of e-Governance can be reaped.

2.4 Capital: -

Capital is referred as money used by Governance to provide their services or to that sector of the economy based on its operation. It fulfills the motive of speedy and efficient at subsidized rate with public and private partnership [3].

In e-Governance, government has to invest a lot for the data security solutions because hackers may pose the integrity of the critical national infrastructure and it becomes crucial disastrous of nation. e-Governance system is also major part of the nation and there are more security threats that harm the government confidentiality as well as citizen's data availability. Threat matrix for e-Governance is shown in Table 1, it is shown that cyber threats affect the pillars of e-Governance which is marks with '√' sign and candamage the confidentiality, integrity and/or availability of system.

Table 1: Cyber Threat Matrix for e-Governance

Pillars of e-Gov affected / Cyber Threat	Connectivity	Content	Capacity	Capital	e-Governance Components
Malware attacks	√	√	√	√	G2C
Denial of Services	√	√	√	√	G2E
Web Defacement	√	√			
Damage to critical databases & applications		√		√	G2B
Mobile Botnets	√		√		G2G

There are various cyber security incidents has gradually increased in India over the last few years. As per the information collected by Computer Emergency Response Team India (CERT-in), 44,679, 49,455 and 50,362 cyber security incidents took place in India during the years 2014, 2015 and 2016, respectively [4]. These incidents include phishing, website defacements, Denial of service attacks, etc.

3. NEED OF CYBER SECURITY IN E-GOVERNANCE

The main security measures such as firewall system, intrusion detection and intrusion prevention system (IDS/IPS), encryption and secure networks must be defined, designed and implemented for government agencies to provide the appropriate levels of security.The people and processes are dependent on the information systems that must be taken as consideration. The government employees as well as users must be trained on cyber security who are daily accessing e-Governance systems.

Electronic governance is implemented with highly complex processes that requires provisioning of hardware and software, networking and process re-engineering and change management. National e-Governance Plan (NeGP) contains the following elements as the methodology and implementation strategy in which cyber security role is required a most.

- Common Support Infrastructure
    - State Wide Area Networks (SWANs)
    - State Data Centres (SDCs)
    - Common Services Centres (CSCs)

- Electronic Service Delivery Gateways.
- Governance
  - Roles of NIC, STQC, CDAC, NISG for strengthen DEITY.
- Centralized Initiative with Decentralized Implementation
- Public-Private Partnerships
- Integrative Elements
- National and State Levels Programs
- Facilitator role of MEITY
- Ownership of Ministries

Graph 1: Indian website defacements tracked by CERT-in during 2017
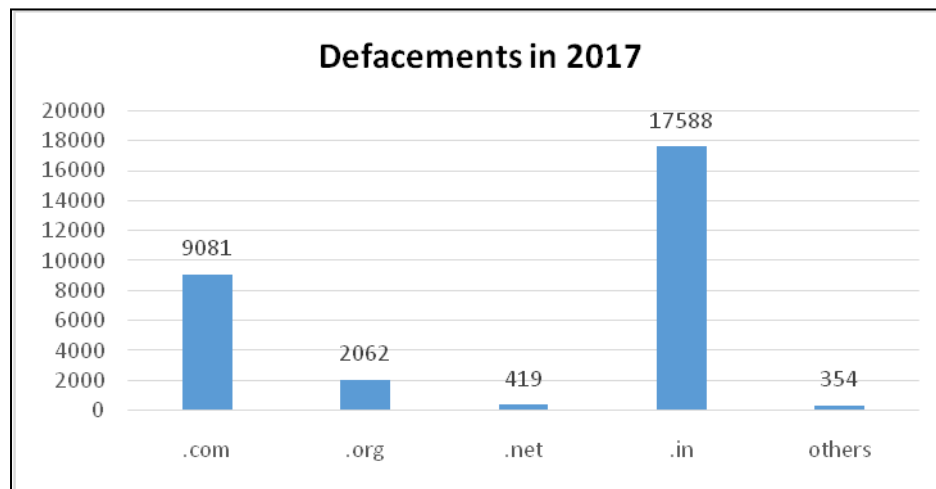
Source: Annual Report 2017, CERT-in

As shown in Graph 1, CERT-in tracked 17588 Indian website defacements incidents during 2017. CERT-in handled 53081 incidents during the year 2017. Various types of incidents such as website defacements, malware attacks, phishing attacks, Distributed Denial of Service attacks (DDoS), data theft, etc. were happened (Graph 2). In addition, 53692 spam incidents were also reported to CERT-in [3].

Graph 2: Summary of incidents handled by CERT-in during 2017
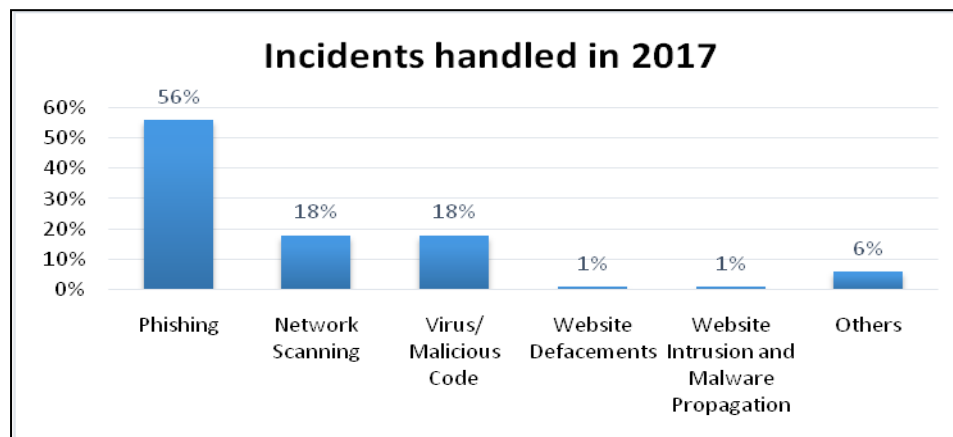
Source: Annual Report 2017, CERT-in

Figure 2: Challenges increasing in cyber space domain
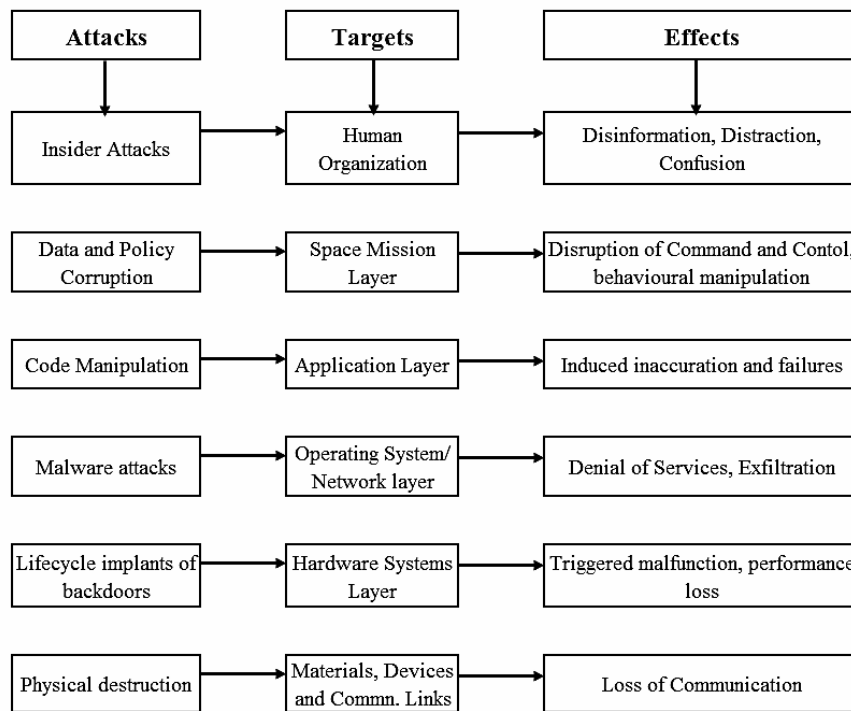
The challenges are increasing in cyber space domain as shown in Figure2. There are many initiatives taken by Indian government, but it is required to change mindset of citizens to support the implementation and the change will happen through e-Governance. Another challenge is business process reengineering, lack of need analysis across Mission Mode Project (MMP), managing with technology trends like Cloud Computing, Mobile and digital signatures and Policy issues. It is basic responsibility to take care of resources as well as to be aware about cyber security.

4. NEED OF CYBER AWARENESS IN INDIA

Cyber security is required for secured e-Governance and for assurance of citizens. Security assurance emphasis depends on the kind of environment in e-Governance.

Figure 3 Risk and mitigations strategies in e-Governance
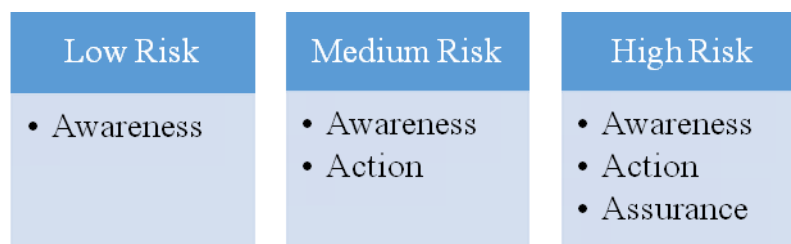
Cyber Security awareness concerns with the best practices at low risk in all the area of e-Governance as shown in Figure 3. As proactive measures people and government should know the security threats and the security policies to take proactive decisions for e-Governance Systems. Security failures

could be disastrous and may lead to unaffordable consequences, assurance that the security controls work when needed at high risk.

India is the fastest growing country and there would be more than 730 million Internet usersby 2020. The rank of India is 3rd after USA and China in terms of the highest number of internet users in the world. According to a 22 October report by security firm "Symantec Corp", India was ranked in the top five countries to be affected by cybercrime [5].

Cert-in conducts trainings and workshops for government officials and public sector industry to create security awareness within the public and private organizations. CERT-in has conducted 22 trainings on various specialized topics of cyber security in the year of 2017 [3].

Security challenges have increased in the past few years in terms of technical complexities, scale and its spread. Information Security domain has been continuously evolving to meet the increasing threats and challenges. Cyber security awareness is the best way to safely take part online as the Internet dependency is increasing. Indian government initiates Information Security Education and Awareness (ISEA) project for general users, academicians, children, government employee, etc. The guidelines are provided on the web portal about a complete understanding of cyber world with latest tips to safeguard every citizen of India. Indian citizens should be aware about cyber security and also share knowledge with others to be safe in digital world.

5. CONCLUSION

E-Governance has already started to conquer role in the global and economy. There are many initiatives taken for securing information systems at different levels in the e-Governance. Many government agencies, public-private partnership, network service providers, large businesses, common users are required to play their role to secure the cyber space within the country. There are so many challenges in cyber security; it is necessary to develop smart security solutions to secure e-Governance systems and infrastructure. Moreover, cyber security awareness is also very important for every Indian citizen to use this technology wisely.

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"A STUDY TO UNDERSTAND THE FACTORS AFFECTING GROWTH OF SHOPPING THROUGH MOBILE COMMERCE IN AHMEDABAD CITY"

Dr. Sarika Srivastava
Assistant Professor
Graduate School of Management Studies
Gujarat Technological University
Ahmedabad, India
ap2_cgbs@gtu.edu.in

Dipanti Joshi
Assistant Professor
Sal Institute of Management
Gujarat Technological University
Ahmedabad, India
dipantijoshi@gmail.com

ABSTRACT

Mobile commerce or M- commerce is an upgradation for shopping online via wireless handheld devices such as smartphones and tablets with a view to transact online for buying various items, payment of bills, booking of tickets etc. In late 90's, the information of internet and e- commerce transformed the way of business and the manner consumer interacts with business. A live example of the same is the way spending of the advertisement has started to move from traditional offline media to online and digital media because marketers have observed huge future opportunity to come close with their potential audience. This paper is aimed at identifying the factors which have direct impact on growth M- commerce applications for the purpose of shopping. The focus is to understand the reasons which positively impact on expansion of M- commerce from the point of view of business players and consumers as well.

Keywords:M-Commerce, E-Commerce, Online Shopping,

1. OVERVIEW OF MOBILE COMMERCE

M- Commerce is transaction of goods and services with the help of wireless devices such as smart phones and PDA-Personal Digital Assistance.[1] The concept of mobile commerce is to enable different applications and services available in the internet to portable devices. M-commerce is basically extended version of E- commerce as it facilitates the user to access with portable devices like mobile phones, tablets etc. Traditionally buying and selling was a matter of physical presence, negotiating with the seller and getting it delivered in real time. Today it is more about convenience, variety and availability. M-Commerce particularly refers to the ability of the customers to propose value through virtual transactions allowingfreedom of location- specificity and time- consumption.

Now a days, people have transferred over from the physical shopping to the mobile phones and the users have become mobile savvy in every aspect. They can get access of everything on smart phones which they want to do. From the applications of mobile phones they can access many facilities such as booking of movie tickets, booking of train or bus tickets, booking of table in a restaurant and much more than expected. So, smart phones have grabbed the latest desired shopping trends which every working individual can dream of.

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[1]https://www.techopedia.com/definition/1540/mobile-e-commerce-m-commerce

1.1 Internet Penetration in India

Fig. 1.1 Internet Penetration in India from 2008 to 2018
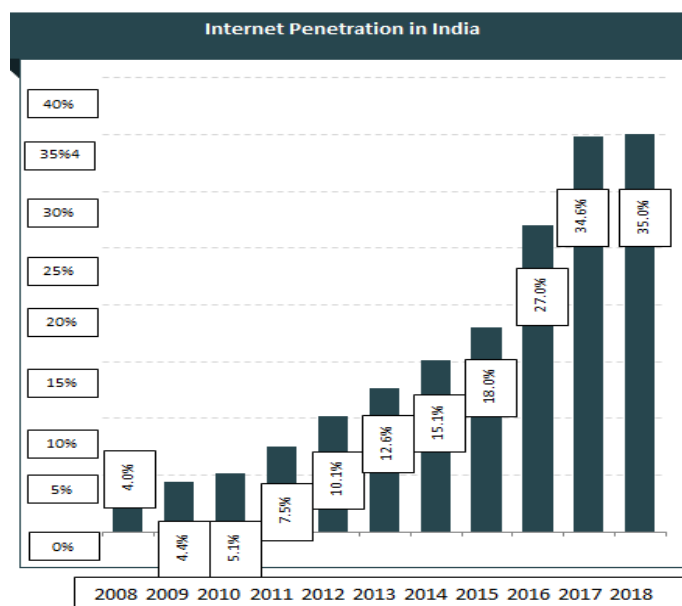
Figure 1.1 shows increasing penetration of internet in India. From 2008 to 2018, the graph of penetration is rapidly increasing. Urban and rural India in both the cases, Analysis of 'Daily Users' suggests that younger generations are the most prolific and old age people usually avoid doing transactions online. Postal mails and voice call are been replaced by messages and social media. M-Commerce enables marketers to connect with the potential consumers and other business partners without establishing physical presence in the market or initiating various types of business models such as LensKart and TravelKhan.[2]

Source: https://www.ibef.org/download/Ecommerce-March-2018

2. LITERATURE REVIEW

2.1 Chiang and Roy (2003) studied on consumer perception while shopping online via internet. The survey results depicted that consumers perceive online shopping more convenient rather than offline shopping. Online shopping was more preferred to avail vast variety and availability for searching rather than product experience.

2.2 Jonna Jarvelainen (2007) examined in her empirical study "Online Purchase Intentions: An Empirical Testing of a Multiple-Theory Model" in Finland that there are many online information seekers who choose to stop the shopping process just before the finishing point of the transaction. The study focused on security and confidentiality issues. The finding of this study demonstrated that trust worthiness and usefulness as well as ease of the use of the system are essential for online transactions.

2.3 Krzysztof Kapera (2012) examined in his study that over the past several years, the world has made enormous progress in the development of digital technologies. People use mobile devices for many reasons starting with communicating with each other, taking pictures, listening to music, playing games and many others new tools which cannot be expected in earlier days. The growing penetration rate of mobile phones with internet connectivity gives companies an opportunity to affect consumers in a different way. Hence, more and more businesses choose to use this tool to carry out marketing functions.

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[2]https://www.ibef.org/download/Ecommerce-March-2018

3. RESEARCH METHODOLOGY

3.1 Research Objectives

i. To understand the growth drivers of M- commerce in India. To identify the factors affecting expansion of shopping with the help of M- commerce applications in Ahmedabad city.

ii. To identify the factors affecting expansion of shopping with the help of M- commerce applications in Ahmedabad city.

3.2 Data collection Methods

The data for the purpose of the study consists of primary and secondary data.The secondary data have been collected from various available resources. The data sources include review of literature available in research papers published in various journals, books, authenticated websites and published reports by various agencies. Primary data was collected with the help of survey method. Well defined questionnaire was used as a research instrument. The questionnaire was randomly administered on professionals that include doctors, CA/CS, lawyers, academicians and engineers. Finally data received from 159 respondents working in Ahmedabad city has been used for further research.Data was collected only from those respondents who had done shopping in last six months with the help of mobile commerce.

4. DATA ANALYSIS

4.1 Growth Drivers of M-Commerce:

4.1.1 Increasing awareness[3]:

- **Demographic factors**: Due to the increasing awareness of internet over the years, large numbers of people are attracted to E- Commerce and M- Commerce. Be a supplier, investor and buyer people are being shifted to use online mode of selling and buying of the products. People are becoming more techno friendly due to various factors like time saving, convenience, offers etc. Numbers of online users are expected to increase by175 million within 2020. Online technocrats are the pillars of Indian online shopping industry. In India men are more techno friendly than women due to demographic and cultural factors.

- **Regional Factors**: Contribution of cities such as Mumbai, Bangalore, and New Delhi with their overpopulation is responsible for major part of online shopping in India. Tier II and III cities contributes 60% snap deal's purchase. Regions with less population also have generated a huge proportion of online sales. Flipkart also surveyed that there was sharp increase in branded products because of the usage of online shopping from tier 2 and tier 3 Indian towns.

- **Generation:** Youngsters with the age group of 25 to 34 years are the most active online shoppers who use online applications regularly. Many people who fall in the category of 35 plus years also buy products online every year. The reason is that they are the earning members of the family and generally remain busy in their profession. However, youngsters are still at number one position in using M- Commerce applications.

- **Convenience:** An effective and impactful driving force is discount that gives a comfortable facility of avoidance of location to purchase any product. Accessibility and availability of applications give

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[3]https://www.ibef.org/download/Ecommerce-March-2018.pdf
https://www.ibef.org/download/Ecommerce-March-2018/mcommercegrowthdrivers

customers a chance to choose from ample of options. Chat bots and personal assistant applications have made transactions user-friendly. Consumers can get vast number of products and brands from various distributers and sellers at one place under one roof of application and they can find the latest fashionable trends from different countries without the limits of geography and spending money on travel and roaming around the world.

- **No Language Barrier:** Search Engines and E retailers provide us the facility to have web content in our comfortable language. Hindi web content has increased by 155% in 2015, whereasthe same content has grown by 300% via mobile internet searching. To cover maximum benefit Make my trip and Snapdeal launched their applications in many regional domestic languages including Hindi in the year 2014. Online business providers observe this as an emerging opportunity segment that can be one of the growth factors in increasing usage of mobile applications in India. This facility works as an backbone for those who prefer transactions in their mother tongue rather than in English.

- **Cashless Transactions:** In recent years more than 140 million debit cards have been added in India. It has been observed that debit card usage has increased at point of sale billing counter by 86 percent during the same tenure. The data is sufficient to understand the comfortability people are having while using debit or credit cards rather than ATM withdrawals. Many retailers insist on making payments via cards rather than cash on high value transactions. In fact they also provide higher discounts and cash backs on particular card payments. To overcome the problem of availability of ATM machines, the card payment is the most feasible option an e-retailer can provide. Digital payments are the masters of game changer in the field of E- Commerce and M- commerce as well. The mindset of cash on delivery will be changed in near future as per MrSachin Bansal, Executive Chairman of Flipkart.According to a report from Google and BCG, due to increased usage of internet by emerging new users of internet and women, digital payments and transactions in India is expectedly increase to more than double to cross the number of US$ 100 billion within the year 2020.

4.1.2   *Government Initiatives:*

- The Government has taken various initiatives since 2014 namely Skill India, Digital India, Make in India, Start-up India. The effective and timely management of these initiatives will support M-commerce growth in our country.
- In The Union budget of 2018-2019, government has funded Rs 8000 cr. to the project of Bharat Net with a view to provide internet via broadband to the panchayats of 150000 villages. The target is to connect more than 250000 gram panchayats by the year to provide more accessibility for the rural India. The government has also planned to set up 500,000 public Wi-Fi hotspots for providing broadband service to 50 million people of villages. It has also allocated Rs. 3073 cr. for the project of Digital India in 2018-19.[4]
- Mr. Arun Jaitely - Finance Minister has suggested different parameters to fasten India's payment mode of transactions for the improvement of cashless economy. This also includes ban on transactions of cash over Rs.300000 and tax incentives to promote cashless infrastructure as to increase more and more Aadhar based payments.
- As the BHIM application have launched, it will boost the digital payments in the country. So far 12.5 million people have adopted BHIM application which is a good number.Along with the same there will be launching of two new schemes such as Referral Bonus Scheme for personal and cash back

offers for merchants. Other than BHIM , many application provide payment services for buyers and sellers of India like Paytm, Freecharge etc.[5]

- All the banks and companies have been instructed by Reserve bank of India to cover-up all the KYCs- Know Your Customer with view to integrate it with mobile wallets and Unified Payment Interface (UPI) by the end of year 2018.[6]

- The Indian government has also rewarded worth around Rs. 153 cr. to 1 million customers for the early acceptance and usage of mobile digital payments to encourage them in further usage under the Lucky GrahakYojana and Digi- Dhan Vyapar Yojana.

- An E-commerce portal has also been launched by Indian government named Trifed and M-commerce application named Tribes India which will help 55000 tribal skilled people to show their talent and earn money as well.[7]

4.1.3 Investments:

An online B2B, Business to Business,marketplace has been launched by Amazon to enable small and domestic enterprisesto buy and sell the products on an online common platform. Metro Cash and Carry, Germany-based, B2B retail store chain is observing an emerging opportunity to start E- Commerce and M- Commerce solutions for B2Bbusiness in India by the end of 2018. Power2SME, one of the largest B2B online marketplaces in India providing raw materials to small scale enterprises has grown to US$36 million from investors capital, Accel Partners and others in September 2017, which will be used towards technology, sales, marketing and geographic expansion.

Increasing FDI inflows, domestic investments, support from key industrial players is helping in the growth of e- commerce. By judging the benefits of entering in to the mobile commerce platforms have increased the investment patterns of supply chain industry. The products being offered to such platforms are usually purchased directly and sell it to the end users directly as well. This would reduce the overall cost of product and increase in the profit of mobile commerce developers. A record break of US$ 9.6 billion has happened from venture capital firms between the month of January and September 2017, which doubled the amount of raised capital during the same period of 2016.

The first six months of 2017 recorded 26 start-up funding deals of value US$ 100 million and above, aggregating to US$ 7.7 billion and responsible for 68 per cent of investments during the period.

Table No. 1: Investments in Mobile Commerce Application-2017

Investor company	Funding	(US$ m)
Flipkart	Soft bank	2,500
Big Basket	Ali baba Group Holding Ltd, Sands capital venture, International Finance corporation, Abraaj Capital	300

Source: https://www.ibef.org/download/Ecommerce-March-2018

4.2 To identify the factors affecting expansion of shopping through M- commerce

To satisfy the above mentioned objective, researchers identified the factors which have high Impact on the perception of shopping among consumers via M-commerce.

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[5]https://www.mygov.in/task/10-initiatives-digital-india/

[6]http://digitalindia.gov.in/content/recent-e-governance-initiatives

[7]http://www.digitalindia.gov.in/di-initiatives

Table No. 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.674
Bartlett's Test of Sphericity	Approx. Chi-Square	670.885
	Df	120
	Sig.	.000

The KMO analysis measures the sampling adequacy (which determines if the responses given with the sample are adequate or not) must be in near value to 0.5 for a genuine factor analysis process. Kaiser (1974) suggested the value 0.5 (value for KMO) as minimum (barely accepted), values between 0.7-0.8 can be accepted, and values above 0.9 are very much sufficient to take in to consideration. Looking at the table below, the KMO measure is 0.674, which is close of 0.7 and therefore can be accepted. The datasuggests that factor analysis was done.

Table No. 3: Total Variance Explained

Component	Initial Eigenvalues Total	% of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %	Rotation Sums of Squared Loadings Total	% of Variance	Cumulative %
1	4.167	26.043	26.043	4.167	26.043	26.043	2.326	14.535	14.535
2	1.621	10.132	36.176	1.621	10.132	36.176	2.153	13.455	27.991
3	1.403	8.770	44.945	1.403	8.770	44.945	2.152	13.448	41.439
4	1.260	7.874	52.819	1.260	7.874	52.819	1.543	9.647	51.086
5	1.149	7.184	60.003	1.149	7.184	60.003	1.427	8.917	60.003
6	.985	6.154	66.156						
7	.946	5.911	72.068						
8	.817	5.106	77.173						
9	.722	4.514	81.688						
10	.605	3.782	85.470						
11	.520	3.250	88.720						
12	.485	3.033	91.752						
13	.425	2.659	94.411						
14	.369	2.304	96.714						
15	.328	2.050	98.765						
16	.198	1.235	100.000						

These constructs represent the perception of mobile commerce application, in which there were sixteen questions. After doing KMO test, researchers have done variance analysis the table of which is mentioned below. The table of variance represents that with the five factors, 60% impact on perception of mobile commerce application.

Table 2.3 Component Matrix[a]

	Component				
	1	2	3	4	5
Wireless device is more user friendly equipment		.671			
Customers can easily access shopping sites through applications			.643		
Stable and strong transmission of mobile data				.821	
Mobile commerce applications have Adequate search option	.608				
Detailed Product assortment helps in shopping					
Cash on delivery is safer payment option			.840		
All Debit /Credit Cards are acceptable in most of the application					.779

Process of exchange is easy			.664	
Refund policies are less ambiguous	.609			
Less concerns of breach of security		.615		
Transfer of money via Mobile phones is safe	.800			
Assured delivery verification is to be done	.710			

Above table suggests that out of sixteen, eleven factors have major impact on the shopping preference via mobile commerce applications. These questions have more than 60% impact on the perception of mobile commerce applications. Looking at the table researchers came to know that four factors belong to factor 1(adequate search option,less ambiguous refund policy, less ambiguous transfer of money, assured delivery verification) with the impact factor value above 0.6(.608, .609, .800, .710 respectively). Factor 2 includes two factors (user-friendliness, less concerns of breach of security) with the value above 0.6(.671 and .615 respectively).Factor 3 has three factors (easy accessibility, cash on delivery, easy exchange process) with values above 0.643(.643, .840, .664 respectively). Factor 4 has one factor(transmission of network) with impact value 0.821 and the fifth factor also hasone factor (acceptability of debit and credit cards) with the impact value 0.779. According to analysis the most influential factor is cash on delivery that has maximum impact on perception of using mobile commerce applications by consumers.

FINDINGS:

While investigating secondary data, researchers came across with the factors that are driving forces of M-commerce usage. Basically there are three major driving forces- Increasing awareness amongst consumers, Government initiatives and Investments in M- commerce market. Increasing initiatives of government leads to more financial benefits of M- commerce players as well as consumers. With the use of primary data, researchers have done factor analysis to identify the important factors that have influence on perception of mobile commerce application. From the analysis, eleven factors were identified which have major impact on perception of mobile commerce application. The factors can be listed as user-friendliness, accessibility, transmission of network, adequate search option, easy money transfer, cash on delivery, acceptability of debit and credit card, easy process of exchange, less ambiguous refund policies, less concerns of breach of security, safety and delivery verification. To increase the growth of mobile commerce in market, the e –retailers have to consider these factors. By working on these factors and improving them, e- retailers can grow in the Indian market.

CONCLUSION:

From findings of the paper, researchers have identified factors that have direct and huge impact on the usage of M- commerce. This data can be useful to M- commerce players and all those business players who wish to go for an application based business strategy in near future. Researchers have also identified the obstacles in using m- commerce and from the data it was found that computer literacy should be enhanced in order to get real benefit of M-commerce. More free Wi-Fi zones should be created to overcome accessibility issues while purchasing products online. Applications must be designed in such user-friendly way so that everyone can understand it very easily. To overcome the issue of safety, M-commerce players should provide more privacy safety options and cash on delivery payment mode. Many people find exchange and refund policies ambiguous, so to cope up this challenge market players should make easy to understand and quick exchange and return policies. Similar research can be extended to other cities of the country to generalize the findings.

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A STUDY ON SELECTED PERCEIVED QUALITY PARAMETERS OF GENERIC MEDICINES AMONGST REGISTERED MEDICAL PRACTITIONERS OF AHMEDABAD

Dr. Kaushal Bhatt
Assistant Professor
Graduate School of Management Studies
Gujarat Technological University
Ahmedabad, Inida
ap1_cgbs@gtu.edu.in

Maaz Saiyed
Research Scholar
Graduate School of Management Studies
Gujarat Technological University
Ahmedabad, India
maaz.arshia@gmail.com

ABSTRACT

Perceived Quality of Generic Medicine and its dimension have been studied by different authors since years, but direct relationship between perceived quality and its parameters (i.e. Overall Knowledge, Overall Availability, Overall Trust and Faith, & Overall Risk) of generic medicines amongst gender, category and qualifications of RMP of Ahmedabad has not been studied. In this research, researcher wants to study the differences in perceived quality of generic medicines amongst the registered medical practitioners of Ahmedabad city. To study this, the type of research used by the researcher is descriptive research and the involved sampling technique is non-probability convenience sampling. In this research the researcher wants to mainly study what the registered medical practitioners of Ahmedabad city are thinking about the generic medicines. For this a structured questionnaire was framed and questions regarding the different aspects of generic medicines were asked in a proper manner. The data from a sample of 137 registered medical practitioners of Ahmedabad city was considered and later it was analyzed by the help of SPSS software. Different statistical tools like ANOVA, Independent Sample t-test, Descriptive analysis, Correlation and Regression was found suitable and applicable to the type of data collected. After application of all the tools it was found that there is significant difference between males and females with regard to overall trust, overall risk, overall knowledge and overall availability. Also it was clear by the study that there is significant difference between categories (i.e. GP, Consultant and Specialist) with regard to overall trust, overall risk, overall knowledge and overall availability.

Keywords: RMPs, Generic Medicines, Perceived Quality, Pharmaceutical, Branded medicines, Pharma Companies

1. INTRODUCTION

Healthcare in India has grown rapidly over the years and has become one of the biggest sectors today in terms of revenues and employment. Owing to its impressive CAGR of 16.5%, the industry size is expected to cross USD 280 billion by 2020[8] (Ahmad, 2018) as per Frost & Sullivan, LSI Financial Services estimates. The improved coverage, the rise in spends by both private and public players, the mergers and acquisitions between domestic and foreign players, the success rate among the Indian companies to secure the Abbreviated New Drug Application (ANDA) and the opportunities in R&D as well as medical tourism are the key reasons for the industry's flourishing growth rate.

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[8]Ahmad, S. (2018). Indian pharma industry is expected to cross $ 280 billion mark by 2020. Retrieved from https://www.business-standard.com/article/companies/indian pharma industry-is-expected-to-cross-280-billion-mark-by-2020-118051801480_1.html

It is an open secret that American democracy is more than 260 years old. Unlike India, it attracts the best of the talents from the world, and the public is ruled by a set of governance with a minimal bureaucratic control. Contrary to that, we are a developing nation with a short history, and merit has very often than not been a casualty. While the perception of the decision is poor-centric, ultimately it is this class which bears the brunt of poor quality in a system dominated by rich and the powerful.

The story of generics versus branded medicine being used to treat patients all over the world is not new. While there is no denial of the fact that good quality generics are always comparable to the branded medicine, the quality of the product depends on the sophisticated processing and manufacturing of a research molecule. While in United States, there is a stringent quality control and a serious periodic monitoring of the quality, this is far from truth in India, where to get a drug license through political or bureaucratic connections by corrupt means is as easy as buying vegetables in the market. The drug control mechanisms in India have huge limitations both in terms of availability of manpower and technology. Rampant corruption in the system makes it worse[9].(Panagariya, 2017)

With the mushrooming of pharma companies with incentives, the owner of the drug stores shall be least concerned with the quality of the drug. While it is true that some of the medical professionals have been hand-in-glove with the pharma companies and could have harmed patient interests, Chemists are unregulated and have no obligations, ethical or commercial for selling products. No medical professional would be against the low cost generic, provided it that is a quality drug but it is believed that not more than 1% of generic drugs sold in India undergo quality tests as practiced in USA or Europe[10]. (Panagariya, 2017) Ensuring availability of uniform quality of generic drugs would facilitate doctors to prescribe them with confidence. If this is ignored it is likely to create a disastrous situation for the common men where his suffering would increase if he is dispensed "cheaper" poor quality generics. The brunt would fall on the have-nots since, the affluent and the powerful would always manage the quality drugs either generic or branded. This has happened in the larger government institutions where the branded medicines were replaced by generics. Remember while comparing generics with the branded medicines, it is just not the content of the ingredient, it is the purity and the concentration producing effective biological levels in the blood. Another fallout of the proposed change would negatively incentivise pharma companies to invest in research and development. Not only will it create huge unemployment issues but will also greatly hamper creation of newer molecules[11].(Pan, 2018)

2. REVIEW OF LITERATURE

2.1 Effect of perceived quality on Generic Medicines
ShamindraNathSanyal, Saroj Kumar Dattafound (1992) that the value premium of the brand was largely although indirectly dependent on the perception towards the quality of branded generics. Secondly, people would have better expectations from physicians who provide a quality experience, irrespective of minor alterations in the quality of the drug.

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[9]Panagariya, A. (2017). Generic medicines in India: The myth and the truth behind the healthcare issue - Firstpost. Retrieved from https://www.firstpost.com/india/generic-medicines-in-india-the-myth-and-the-truth-behind-the-healthcare-issue-3413204.html

[10]Panagariya, A. (2017). Generic medicines in India: The myth and the truth behind the healthcare issue - Firstpost. Retrieved from https://www.firstpost.com/india/generic-medicines-in-india-the-myth-and-the-truth-behind-the-healthcare-issue-3413204.html

[11]Pan, A. (2018). PressReader.com - Connecting People Through News. Retrieved from https://www.pressreader.com/india/rural-marketing/20170601/282437054102089

2.2 Factors affecting the opinions of physicians regarding generic drugs

PawelLewek, JanuszSmigielski, PrzemyslawKardasfound (2001) that physicians recommend cheaper alternatives to branded drugs to their patients and suggest them for personal use. These factors in turn affect the physician's perception of generic drugs.

2.3 Evaluation the Awareness and Attitudes of Physicians Towards Generic Medicines

GauriBilla, Karan Thakkar, SaritaJaiswar, Dinesh Dhodi (2003) found that the doctors did acknowledge the rising cost of medicines. The research also stresses the requirement for alternative medicines that are affordable and emphasizes the role of the government in cutting down on the value of prescription medicines.

2.4 Physicians' and Pharmacists' Perspectives on Generic Drug Use

Else-Lydia Toverud, Katrin Hartmann, HelleHa°konsen (2003) found in their research that physicians were aware of the positive impact generic drugs have in making medicines globally accessible. The researchers also point out that the perception towards generic drugs also varies by the development of their healthcare systems. For instance, countries with advanced healthcare systems produce generic alternatives that are adequately bioequivalent and hence are safer for consumption.

2.5 Perceptions and attitudes of Physicians

Abdullah A. Alghasham (2008) found that while most physicians responded favourably towards the substitution of branded medicines with generic alternatives, there were certain cases where they recommended branded drugs. Secondly, companies with a brand name were more likely to send their representatives on visits or to distribute samples to physicians. Thirdly, physicians believed the government could play a positive role in ensuring the quality of the generic drugs and compel the physicians to prescribe them. Fourthly, there was no major variation in the degree of pressure faced by physicians from customers in prescribing branded drugs or their generic substitutes.

3. RESEARCH METHODOLOGY

3.1 Research Gaps

1. As this study is targeting the RMPs across the city Ahmedabad which highly unexplored landscape when it comes to study like this on Generic Medicines and their perceived quality.
2. Also by this study researcher wants to target the RMPs of Ahmedabad, as this is not researched market.

3.2 Research Questions

1. What are the differences in perceived quality parameters (i.e. Overall Knowledge, Overall Availability, Overall Trust and Faith, & Overall Risk) of generic medicines amongst gender of RMP of Ahmedabad?
2. What are the differences in perceived quality parameters (i.e. overall perceptions, overall BABE, overall efficiency, overall efficacy, overall risk and overall trust and faith) of generic medicines amongst category and qualification of RMP of Ahmedabad?

3.3 Research Objectives

- To study the difference in perceived quality parameters (i.e. Overall Knowledge, Overall Availability, Overall Trust and Faith, & Overall Risk) of generic medicines amongst gender of RMP of Ahmedabad
- To study the difference in perceived quality parameters (i.e. overall perceptions, overall BABE,

overall efficiency, overall efficacy, overall risk and overall trust and faith) of generic medicine

3.4 Research design

The target population comprise individuals who are currently Registered Medical Practitioner, in the hospitals of Ahmedabad and belong to all income groups. The target group has been restricted by geography and the sample has been selected from Ahmedabad city of Gujarat, India Hence I firmly select **Descriptive research** design for our research work.

3.5 Data Sources

3.5.1 Secondary Data: Through
1. Published Papers in renowned Journals
2. Renowned Pharma Journals
3. Articles
4. Government Policies
5. Books
6. Internet
7. Current Government Drug Policy

3.5.2 Primary Data:
The researcher will attempt to collect the response of 137 respondents through Questionnaires.

3.6 Sampling design
Convenience sampling have been employed for determining the sample of 137 respondents. The respondents in the sample includes Registered Medical Practitioner of all the specialization across Urban, Semi – Urban and Rural areas.

3.7 Variable of the Study
There are two type of variable that have been considered in the study.
1. Independent Variables
2. Dependent Variable

Independent Variables: *Dependent Variable:*

| Overall Knowledge |
| Overall Perception |
| Overall Efficiency |
| Overall BABE |
| Overall Availability |
| Overall Trust and Faith |
| Overall Risk |
| Overall Efficacy |

Overall Perceived Quality
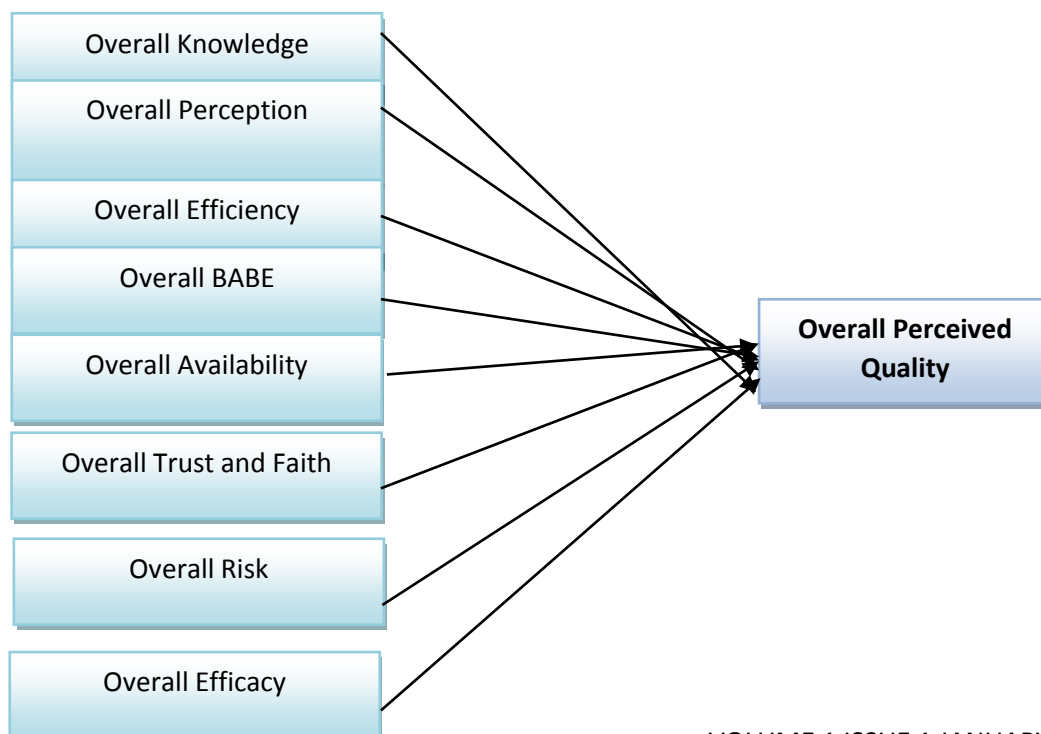
3.8 Hypotheses of the Study

Table 1 List of Hypothesis

Sr. No	Hypothesis
1	H_0: There is no significant difference between genders of RMPs regarding overall perceived quality parameters (i.e. overall perceptions, overall BABE, overall efficiency, overall efficacy, overall risk and overall trust and faith).
2	H_0: There is no significant difference among various categories of RMPs regarding overall perceived quality parameters (i.e. overall perceptions, overall BABE, overall efficiency, overall efficacy, overall risk and overall trust and faith) of generic medicine.
3	H_0: There is no significant difference among various qualifications of RMPs regarding overall perceived quality parameters (i.e. overall perceptions, overall BABE, overall efficiency, overall efficacy, overall risk and overall trust and faith) of generic medicine.

4. DATA ANALYSIS AND INTERPRETATION:

The difference in Gender with regards Overall Knowledge Overall Availability, Overall Trust and Faith and Overall Risk of Generic Medicine

T-Test

Independent Samples Test		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	Df
OK N	Equal variances assumed	7.068	.009	2.569	135
	Equal variances not assumed			2.665	134.663
OA V	Equal variances assumed	.821	.367	2.497	135
	Equal variances not assumed			2.467	120.586
OT F	Equal variances assumed	.163	.687	2.391	135
	Equal variances not assumed			2.356	118.934
OR SK	Equal variances assumed	.052	.820	-3.468	135
	Equal variances not assumed			-3.484	129.097

4.1 Gender and Overall Knowledge

H_0: There is no significant difference between male and female regarding overall knowledge
H_1: There is significant difference between male and female regarding knowledge

Considering the independent sample test table, the value F suggest 7.068 with significant value is 0.009, it indicates that Levene's Test significant value which is less than 0.05, it indicates that there is no similarity in the variance between male and female. Considering the t value is 2.569, and significant two tailed

value is 0.009, which is <u>less than *0.05, so* the researcher **rejects** null Hypothesis.</u> It indicates that there is significant difference between male and female regarding the overall knowledge

4.2 Gender and Overall Availability

H_0: There is no significant difference between male and female regarding overall availability
H_2: There is significant difference between male and female regarding availability

Considering the independent sample test table, the value F suggest 0.821 with significant value is 0.367, it indicates that Levene's Test significant value which is less than 0.05, it indicates that there is no similarity in the variance between male and female. Considering the t value is 2.497, and significant two tailed value is 0.367, which is <u>less than *0.05, so* we **Accept**null Hypothesis.</u> It indicates that there is no significant difference between male and female regarding the overall availability.

4.3 Gender and Overall Trust and Faith

H_0: There is no significant difference between male and female regarding overall trust and faith
H_3: There is significant difference between male and female regarding trust and faith

Considering the independent sample test table, the value F suggest 0.163 with significant value is 0.687, it indicates that Levene's Test significant value which is less than 0.05, it indicates that there is no similarity in the variance between male and female. Considering the t value is 2.391, and significant two tailed value is 0.687, which is <u>less than *0.05, so* we **Accept**null Hypothesis.</u> It indicates that there is no significant difference between male and female regarding the overall trust and faith.

4.4 Gender and Overall Risk

H_0: There is no significant difference between male and female regarding overall risk
H_4: There is significant difference between male and female regarding risk

Considering the independent sample test table, the value F suggest 0.052 with significant value is 0.820, it indicates that Levene's Test significant value which is less than 0.05, it indicates that there is no similarity in the variance between male and female. Considering the t value is -3.468, and significant two tailed value is 0.820, which is <u>less than *0.05, so* we **Accept**null Hypothesis.</u> It indicates that there is no significant difference between male and female regarding the overall risk.

4.5 Category and Overall Perceptions
Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
OPE	Based on Mean	2.656	2	134	.074
	Based on Median	1.854	2	134	.161
	Based on Median and with adjusted df	1.854	2	50.859	.167
	Based on trimmed mean	1.913	2	134	.152

The Levene's Test table indicated that F ratio between and within the sample is 2.656 it means variations between the samples is 2 times more than the variations within the samples. While significant value of the test is 0.074 which is more than 0.05, it indicates that there is no significant difference amongst the value of variance in different groups.

H_0: There is no significant difference among various categories of doctor regarding overall perceptions of generic medicine

H_1: There is significant difference among categories of doctor regarding overall perceptions of generic medicine

Here the researcher wants to understand if there is any significant difference amongst the group related with overall perceptions with respect to categories of doctors.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
OPE	Between Groups	2.414	2	1.207	3.554	.031
	Within Groups	45.499	134	.340		
	Total	47.912	136			

This is the core part of one-way ANOVA analysis and that will derive there is a significant difference amongst the group or not. Here the researcher has the model of test between the subject effects. So far as this content is concerned, the researcher has considered various category groups as a fixed factor and overall perceptions is considered as a dependent variable. For the category group, the value of F ratio is 3.554; The value of significance is 0.031 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference among various category groups and overall perceptions.

Here the researcher wants to understand in which of the categories of doctors, significant difference has higher values regarding overall perceptions of Generic Medicines.

4.6 Post Hoc Tests

Multiple Comparisons

Tukey HSD							
Dependent Variable	(I) q4category	(J) q4category	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
OPE	Gp	specialist	.12343	.11525	.534	-.1497	.3966
		consultant	-.23556	.12719	.157	-.5370	.0659
	specialist	Gp	-.12343	.11525	.534	-.3966	.1497
		consultant	-.35899*	.13538	.024	-.6798	-.0381
	consultant	Gp	.23556	.12719	.157	-.0659	.5370
		specialist	.35899*	.13538	.024	.0381	.6798

*. The mean difference is significant at the 0.05 level.

Specialist: analyzing the Tukey multiple comparisons, the mean difference of is -0.35899 and significant value is 0.024 and consultant significant value is 0.024 is less than 0.05 indicates that these two categories are significantly different in terms of average value for overall perceptions.

4.7 Category and Overall Efficiency

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
OEF	Based on Mean	.780	2	134	.461
	Based on Median	.729	2	134	.485
	Based on Median and with adjusted df	.729	2	128.807	.485

Based on trimmed mean	.588	2	134	.557	

The Levene's Test table indicated that F ratio between and within the sample is 0.780 it means variations between the samples is 1 time more than the variations within the samples. While significant value of the test is 0.461 which is more than 0.05, it indicates that there is no significant difference amongst the value of variance in different groups.

H_0: There is no significant difference among various categories of doctor regarding overall efficiency of generic medicine

H_2: There is significant difference among categories of doctor regarding overall efficiency of generic medicine

Here the researcher wants to understand if there is any significant difference amongst the group related with overall efficiency with respect to categories of doctors.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
OEF	Between Groups	5.550	2	2.775	7.780	.001
	Within Groups	47.791	134	.357		
	Total	53.341	136			

This is the core part of one-way ANOVA analysis and that will derive there is a significant difference amongst the group or not. Here the researcher has the model of test between the subject effects. So far as this content is concerned, the researcher has considered various category groups as a fixed factor and overall efficiency is considered as a dependent variable. For the category group, the value of F ratio is 7.780; The value of significance is 0.001 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference among various category groups and overall efficiency.

Once the researcher has derived statistical inferences amongst the category groups, now the researcher wants to understand that which category group is significantly associated with remaining category groups and which category groups is significantly different than the remaining. Since the category groups having equal intervals the researcher has applied post hoc Tukey test to derive the facts.

4.8 Post Hoc Tests

Multiple Comparisons

						95% Confidence Interval	
Dependent Variable	(I) q4category	(J) q4category	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
OEF	Gp	specialist	-.20107	.11812	.208	-.4810	.0789
		consultant	.34486*	.13035	.025	.0359	.6538
	specialist	Gp	.20107	.11812	.208	-.0789	.4810
		consultant	.54593*	.13875	.000	.2171	.8748
	consultant	Gp	-.34486*	.13035	.025	-.6538	-.0359
		specialist	-.54593*	.13875	.000	-.8748	-.2171

Consultant: analyzing the Tukey multiple comparisons, the mean difference of is -0.34486 and significant value is 0.025 and GP significant value is 0.025 is less than 0.05 indicates that these two categories are significantly different in terms of average value for overall efficiency.

Consultant: analyzing the Tukey multiple comparisons, the mean difference of is -0.54593 and significant value is 0.000 and specialist significant value is 0.000 is less than 0.05 indicates that these two categories are significantly different in terms of average value for overall efficiency.

4.9 Category and Overall Trust and Faith
Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
OTF	Based on Mean	8.480	2	134	.000
	Based on Median	6.783	2	134	.002
	Based on Median and with adjusted df	6.783	2	90.775	.002
	Based on trimmed mean	8.771	2	134	.000

The Levene's Test table indicated that F ratio between and within the sample is 8.480 it means variations between the samples is 8 times more than the variations within the samples. While significant value of the test is 0.000 which is less than 0.05, it indicates that there is significant difference amongst the value of variance in different groups.

As Homogeneity of Variances is not found, it is not possible to test them for ANOVA.

An alternative test of Anova known as Welch Test is performed in order to find the relation.

H_0: There is no significant difference amongst various categories of doctor regarding overall trust and faith of generic medicine

H_3: There is significant difference amongst categories of doctor regarding overall trust and faith of generic medicine

Here the researcher wants to understand if there is any significant difference amongst the group related with overall trust and faith with respect to categories of doctors.

Robust Tests of Equality of Means

	Statistic[a]	df1	df2	Sig.
Welch	4.478	2	67.369	.015

a. Asymptotically F distributed.

This is the core part of Welch Test analysis and that will derive there is a significant difference amongst the group or not. Here the researcher has the model of test between the subject effects. The value of F ratio is 4.478; The value of significance is 0.015 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference among various category groups and overall trust and faith.

Once the researcher has derived statistical inferences amongst the category groups, now the researcher wants to understand that which category group is significantly associated with remaining category groups and which category groups is significantly different than the remaining. Since the category groups having equal intervals the researcher has applied post hoc Games – Howell test to derive the facts.

4.10 Post Hoc Tests

Multiple Comparisons

					95% Confidence Interval	95% Confidence Interval
(I) q4category	**(J) q4category**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	Lower Bound	Upper Bound
Gp	Specialist	.34039*	.13887	.045	.0066	.6742
	Consultant	.24749	.11272	.081	-.0245	.5195
Specialist	Gp	-.34039*	.13887	.045	-.6742	-.0066
	Consultant	-.09290	.16049	.832	-.4768	.2910
Consultant	Gp	-.24749	.11272	.081	-.5195	.0245
	specialist	.09290	.16049	.832	-.2910	.4768

Header: Games-Howell

*. The mean difference is significant at the 0.05 level.

GP: analyzing the Games – Howell multiple comparisons, the mean difference of is 0.34039 and significant value is 0.045 and specialist significant value is 0.045 is less than 0.05 indicates that these two categories are significantly different in terms of average value for overall trust and faith.

4.11 The difference among various qualifications of RMPs regarding overall perceived quality parameters (i.e. overall perceptions, overall BABE, overall efficiency, overall efficacy, overall risk and overall trust and faith) of generic medicine.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
OAV	Between Groups	10.432	3	3.477	8.416	.000
	Within Groups	54.951	133	.413		
	Total	65.383	136			
OPE	Between Groups	4.609	3	1.536	4.718	.004
	Within Groups	43.303	133	.326		
	Total	47.912	136			
OBABE	Between Groups	6.328	3	2.109	6.136	.001
	Within Groups	45.720	133	.344		
	Total	52.049	136			
OEF	Between Groups	4.780	3	1.593	4.364	.006
	Within Groups	48.560	133	.365		
	Total	53.341	136			
OTF	Between Groups	5.769	3	1.923	5.223	.002
	Within	48.971	133	.368		

	Groups					
	Total	54.740	136			
ORSK	Between Groups	8.258	3	2.753	8.408	.000
	Within Groups	43.543	133	.327		
	Total	51.801	136			
OEFFIC ACY	Between Groups	11.532	3	3.844	8.376	.000
	Within Groups	61.041	133	.459		
	Total	72.573	136			

4.12 Qualification and Overall Availability

H_0: There is no significant difference amongst various qualifications of doctor regarding overall availability of generic medicine

H_1: There is significant difference amongst various qualifications of doctor regarding overall availability of generic medicine

In the core part of one-way ANOVA analysis and that will derive there is a significant difference amongst the group or not. Here the researcher has the model of test between the subject effects. So far as this content is concerned, the researcher has considered various qualifications groups as a fixed factor and overall availability is considered as a dependent variable. For the category group, the value of F ratio is 8.416; The value of significance is 0.000 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference amongst various qualifications groups and overall availability.

4.13 Qualification and Overall Perceptions

H_0: There is no significant difference amongst various qualifications of doctor regarding overall perceptions of generic medicine

H_2: There is significant difference amongst various qualifications of doctor regarding overall perceptions of generic medicine

For the category group, the value of F ratio is 4.718; The value of significance is 0.004 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference amongst various qualifications groups and overall perceptions.

4.14 Qualification and Overall BA-BE

H_0: There is no significant difference amongst various qualifications of doctor regarding overall BA-BE of generic medicine

H_3: There is significant difference amongst various qualifications of doctor regarding overall BA-BE of generic medicine

For the category group, the value of F ratio is 6.136; The value of significance is 0.001 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference amongst various qualifications groups and overall BA-BE.

4.15 Qualification and Overall Efficiency

H_0: There is no significant difference amongst various qualifications of doctor regarding overall efficiency of generic medicine

H_4: There is significant difference amongst various qualifications of doctor regarding overall efficiency of generic medicine

For the category group, the value of F ratio is 4.364; The value of significance is 0.006 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference amongst various qualifications groups and overall efficiency.

4.16 Qualification and Overall Trust and Faith

H_0: There is no significant difference amongst various qualifications of doctor regarding overall Trust and Faith of generic medicine

H_5: There is significant difference amongst various qualifications of doctor regarding overall Trust and Faith of generic medicine

For the category group, the value of F ratio is 5.223; The value of significance is 0.002 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference amongst various qualifications groups and overall trust and faith.

4.17 Qualification and Overall Risks

H_0: There is no significant difference amongst various qualifications of doctor regarding overall risk of generic medicine

H_6: There is significant difference amongst various qualifications of doctor regarding overall risk of generic medicine

For the category group, the value of F ratio is 8.408; The value of significance is 0.000 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference amongst various qualifications groups and overall risks.

Qualification and Overall Efficacy

H_0: There is no significant difference amongst various qualifications of doctor regarding overall efficacy of generic medicine

H_7: There is significant difference amongst various qualifications of doctor regarding overall efficacy of generic medicine

For the category group, the value of F ratio is 8.376; The value of significance is 0.000 which is less than 0.05, it indicates that Null Hypothesis cannot be accepted and in this case the researcher accepts the alternative Hypothesis. Hence there is significant difference amongst various qualifications groups and overall efficacy.

5. FINDINGS

- ❖ When overall different aspects of perceived quality have been checked considering gender, it has been found out that there is significant difference between males and females with regard to overall trust, overall risk, overall knowledge and overall availability.

❖ There is significant difference with regard to overall perception among various categories namely general practitioners, specialists and consultants. Further considering the post hoc analysis it has been found out that Specialist and consultants are significantly different in terms of average value for overall perceptions when multiple comparisons between different categories has been performed. More over specialist uses more generic medicine in comparison to the consultants.

❖ There is significant difference with regard to overall efficiency among various categories namely general practitioners, specialists and consultants. Further considering the post hoc analysis it has been found out that consultants and GP are significantly different in terms of average value for overall efficiency when multiple comparisons between different categories has been performed. Further considering the post hoc analysis it has been found out that consultants and specialists are significantly different in terms of average value for overall efficiency when multiple comparisons between different categories has been performed.

❖ There is significant difference with regard to overall trust and faith among various categories namely general practitioners, specialists and consultants. Further considering the post hoc analysis it has been found out that GP and specialists are significantly different in terms of average value for overall efficiency when multiple comparisons between different categories has been performed.

❖ There is significant difference with regard to overall availability among various categories namely general practitioners, specialists and consultants. Further considering the post hoc analysis it has been found out that GP and specialists are significantly different in terms of average value for overall efficiency when multiple comparisons between different categories has been performed.

❖ There is significant difference with regard to overall availability among various categories namely general practitioners, specialists and consultants.

❖ There is significant difference with regard to overall availability among various qualifications namely MBBS, MD and MS. There is significant difference with regard to overall perceptions among various qualifications namely MBBS, MD and MS. There is significant difference with regard to overall BA-BE among various qualifications namely MBBS, MD and MS. There is significant difference with regard to overall efficiency among various qualifications namely MBBS, MD and MS. There is significant difference with regard to overall trust and faith among various qualifications namely MBBS, MD and MS. There is significant difference with regard to overall risks among various qualifications namely MBBS, MD and MS. There is significant difference with regard to overall efficacy among various qualifications namely MBBS, MD and MS.

6. CONCLUSION

Perceived Quality of Generic Medicine and its dimension have been studied by different authors since years, but direct relationship between perceived quality of generic medicine and overall knowledge has not been studied so far. In this research, an attempt was made to establish a bridge between overall knowledge of generic medicines and perceived quality of generic medicine. Again the overall perceived quality is also connected with overall perceptions, overall BABE, overall efficiency, overall efficacy, overall risk and overall trust and faith. There is a lack of awareness with regard to the benefits of generic medicines both on demand side and supply side. So hereby researcher attempts a research which is specifically targeted to the registered medical practitioners of Ahmedabad city. Again, the overall knowledge is also connected with overall perceptions, overall BABE (Bio Availability and Bio Equivalence), overall efficiency, overall efficacy, overall risk and overall trust and faith. For the purpose of research, registered medical practitioners amongst Ahmedabad, Gujarat were selected. Data was collected from the 137 RMPs and hypothesized relation was established between overall perceptions, overall BABE, overall efficiency, overall efficacy, overall risk and overall trust and faith, overall

knowledge and overall perceived quality of generic medicines. The result of the analysis stipulates that there are significant differences between these parameters w.r.t the gender, qualification and category.

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SIMULTANEOUS ESTIMATION OF ISOMERIC *(R-S)* CEFPODOXIME PROXETIL AND DICLOXACILLIN SODIUM IN BULK AND PHARMACEUTICAL DOSAGE FORM BY RP- HPLC AND HPTLC METHODS

KashyapN.Thummar
Assistant Professor

Graduate School of Pharmacy
Gujarat Technological University
ap_kashyap@gtu.edu.in

Sakariya Vijay
M.Pharm Student
Department of Pharmaceutical Science
Saurashtra University
vijaysakariya@gmail.com

Lalwani Krishna
M.Pharm Student
Department of Pharmaceutical Science
Saurashtra University
lalvanikrina772@gmail.com

DudhatraBhumika
M.S.Student
Gujarat Forensic Science University
bhumikadudhatra@yahoo.com

Prof.(Dr.) NavinSheth
Vice Chancellor
Gujarat Technological University
navin_sheth@yahoo.com

ABSTRACT

The pressurized liquid chromatography (RP- HPLC) and planner chromatography (HPTLC) were developed for the simultaneous estimation of dicloxacillin sodium and isomeric *(R-S)* cefpodoximeproxetil in bulk and pharmaceutical dosage form. In RP-HPLC, the chromatographic separation was achieved on HIBER C18 (250 x 4.6, 5 µm) column for dicloxacillin (DCX) and cefpodoximeproxetil (CPD), consisted a moving phase of methanol: 10 mM potassium dihydrogen phosphate: triethylamine (55:45: 0.13, v/v/v) having pH-6 using ortho phosphoric acid with 1.0 mL/min of analytical flow rate. The quantification of analytes were done at 225 nm using photo diode array detector. The elution times of DCX and CPD were 5.8 min and 10.6 min, respectively. In HPTLC, chromatograms were developed using a mobile phase containing toluene: methanol: ethyl acetate: glacial acetic acid (7.0:2.5:0.5:0.1, v/v/v/v) on precoated silica gel $60F_{254}$ as the stationary phase. Saturation time was 15 min. and densitometric detection at 235 nm. The R_f value of DCX and CPD were 0.46 and 0.69, respectively. The proposed methods were fully validated in terms of ICH (Q2) R1 guideline. These methods were successfully assessed for the simultaneous quantification of DCX and CPD in combined marketed tablet dosage form.

Keywords: Dicloxacillin sodium, Cefpodoximeproxetil, RP-HPLC, HPTLC, Validation

1. INTRODUCTION

Dicloxacillin (DCX), (Figure: 1(a)) a narrow-spectrum beta-lactam antibiotic of the penicillin class [1]. It is commonly used in pneumonia, septic arthritis and throat infections [2]. It is official in IP [1], BP [3] and USP [4]. Cefpodoximeproxetil(CPD), (Figure : 1(b)), is third generation cephalosporin antibiotic to cure spreadable disease triggered by bacteria such as bronchitis, urinary tract infections, pneumonia; ear, gonorrhea, throat, and skin infection [5]. It is official in Indian Pharmacopoeia[6],and United States Pharmacopoeia [7] which recommends liquid chromatography method for its analysis.

The combination therapy is available for DCX and CPD and used in the treatment of infection causes by bacteria. Review of Literature revealed that few spectrophotometric [8-9], and HPLC [10-11], methods were reported for the quantification of individual DCX or with its combined other drug. On the other hand various spectrophotometric [12-14], HPLC [15-16], and HPTLC [17] methods were available for

estimation of CPD individually or in combination with other drugs. Hithero, First orderDerivative spectroscopy [18], method was reported for analysis of DCX and CPD in combination. Therefore, the present work is focused on to develop a rapid, accurate and precise RP-HPLC and HPTLC method and, fully validated as per international council on harmonization (ICH) guidelines [19].
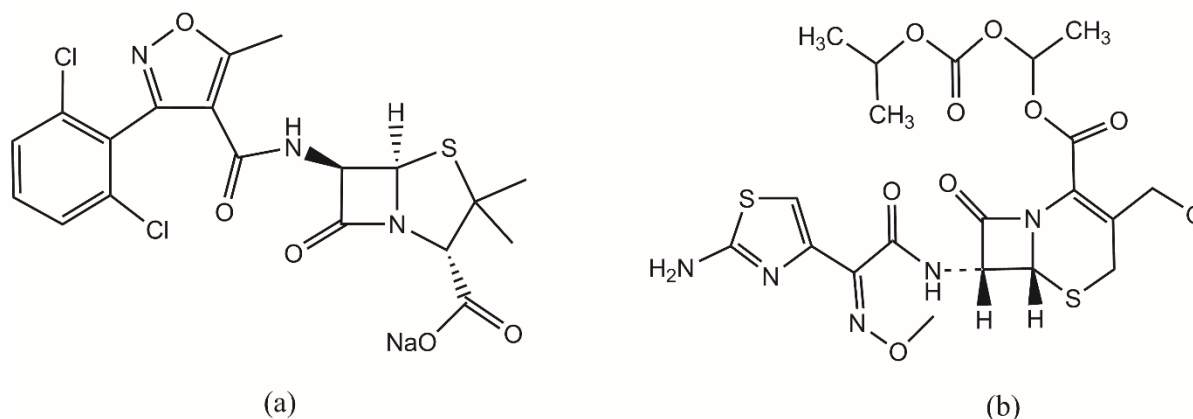

(a)   (b)

Figure 1: Chemical structure of (a) Dicloxacillin sodium, (b) Cefpodoximeproxetil

2. EXPERIMENTALS:

2.1 Instrumentation:
The chromatographic system consisted of HPLC (Shimadzu-Kyoto, Japan) containing LC-20AD pump, variable wavelength programmable SPD -M20A-PDA detector and having 20 μL fixed loop of manual rheodyne injector. The DCX and CPD were quantified at 225 nm. The chromatographic separation was employed on column having dimension was HIBER® C18 (250 × 4.6 mm, 5 μm). In HPTLC Sample applicator- Linomat – V and TLC scanner, Twin trough chamber, Hamilton Syringe (100 μL). The densitometric detection were set at 235 nm. The system was controlled with WinCATS software V 4.0.

2.2 Chemicals and Reagents
The standrard of DCX and CPD were collected form Department of pharmaceutical sciences, Saurashtra University, Rajkot. All HPLC and analytical grade chemicals were purchased from Merck Ltd., India. Methanol, Triethylamine both (HPLC grade) and potassium dihydrogen phosphate, benzene, anhydrous acetic acid, ethyl acetate, toluene of analytical grade. HPLC grade water was prepared from milliQ synergy UV apparatus (Merck Millipore, India). Tablet formulation Zedocef® DXL 200 (Macleod's Pharmaceutical Ltd. Mumbai, India.) having labeled claim of 500 mg of DCX and 200 mg of CPD, were procured from market.

2.3 Preparation of standard stock solutions
The equivalent amount of 50 mg of DCX and 20 mg CPD were weighed and transferred in two different 10 mL volumetric flasks. Both analytes were dissolved in 5 mL of methanol by ultra-sonication and then dilute up to 10 mL with same solvent to obtain final concentration 5000 µg/mL for DCX and 2000 µg/mL for CPD. The appropriate volume (1 mL) was taken and dilute to 10 mL in volumetric flask to achieve 500 µg/mL and 200µg/mL considered it as standard stock solution and use for both methods.

2.4 Chromatographic conditions
The various combination of mobile phase were tried for RP-HPLC and HPTLC. In RP-HPLC, the satisfactory results shown to the mobile phase containing water: 10 mM potassium dihydrogen phosphate:

triethylamine (55:45:0.13, v/v/v) with flow rate 1 mL/min using a HIBER C18 (250 × 4.6, 5 µm) column and UV detection at 225 nm by PDA detector.In HPTLC, TLC aluminum plates precoated with silica gel 60F$_{254}$ used as the stationary phase with a moving phase containing toluene: methanol: ethyl acetate: glacial acetic acid (7.0:2.5:0.5:0.1, v/v/v/v). Saturation time was set for 15 min and detection was performed at 235 nm. The application of the samples were done by a 100 µLhamilton syringe.

2.5 Method Validation

The RP-HPLC and HPTLC methods were validated according to ICH Q2 R1 guideline.

2.5.1 Linearity and Range
In HPLC, the aliquots of DCX and CPD were prepared in separate 10 mL volumetric flask with methanol having concentration range 62.5-162.5 µg/mL for DCX and 25-65 µg/mL for CPD respectively. The standard solutions were inserted using a 20 µL of injection volume and chromatograms were recorded.
In HPTLC, the calibration curve was plotted by analyzing five individual levels in the linear range of 1-5 µg/band for DCX and 0.4-2 µg/band for CPD, the calibration curve was qualify by its correlation co-efficient value for both drugs.

2.5.2 Precision
The intra-day precision were performed by analyzing the corresponding responses 3 times within the day and 3 times on the 3 different days for the inter-day precision. For three same concentrations of DCX (100 µg/mL), CPD (40 µg/mL) in HPLC and DCX (3 µg/band), CPD (1.2 µg/band) in HPTLC and the results were expressed in relative standard deviation. The instrumental precision were performed by evaluating response six times of same concentrations of DCX (100 µg/mL) and CPD (40 µg/mL) in HPLC and DCX (3 µg/band) and CPD (1.2 µg/band) in HPTLC. The precision were measured by relative standard deviation.

2.5.3 Accuracy
The accuracy of the methods were evaluated by percentage recoveries of DCX and CPD by standard method of additions at 3 levels i.e. 80%, 100% and 120%. Known amount of DCX (80, 100, 120 µg/mL) and CPD (32, 40, 48 µg/mL) were added to a pre-quantified sample solution (having DCX and CPD in 100:40 µg/mL proportion, respectively), in HPLC, for HPTLC, known amount of DCX (1.6, 2, 2.4 µg/band) and CPD (0.64, 0.8, 0.96 µg/band) were added to a pre-quantified sample solution (having DCX and CPD in 2:0.8 µg/band proportion, respectively) and the final amount of DCX and CPD were calculated by measuring the peak areas and by fitting these values to the linear regression equation of calibration curve to measure the recovered amount and thereby % recoveries.

2.5.4 Limit of detection (LOD) and limit of quantification (LOQ)
LOD and LOQ were calculated using the following equation as per ICH guidelines. Both LOD and LOQ were analyzed by equation methods.
LOD = 3.3 ×σ /S;
LOQ = 10 ×σ /S;
Where σ is the standard deviation of y-intercepts of regression lines and S is the slope of the calibration curve.

2.5.5 Robustness
Robustness of the method was studied by minor changing the experimental conditions such as pH of mobile phase, flow rate and % of organic phase in HPLC and while saturation time, mobile phase ratio in HPTLC. The methods were prove against the value of relative standard deviation obtained.

2.5.6 Analysis of marketed formulations

A marketed formulation having 500 mg of DCX and 200 mg of CPD was taken in sufficient quantity, the test solutions were properly sonicate for 10 min to dissolve the analytes and further the test solutions were prepared in manner to made clear solution. The test solution was diluted with methanol to get thefinal solution containing DCX and CPD in 50:20 µg/ mL proportion, respectively. The final test solution was assessed as per above discuss chromatographic conditioned and peak areas were measured. The estimation of DCX and CPD were done by keeping these values to the linear regression equation of calibration curve.

3. RESULTS AND DISCUSSION:

3.1 Mobile phase optimization

Several trials were taken containing methanol, water, ACN and aqueous buffer in various mixture as mobile phases in the development stage of method. At last, the mixture of 10 mM KH_2PO_4: Methanol: Triethylamine (45:55:0.13, v/v), pH adjusted to 6 with o-phosphoric acid was found to appropriate and gave well-resolved peaks for DCX and CPD with isomeric separation in HPLC. The retention time for DCX was 5.8 min and for isomer of CPD (R-S) was found to be 12.8 and 10.6 min, respectively (Figure 2). The separation between DCX and CPD was found to 6.52. The mobile phase flow rate was maintained at 1 mL/min. Detection was performed at 225 nm.

In HPTLC Finally, the system containing mixture of toluene: methanol: ethyl acetate: glacial acetic acid (7.0:2.5:0.5:0.1, v/v/v/v) was found to satisfactory and gave two well-resolved peaks for DCX and CPD. The R_f value for DCX and CPD were 4.6 and 6.9, respectively. Saturation time of mobile phase was 15 min after several optimization. Detection wavelength was finalize at isosbestic point at which both drug spectra was crossed constantly that was at 235 nm. The data indicates, method represent good separation of both compounds (Figure 3).

(a) (b)

(c) (d)
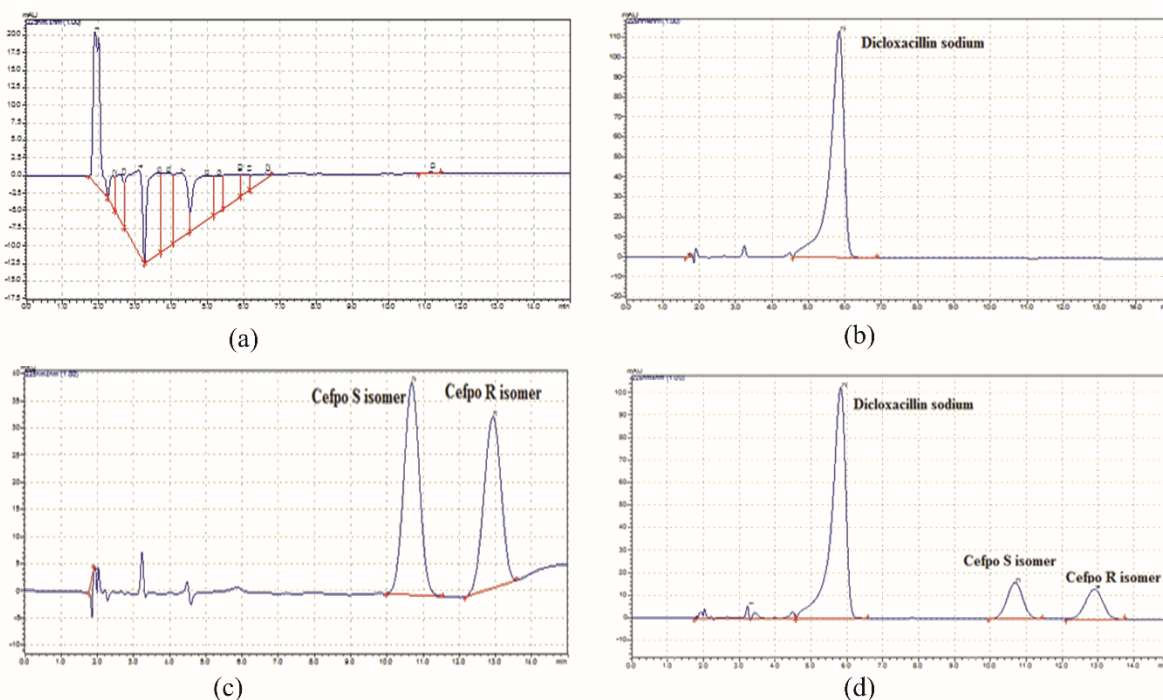
Figure 2: (a) HPLC chromatogram of blank, **(b)** HPLC Chromatogram of DCX (R_t 5.8 min), **(C)** HPLC chromatogram of CPD *S-isomer* (R_t 10.6 min) and CPD R-*isomer* (Rt 12.8) and **(d)** standard

chromatogram of Mixture solution of both drugs,
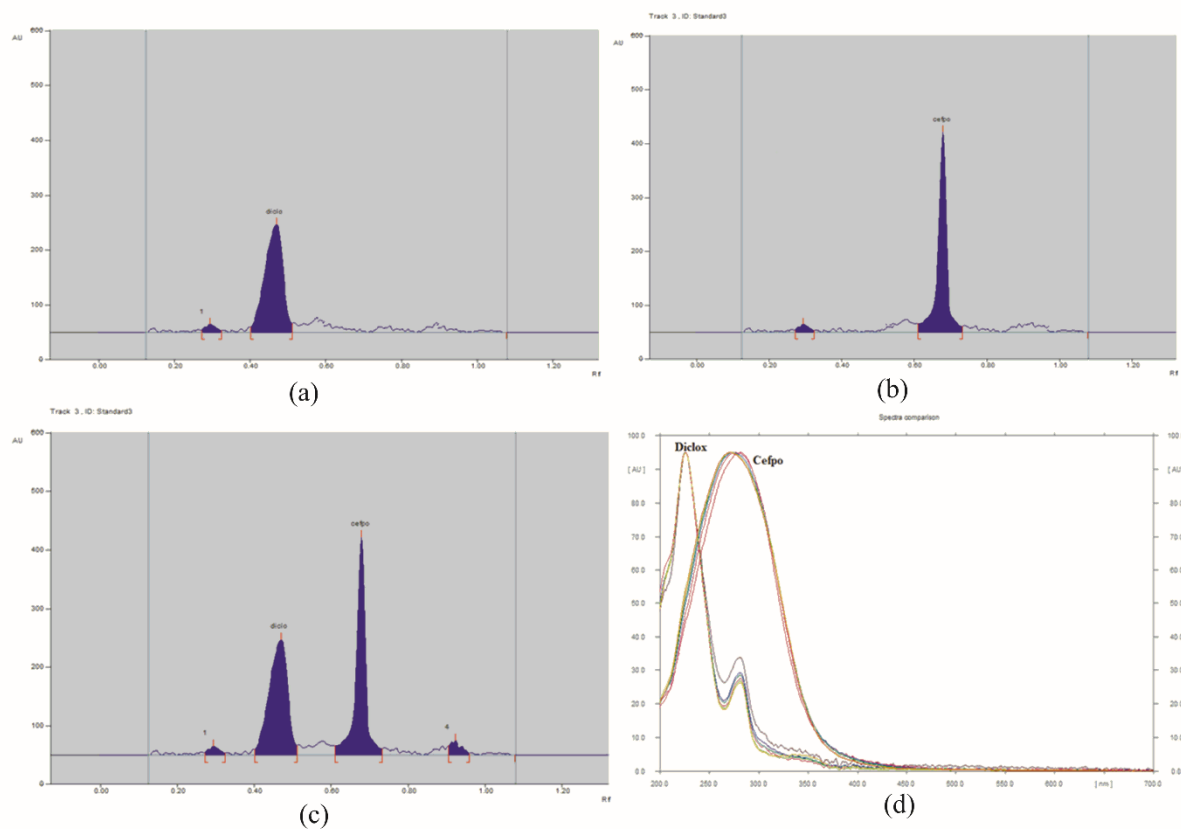
Figure 3: (a) HPTLC chromatogram of DCX (R$_f$ 0.46), **(b)** HPTLC chromatogram of CPD (R$_f$ 0.69), (C) HPTLC chromatogram of standard mixture solution of both drugs, (d) Peak purity spectra of both drugs.

3.2 Validation of the Proposed Method:

3.2.1 Linearity and Range

The linear range DCX was found for the calibration range of 62.5–112.5 µg/mL and 1–5 µg/band within a correlation coefficient of 0.992 and 0.998 in HPLC and HPTLC respectively. And linear range for CPD, it was 25–45 µg/mL and 0.2–2 µg/bands within a correlation coefficient of 0.996 and 0.999 in HPLC and HPTLC respectively. The linearity data were reported in table 1.

Table 1: The measured data from calibration curvesf

Parameters	HPLC		HPTLC	
	DCX	**CPD**	**DCX**	**CPD**
Conc.Range	62.5-112.5 (µg/mL)	25-45(µg/mL)	1–5(µg/band)	0.4-2 (µg/band)
Slope (m)	27198	11361	2001	4066
SD of slope	101.25	739.78	110	650
Intercept(c)	76348	45148	945.2	1484
Correlation coefficient (R^2)	0.992	0.996	0.998	0.999

3.2.2 Precision

The precision values (RSD) for DCX and CPD were found to 0.80–0.99% and 0.55–0.58% in HPLC while 5–2% and 0.5–1.14% in HPTLC respectively. The RSD values for intra-day were within the 1.94 % for both drugs in HPLC and HPTLC methods and inter-day precision were within the 2 % for both drugs in HPLC and HPTLC methods. The all RSD values fall in acceptable limit hence it indicate that the methods were precise.

3.2.3 Accuracy

The trueness of the methods were done by calculating recoveries of DCX and CPD by standard method of addition. The percentage recoveries were found to 99.86–100.09% and 99.54–100.15% for DCX and CPD, respectively in HPLC. While for HPTLC recoveries were 99.40–99.84% and 98.21–99.57% for DCX and CPD respectively (table 3). The high values indicate that the method was accurate.

Table 3: The accuracy data for theproposed method

Drug	Level(n=3)	Amount found (µg/band)		% recovery		RSD	
		HPLC	HPTLC	HPLC	HPTLC	HPLC	HPTLC
DCX	80 %	180.12	3.55	100.06	99.56	0.51	0.42
	100%	199.72	3.95	99.86	99.84	0.35	0.27
	120%	220.21	4.37	100.06	99.40	0.23	0.56
CPD	80%	71.67	1.43	99.54	98.21	0.11	1.01
	100%	80.12	1.58	100.15	99.26	0.47	1.0
	120%	87.52	1.75	99.57	99.57	0.19	0.55

3.2.4 LOD and LOQ

The LOD for DCX and CPD were 1.44 µg/mL and 0.59 µg/mL, respectively   while LOQ were 4.36 µg/mL and 1.80 µg/mL, respectively in HPLC while in HPTLC, LOQ limit for DCX and CPD were 0.24 µg/mL and 0.08 µg/mL, respectively, while LOQ were 0.53 µg/mL and 0.24 µg/mL, respectively The determined value represented the methods were sensitive, accurate and precise.

3.2.5 Robustness

Table 4 shows that the methods were found robust and have no any detrimental effect on the response of analytes. The RSD values indicated that the methods were robust.

Table 4: Results (RSD values) of robustness parameters of HPLC and HPTLC methods

		HPLC Method	
Sr. no.	Method parameter/Condition	RSD of Peak area (n = 6)	
		Condition 1[*]	Condition 2[#]
1	Flow rate (± 0.1 mL/min)	0.73	0.56
		0.64	0.31
2	Mobile phase ratio (± 1 v/v)	0.89	0.56
		0.53	0.27
		HPTLC Method	

Sr.	Method parameter/Condition	RSD of Peak area (n = 6)	
no.		Condition 1*	Condition 2#
1	Saturation time 15min.(± 1 min)	2.0	1.50
		1.58	1.55
2	Mobile phase ratio (± 0.5 v/v)	1.75	1.82
		1.97	1.45

*Positive deviation (+) from the original condition
Negative deviation (-) from the original condition

### 3.2.6 Analysis of marketed formulation

The test solution were prepared in methanol and clean solution having DCX and CPD in 50:20 µg/ mL proportion, respectively, were injected and peak areas were measured. The % assay of DCX and CPD in tablet dosage form were calculated and reported in (Table 5).

Table 5 Analysis of marketed formulation by HPLC and HPTLC

Brand (Tablet)	Amount taken		% assay ± SD (n=5)	
Zedocef® DXL	DCX	CPD	DCX	CPD
HPLC (µg/mL)	50	20	100.02 ± 1.65	90.48 ± 1.21
HPTLC (µg/band)	3	1.2	99.65 ± 1.70	99.08 ± 1.58

3.3 Statistical Analysis

The statistical analysis was also evaluated to compare both methods by paired t-test using accuracy data of both HPLC and HPTLC method. It was concluded that there was no significant difference between the HPLC and HPTLC methods (Figure 4)
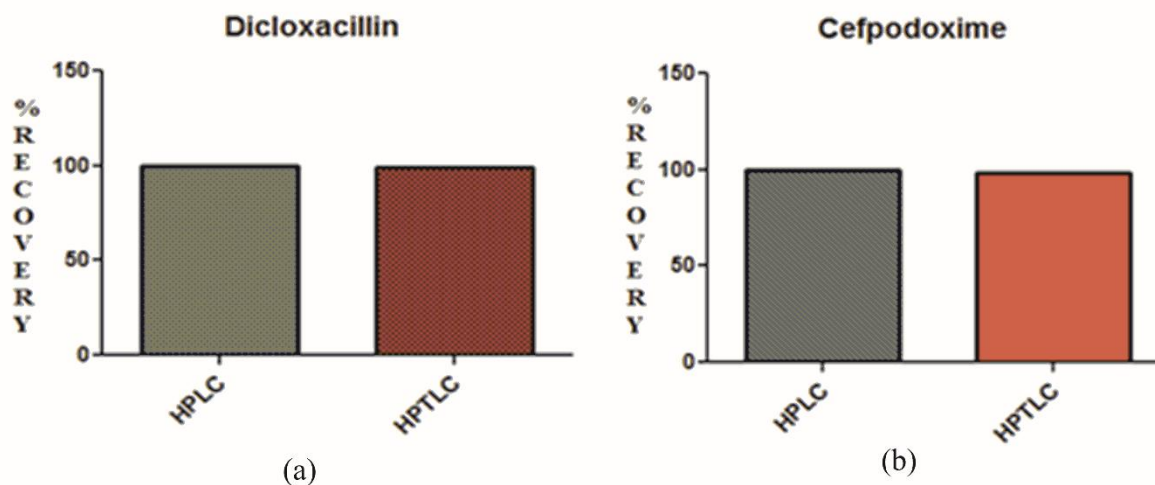
Figure 4 : T-test comparison graph of (a) DCX and (b) CPD

CONCLUSION

The RP-HPLC and HPTLC method have been successfully developed for simultaneous estimation of DCX and CPD. This method could be used for pure drug analysis, assay of drug formulation and stability study. The purposed   method did not use any extraction step in recovering of drug from the formulation excipients and matrixes and their by decrease degree of error, and overall cost of drug analysis. This both

method RP-HPLC and HPTLC were fully validated as per ICH guideline and found to simple, accurate, simple, precise, and economical. This method could be applied in routine quality control laboratories.

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CONFLICT OF INTEREST

The authors does not have any conflict of Interest.

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Contact Person

Dr. Sarika Srivastava
Assistant Professor, Graduate School of Management Studies, GTU
Editorial Board Member
Multidisciplinary International Research Journal of Gujarat Technological University

Correspondence Address

Room No. B-207
Gujarat Technological University
Nr.Vishwakarma Government Engineering College
Nr.Visat Three Roads, Visat - Gandhinagar Highway
Chandkheda, Ahmedabad, Gujarat (INDIA)
Pincode – 382424
Phone: (079) 23267590 / 505
Email: researchjournal@gtu.edu.in
Website: http://www.researchjournal.gtu.ac.in

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