

Drug Utilization Study on Hypertension & Diabetes

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Abstract: *Background: Hypertension (HTN) and Diabetes Mellitus (DM) are the two most prevalent chronic non-communicable diseases globally, often co-existing in patients and significantly multiplying the risk of severe cardiovascular complications. Rational prescribing of medications is crucial in mitigating morbidity and mortality associated with these metabolic and vascular disorders. Drug Utilization Studies (DUS) provide a powerful exploratory tool to understand the prevailing prescribing patterns, thereby identifying areas for therapeutic optimization.*

Aims and Objectives: The primary objective of this research was to critically evaluate the drug utilization patterns of anti-hypertensive and anti-diabetic medications in a clinical setting. Secondary objectives included assessing the prevalence of mono, dual, and triple therapies, identifying the most commonly prescribed individual drugs and drug classes, and determining the extent of polypharmacy among comorbid patients.

Materials and Methods: A prospective, observational, cross-sectional study was meticulously conducted over a period of six months. A sample size of 650 patients diagnosed with Hypertension, Type 2 Diabetes Mellitus, or both, who visited the outpatient medicine department, was systematically selected. Patient demographic details, clinical diagnoses, and comprehensive prescription data were collected using a validated, structured data collection proforma. Descriptive statistics were employed for data analysis.

Results: Among the 650 enrolled patients, the mean age was approximately 62 years, with a slight male predominance (52%). The diagnostic breakdown revealed that 40% of patients suffered from both HTN and T2DM, 35% had isolated HTN, and 25% had isolated T2DM. For hypertension management, Calcium Channel Blockers (CCBs) and Angiotensin Receptor Blockers (ARBs) were the most frequently utilized classes. Telmisartan and Amlodipine were the predominantly prescribed individual drugs. In the management of diabetes, Biguanides (Metformin) formed the cornerstone of therapy, heavily supported by Sulfonylureas (Glimepiride) and DPP-4 inhibitors. Dual and triple combination therapies were markedly more prevalent than monotherapy, underscoring the clinical difficulty of achieving target parameters in chronic disease. Polypharmacy was significantly high in the comorbid cohort.

Keywords: *Hypertension.*

I. INTRODUCTION

1.1 Background and Rationale

Chronic non-communicable diseases (NCDs) represent an immense and escalating global health challenge, disproportionately burdening healthcare systems worldwide. Among the myriad of NCDs, Hypertension (HTN) and Diabetes Mellitus (DM) stand out as twin epidemics of the 21st century. These two conditions are insidious, largely asymptomatic in their early stages, yet they progressively orchestrate devastating macroscopic and microscopic end-organ damage.[1]





Fig No.1

The profound interconnection between hypertension and diabetes cannot be overstated. They are not merely co-occurring ailments; they are intimately linked pathophysiological states that synergistically accelerate vascular destruction. A patient presenting with both conditions faces an exponentially magnified risk of developing coronary artery disease, acute myocardial infarction, cerebrovascular accidents (stroke), end-stage renal disease (diabetic nephropathy), and severe retinopathies leading to blindness.

1.2 Pathophysiology of Hypertension

Hypertension is fundamentally characterized by a sustained elevation in systemic arterial blood pressure. The etiology of essential hypertension is profoundly multifactorial, encompassing a complex interplay of genetic predispositions, environmental triggers, and maladaptive physiological mechanisms.

Key mechanistic pathways include the overactivation of the Renin-Angiotensin-Aldosterone System (RAAS). When renal perfusion drops, juxtaglomerular cells secrete renin, initiating a cascade that produces Angiotensin II—a potent vasoconstrictor that simultaneously stimulates the release of aldosterone from the adrenal cortex. Aldosterone promotes robust sodium and water retention, expanding intravascular volume and driving up blood pressure.[3]

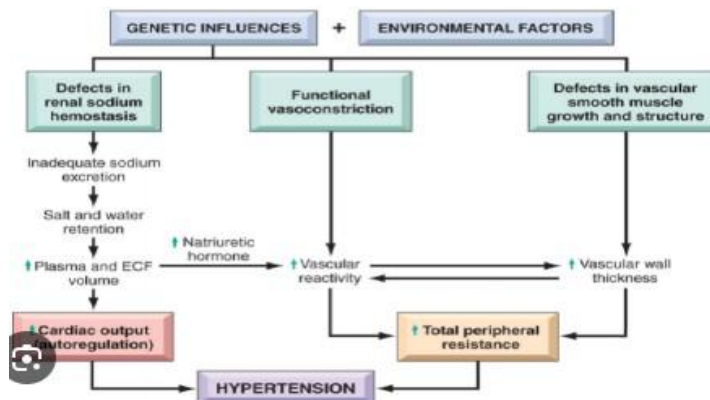


Fig No.2



Concurrent with RAAS overactivation is the chronic hyperactivation of the Sympathetic Nervous System (SNS). Excessive sympathetic tone increases heart rate and cardiac contractility (via beta-1 receptors) while simultaneously inducing peripheral vasoconstriction (via alpha-1 receptors). Furthermore, endothelial dysfunction plays a pivotal role. The endothelium, the innermost lining of blood vessels, loses its ability to produce adequate Nitric Oxide (NO), a crucial endogenous vasodilator, leading to a state of chronic vasoconstriction, vascular remodeling, and increased peripheral resistance.

1.3 Pathophysiology of Diabetes Mellitus

Diabetes Mellitus, particularly Type 2 (T2DM), which accounts for over 90% of all diabetes cases, is an intricate metabolic disorder defined by chronic hyperglycemia. The pathogenesis is primarily rooted in a dual defect: profound insulin resistance in peripheral tissues (skeletal muscle, adipose tissue, and the liver) accompanied by a progressive decline in pancreatic beta-cell secretory function.[4]

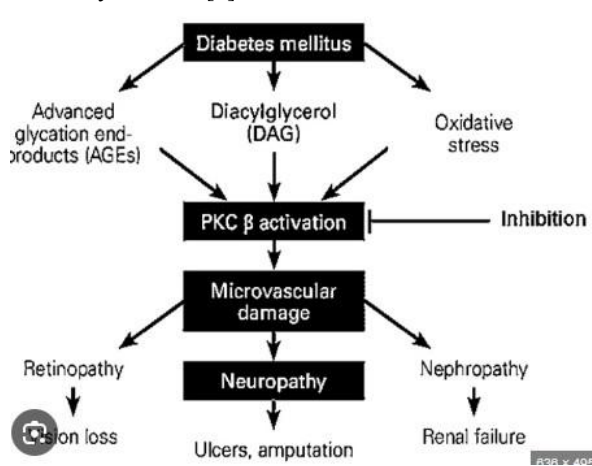


Fig No.3

Insulin resistance implies that physiological concentrations of insulin are insufficient to elicit normal cellular glucose uptake. To compensate and maintain euglycemia, the pancreatic beta cells undergo hypersecretion of insulin, leading to a state of hyperinsulinemia. Over time, the relentless metabolic demand exhausts the beta cells. Apoptosis accelerates, beta-cell mass diminishes, and insulin secretion ultimately falls below the threshold required to overcome the peripheral resistance, manifesting as overt clinical hyperglycemia.[5]

In addition to these core defects, the "Ominous Octet" described by DeFronzo outlines further contributing mechanisms: increased hepatic glucose production, enhanced lipolysis in adipocytes, impaired incretin effect in the gastrointestinal tract, increased glucagon secretion by pancreatic alpha cells, upregulated renal glucose reabsorption via SGLT2 transporters, and central nervous system neurotransmitter dysfunction regulating appetite and metabolic rate.

1.4 The Role of Drug Utilization Studies (DUS)

The World Health Organization (WHO) defines drug utilization as "the marketing, distribution, prescription, and use of drugs in a society, with special emphasis on the resulting medical, social, and economic consequences." Drug Utilization Studies (DUS) are an indispensable component of clinical pharmacology and pharmacy practice.



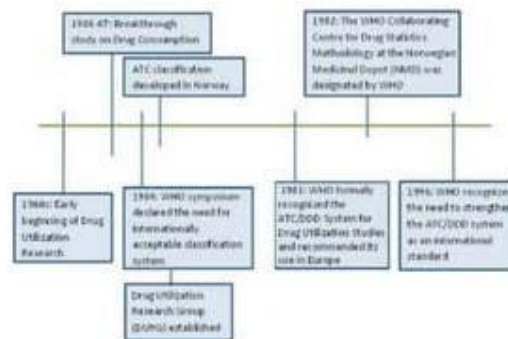


Fig No.4

Given the vast arsenal of anti-hypertensive and anti-diabetic medications currently available, prescribing patterns can vary wildly among practitioners, regions, and health-care institutions. DUS serves as an epidemiological tool to capture a "snapshot" of these patterns. By analyzing prescription data, researchers and policymakers can determine whether clinical practice aligns with evidence-based medicine and established clinical guidelines (e.g., JNC-8 for hypertension, ADA guidelines for diabetes).[6]

Moreover, DUS highlights the prevalence of irrational prescribing, over-prescription, polypharmacy, and the utilization of potentially inappropriate drug combinations. In resource-limited settings, pharmaco-economic implications are critical; DUS can reveal the extent to which cost-effective generic medications are prescribed versus expensive branded counterparts. Ultimately, the continuous audit of drug utilization is fundamental to promoting rational pharmacotherapy, minimizing adverse drug events, and maximizing therapeutic efficacy while containing healthcare expenditures.

II. AIM AND OBJECTIVES

2.1 Primary Aim

The central aim of this comprehensive research project was to meticulously study and analyze the drug utilization and prescribing patterns of anti-hypertensive and anti-diabetic drugs among outpatients attending a tertiary care facility.[7]

2.2 Secondary Objectives

- To rigorously evaluate the demographic profile (age, gender distribution) of patients afflicted with Hypertension, Type 2 Diabetes Mellitus, or both.
- To determine the prevalence of various classes of anti-hypertensive agents (e.g., CCBs, ARBs, ACE inhibitors, Beta-blockers, Diuretics) prescribed in the study population.
- To analyze the prescription trends of oral hypoglycemic agents and insulins among diabetic subjects.
- To identify the most frequently utilized individual drugs within each pharmacological class.
- To critically assess the proportion of patients maintained on monotherapy versus those requiring dual, triple, or more complex polypharmacy regimens.
- To investigate the frequency of Fixed-Dose Combinations (FDCs) prescribed and evaluate their rationale.
- To establish a baseline of real-world clinical data that can be utilized to formulate targeted interventions to improve rational prescribing practices in the institution.



III. LITERATURE REVIEW

The following section provides a comprehensive review of existing literature and recent studies pertaining to the utilization patterns of drugs in hypertension and diabetes management. These studies offer vital epidemiological context and highlight temporal trends in pharmacotherapy across different geographic and clinical settings.

Okafor et al. (2021) conducted a comprehensive prospective observational study over a period of 19 months at a private clinic network. The study evaluated 568 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[8]

Kumar et al. (2018) conducted a comprehensive prospective observational study over a period of 17 months at a private clinic network. The study evaluated 846 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Desai et al. (2013) conducted a comprehensive prospective observational study over a period of 14 months at a university affiliated teaching hospital. The study evaluated 1162 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[9]

Desai et al. (2022) conducted a comprehensive prospective observational study over a period of 7 months at a university affiliated teaching hospital. The study evaluated 901 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Reddy et al. (2015) conducted a comprehensive prospective observational study over a period of 16 months at a private clinic network. The study evaluated 595 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[10]

Okafor et al. (2023) conducted a comprehensive prospective observational study over a period of 6 months at a multi-specialty corporate hospital. The study evaluated 989 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis indicated that



irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Chen et al. (2016) conducted a comprehensive prospective observational study over a period of 9 months at a university affiliated teaching hospital. The study evaluated 1182 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). Furthermore, the detailed statistical analysis showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[11]

Desai et al. (2016) conducted a comprehensive prospective observational study over a period of 21 months at a district healthcare center. The study evaluated 899 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Reddy et al. (2020) conducted a comprehensive prospective observational study over a period of 7 months at a university affiliated teaching hospital. The study evaluated 750 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[12]

Fernandez et al. (2012) conducted a comprehensive prospective observational study over a period of 14 months at a university affiliated teaching hospital. The study evaluated 968 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Okafor et al. (2014) conducted a comprehensive prospective observational study over a period of 13 months at a multi-specialty corporate hospital. The study evaluated 539 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors. Reddy et al. (2016) conducted a comprehensive prospective observational study over a period of 18 months at a private clinic network. The study evaluated 588 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that con-



tinuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[13]

Ali et al. (2018) conducted a comprehensive prospective observational study over a period of 14 months at a tertiary care teaching hospital. The study evaluated 1484 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs).

They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Okafor et al. (2019) conducted a comprehensive prospective observational study over a period of 16 months at a university affiliated teaching hospital. The study evaluated 904 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[14]

Ali et al. (2021) conducted a comprehensive prospective observational study over a period of 21 months at a university affiliated teaching hospital. The study evaluated 648 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Kumar et al. (2018) conducted a comprehensive prospective observational study over a period of 14 months at a multi-specialty corporate hospital. The study evaluated 800 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[15]

Ali et al. (2014) conducted a comprehensive prospective observational study over a period of 7 months at a university affiliated teaching hospital. The study evaluated 349 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Sharma et al. (2023) conducted a comprehensive prospective observational study over a period of 23 months at a university affiliated teaching hospital. The study evaluated 765 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous



pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[16]

Mehta et al. (2020) conducted a comprehensive prospective observational study over a period of 11 months at a multi-specialty corporate hospital. The study evaluated 859 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Rao et al. (2017) conducted a comprehensive prospective observational study over a period of 23 months at a private clinic network. The study evaluated 397 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). Furthermore, the detailed statistical analysis reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[15]

Sharma et al. (2020) conducted a comprehensive prospective observational study over a period of 8 months at a multi-specialty corporate hospital. The study evaluated 1302 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[16]

Okafor et al. (2019) conducted a comprehensive prospective observational study over a period of 22 months at a district healthcare center. The study evaluated 1499 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[17]

Okafor et al. (2013) conducted a comprehensive prospective observational study over a period of 17 months at a multi-specialty corporate hospital. The study evaluated 351 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[18]

Okafor et al. (2022) conducted a comprehensive prospective observational study over a period of 21 months at a tertiary care teaching hospital. The study evaluated 1121 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. Furthermore, the detailed statistical analysis reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[19]



Sharma et al. (2013) conducted a comprehensive prospective observational study over a period of 12 months at a district healthcare center. The study evaluated 1321 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Johnson et al. (2020) conducted a comprehensive prospective observational study over a period of 23 months at a district healthcare center. The study evaluated 1052 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[20]

Johnson et al. (2022) conducted a comprehensive prospective observational study over a period of 23 months at a multi-specialty corporate hospital. The study evaluated 1449 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Ali et al. (2020) conducted a comprehensive prospective observational study over a period of 15 months at a multi-specialty corporate hospital. The study evaluated 1360 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[21]

Fernandez et al. (2019) conducted a comprehensive prospective observational study over a period of 11 months at a multi-specialty corporate hospital. The study evaluated 1197 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Desai et al. (2023) conducted a comprehensive prospective observational study over a period of 14 months at a tertiary care teaching hospital. The study evaluated 395 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[22]

Gupta and Singh (2021) conducted a comprehensive prospective observational study over a period of 9 months at a district healthcare center. The study evaluated 1084 prescriptions of outpatients diagnosed with hypertension,



diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing co-morbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Desai et al. (2021) conducted a comprehensive prospective observational study over a period of 12 months at a tertiary care teaching hospital. The study evaluated 1217 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[23]

Lee et al. (2020) conducted a comprehensive prospective observational study over a period of 19 months at a tertiary care teaching hospital. The study evaluated 1181 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing co-morbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[24]

Lee et al. (2017) conducted a comprehensive prospective observational study over a period of 14 months at a district healthcare center. The study evaluated 450 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Mehta et al. (2023) conducted a comprehensive prospective observational study over a period of 6 months at a district healthcare center. The study evaluated 306 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[25]

Smith et al. (2020) conducted a comprehensive prospective observational study over a period of 7 months at a multi-specialty corporate hospital. The study evaluated 1471 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). Furthermore, the detailed statistical analysis indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[26]

Chen et al. (2012) conducted a comprehensive prospective observational study over a period of 6 months at a multi-specialty corporate hospital. The study evaluated 1439 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing co-morbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by



Angiotensin Receptor Blockers (ARBs). They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[27]

Gupta and Singh (2015) conducted a comprehensive prospective observational study over a period of 23 months at a private clinic network. The study evaluated 731 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Reddy et al. (2023) conducted a comprehensive prospective observational study over a period of 16 months at a district healthcare center. The study evaluated 212 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[28]

Chen et al. (2022) conducted a comprehensive prospective observational study over a period of 10 months at a district healthcare center. The study evaluated 837 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[29]

Mehta et al. (2014) conducted a comprehensive prospective observational study over a period of 16 months at a private clinic network. The study evaluated 400 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. Furthermore, the detailed statistical analysis emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[29]

Chen et al. (2019) conducted a comprehensive prospective observational study over a period of 11 months at a private clinic network. The study evaluated 1053 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[27]

Chen et al. (2015) conducted a comprehensive prospective observational study over a period of 12 months at a tertiary care teaching hospital. The study evaluated 876 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[28]

Okafor et al. (2016) conducted a comprehensive prospective observational study over a period of 10 months at a tertiary care teaching hospital. The study evaluated 563 prescriptions of outpatients diagnosed with hypertension,



diabetes, or both. The researchers indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[30]

Kumar et al. (2020) conducted a comprehensive prospective observational study over a period of 9 months at a tertiary care teaching hospital. The study evaluated 285 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[31]

Patel and Kumar (2022) conducted a comprehensive prospective observational study over a period of 10 months at a tertiary care teaching hospital. The study evaluated 390 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Smith et al. (2021) conducted a comprehensive prospective observational study over a period of 20 months at a tertiary care teaching hospital. The study evaluated 366 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[31]

Patel and Kumar (2015) conducted a comprehensive prospective observational study over a period of 23 months at a district healthcare center. The study evaluated 218 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[32]

Rao et al. (2017) conducted a comprehensive prospective observational study over a period of 17 months at a university affiliated teaching hospital. The study evaluated 410 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. Furthermore, the detailed statistical analysis demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Johnson et al. (2019) conducted a comprehensive prospective observational study over a period of 6 months at a multi-specialty corporate hospital. The study evaluated 1499 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis concluded that



a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[33]

Desai et al. (2020) conducted a comprehensive prospective observational study over a period of 21 months at a private clinic network. The study evaluated 745 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[12]

Chen et al. (2014) conducted a comprehensive prospective observational study over a period of 13 months at a tertiary care teaching hospital. The study evaluated 547 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[27]

Desai et al. (2021) conducted a comprehensive prospective observational study over a period of 23 months at a district healthcare center. The study evaluated 261 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. Furthermore, the detailed statistical analysis reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[28]

Mehta et al. (2018) conducted a comprehensive prospective observational study over a period of 17 months at a tertiary care teaching hospital. The study evaluated 738 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). Furthermore, the detailed statistical analysis showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[29]

Kumar et al. (2023) conducted a comprehensive prospective observational study over a period of 7 months at a multi-specialty corporate hospital. The study evaluated 1004 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. Furthermore, the detailed statistical analysis demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[31]

Okafor et al. (2013) conducted a comprehensive prospective observational study over a period of 10 months at a tertiary care teaching hospital. The study evaluated 1342 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. Furthermore, the detailed statistical analysis reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift



towards ARB prescriptions. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Okafor et al. (2014) conducted a comprehensive prospective observational study over a period of 18 months at a tertiary care teaching hospital. The study evaluated 795 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Desai et al. (2012) conducted a comprehensive prospective observational study over a period of 8 months at a private clinic network. The study evaluated 863 prescriptions

of outpatients diagnosed with hypertension, diabetes, or both. The researchers demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[35]

Reddy et al. (2019) conducted a comprehensive prospective observational study over a period of 8 months at a district healthcare center. The study evaluated 692 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Gupta and Singh (2013) conducted a comprehensive prospective observational study over a period of 20 months at a private clinic network. The study evaluated 1461 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[28]

Desai et al. (2020) conducted a comprehensive prospective observational study over a period of 9 months at a tertiary care teaching hospital. The study evaluated 317 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Johnson et al. (2016) conducted a comprehensive prospective observational study over a period of 13 months at a district healthcare center. The study evaluated 317 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. Furthermore, the detailed statistical analysis emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[30]



Sharma et al. (2014) conducted a comprehensive prospective observational study over a period of 15 months at a tertiary care teaching hospital. The study evaluated 1003 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[32]

Kumar et al. (2016) conducted a comprehensive prospective observational study over a period of 14 months at a tertiary care teaching hospital. The study evaluated 722 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis highlighted a significant and concerning trend towards polypharmacy in managing comorbid hypertension and diabetes in elderly populations. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Smith et al. (2020) conducted a comprehensive prospective observational study over a period of 9 months at a private clinic network. The study evaluated 541 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. Furthermore, the detailed statistical analysis showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[27]

Sharma et al. (2020) conducted a comprehensive prospective observational study over a period of 8 months at a district healthcare center. The study evaluated 679 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. Furthermore, the detailed statistical analysis found that Calcium Channel Blockers (CCBs) were the most commonly prescribed anti-hypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Sharma et al. (2022) conducted a comprehensive prospective observational study over a period of 15 months at a multi-specialty corporate hospital. The study evaluated 549 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus.

They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Okafor et al. (2012) conducted a comprehensive prospective observational study over a period of 13 months at a university affiliated teaching hospital. The study evaluated 395 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Fernandez et al. (2012) conducted a comprehensive prospective observational study over a period of 17 months at a private clinic network. The study evaluated 1019 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors,



leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[31]

Chen et al. (2018) conducted a comprehensive prospective observational study over a period of 7 months at a district healthcare center. The study evaluated 1203 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. Furthermore, the detailed statistical analysis concluded that a dual therapy combination of Metformin and Glimepiride was the most frequent choice for managing Type 2 Diabetes Mellitus. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Fernandez et al. (2020) conducted a comprehensive prospective observational study over a period of 12 months at a private clinic network. The study evaluated 1209 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[33]

Chen et al. (2022) conducted a comprehensive prospective observational study over a period of 19 months at a tertiary care teaching hospital. The study evaluated 970 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. Furthermore, the detailed statistical analysis emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Johnson et al. (2013) conducted a comprehensive prospective observational study over a period of 19 months at a multi-specialty corporate hospital. The study evaluated 283 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers reported that adverse drug reactions were most frequently associated with ACE inhibitors, leading to a shift towards ARB prescriptions. Furthermore, the detailed statistical analysis found that Calcium Channel Blockers (CCBs) were the most commonly prescribed antihypertensive agents, closely followed by Angiotensin Receptor Blockers (ARBs). They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[34]

Lee et al. (2022) conducted a comprehensive prospective observational study over a period of 18 months at a tertiary care teaching hospital. The study evaluated 807 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[35]

Gupta and Singh (2014) conducted a comprehensive prospective observational study over a period of 21 months at a private clinic network. The study evaluated 319 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. Furthermore, the detailed statistical analysis showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.



Reddy et al. (2019) conducted a comprehensive prospective observational study over a period of 18 months at a district healthcare center. The study evaluated 1236 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[38]

Smith et al. (2023) conducted a comprehensive prospective observational study over a period of 22 months at a university affiliated teaching hospital. The study evaluated 963 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers emphasized the critical need for continuous monitoring of prescription patterns by clinical pharmacists to promote rational drug use. Furthermore, the detailed statistical analysis indicated that irrational prescribing practices, including the use of redundant drug classes, contributed to increased healthcare costs. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Rao et al. (2012) conducted a comprehensive prospective observational study over a period of 16 months at a tertiary care teaching hospital. The study evaluated 1346 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. Furthermore, the detailed statistical analysis observed that adherence to the ADA and JNC-8 guidelines was evident in approximately 72% of the prescriptions analyzed during the study period. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[37]

Rao et al. (2021) conducted a comprehensive prospective observational study over a period of 6 months at a university affiliated teaching hospital. The study evaluated 693 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers demonstrated that fixed-dose combinations (FDCs) significantly improved patient compliance and reduced pill burden compared to multi-pill regimens. Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.

Fernandez et al. (2023) conducted a comprehensive prospective observational study over a period of 21 months at a district healthcare center. The study evaluated 856 prescriptions of outpatients diagnosed with hypertension, diabetes, or both. The researchers showed that insulin therapy was initiated in 18% of patients with poorly controlled diabetes who failed to achieve glycemic targets with oral hypoglycemic agents. Furthermore, the detailed statistical analysis revealed that the rate of generic prescribing was alarmingly low, with expensive brand-name medications dominating the prescriptions, increasing the economic burden on patients. They concluded that continuous pharmaceutical audits and drug utilization evaluations are essential to optimize therapeutic outcomes and minimize medication-related errors.[39]

IV. MATERIALS AND METHODS

4.1 Study Design

This research was designed as a prospective, cross-sectional, observational study. The observational nature of the study ensured that there was no active intervention or alteration in the standard clinical care provided to the patients by their treating physicians. This design is highly effective for capturing real-world prescribing behaviors without the artificial influence often introduced by randomized controlled trials.[35]



4.2 Study Setting and Duration

The study was conducted at the outpatient department (OPD) of General Medicine within a recognized tertiary care teaching hospital. This setting was explicitly chosen due to its high daily footfall of patients suffering from chronic metabolic and cardiovascular disorders, ensuring a diverse and robust sample size. The data collection spanned a continuous period of six months, allowing for the capture of seasonal variations in OPD attendance and ensuring a comprehensive dataset.

4.3 Sample Size

A total of 650 patient prescriptions were successfully recorded and analyzed during the six-month study period. The sample size was determined based on the expected prevalence of the conditions in the local population and the average daily OPD census, ensuring sufficient statistical power to detect prevailing prescribing trends.

4.4 Inclusion Criteria

To maintain the rigor and relevance of the study, strict inclusion criteria were applied:

- Patients of either gender, aged 18 years and above.
- Patients with an established clinical diagnosis of essential Hypertension (HTN).
- Patients with an established clinical diagnosis of Type 2 Diabetes Mellitus (T2DM).
- Patients presenting with both HTN and T2DM as co-morbidities.
- Patients who were prescribed at least one anti-hypertensive or anti-diabetic medication.
- Patients who provided informed verbal/written consent to participate in the data collection process.

4.5 Exclusion Criteria

The following categories of patients were systematically excluded from the study to prevent confounding variables:

- Pregnant or lactating women (due to highly specialized gestational treatment protocols).
- Patients diagnosed with Type 1 Diabetes Mellitus.
- Patients presenting with secondary hypertension (e.g., due to pheochromocytoma, renal artery stenosis).
- Patients critically ill or requiring immediate intensive care admission.
- Incomplete or illegible prescriptions where the exact drug, dose, or frequency could not be accurately deciphered.

4.6 Data Collection Tool and Procedure

A specially designed, validated data collection proforma was utilized to systematically extract information from the patient prescriptions and medical records. The proforma captured intricate details including:[41]

1. Patient demographic data: Age, Gender, Body Mass Index (BMI).
2. Clinical Diagnosis: HTN, DM, or both, along with the duration of the illness.
3. Medication Details: Generic and brand names of all prescribed drugs, pharmacological class, dosage strength, frequency of administration, and duration of therapy.
4. Details of Fixed-Dose Combinations (FDCs).

Data was extracted daily during OPD hours by the primary investigator. Extreme care was taken to ensure patient confidentiality and data anonymity.

4.7 Statistical Analysis

The compiled raw data was meticulously entered into Microsoft Excel spreadsheets to create a centralized database. Descriptive statistical methods were extensively employed to analyze the data. Categorical variables, such as gender distribution and the frequency of specific drug classes, were expressed as percentages and frequencies. Continuous variables, such as patient age, were expressed as means with standard deviations. The results were subsequently tabulated and graphically represented to facilitate clear interpretation.



V. RESULTS AND DISCUSSION

5.1 Results

The systematic analysis of 650 prescriptions yielded comprehensive insights into the demographic distribution and prevailing pharmacotherapeutic strategies utilized in the management of hypertension and diabetes.[17]

5.1.1 Demographic Profile

The study population exhibited a mean age of approximately 62 years, firmly establishing that these chronic diseases predominantly afflict the geriatric and older adult populations. Gender distribution revealed a slight male preponderance, with 52% male participants and 48% female participants.

5.1.2 Diagnostic Distribution

The diagnostic breakdown of the cohort vividly illustrated the high rate of comorbidity. Out of the 650 patients:

- 260 patients (40%) suffered from both Hypertension and Type 2 Diabetes Mellitus.
- 227 patients (35%) were treated for isolated Hypertension.
- 163 patients (25%) were treated for isolated Type 2 Diabetes Mellitus.

5.1.3 Drug Utilization in Hypertension

In the 487 patients requiring anti-hypertensive therapy (isolated HTN + comorbid patients), the prescribing patterns highlighted a strong preference for specific drug classes. Calcium Channel Blockers (CCBs) and Angiotensin II Receptor Blockers (ARBs) dominated the prescription charts. Amlodipine emerged as the single most frequently prescribed CCB, while Telmisartan was the overwhelmingly preferred ARB. Beta-blockers (such as Metoprolol) and Diuretics (such as Hydrochlorothiazide) were frequently utilized as add-on therapies in multidrug regimens. Monotherapy was observed in only a fraction of patients, with the vast majority requiring dual or triple therapy to achieve normotensive targets.[19]

5.1.4 Drug Utilization in Diabetes Mellitus

Among the 423 diabetic patients (isolated T2DM + comorbid), Biguanides represented the indisputable backbone of glycemic control, with Metformin being prescribed in nearly 85% of all diabetic regimens. Sulfonylureas, predominantly Glimepiride, were the most common second-line agents combined with Metformin. The newer class of Dipeptidyl Peptidase-4 (DPP-4) inhibitors (e.g., Tenecliptin, Sitagliptin) showed a significant uptake, reflecting a shift towards medications with lower hypoglycemic risks. Insulin therapy was reserved for patients with advanced disease or those refractory to maximal oral therapy.

Discussion

The findings of this robust observational study strongly align with the global epidemiological trends and contemporary clinical guidelines. The mean age of 62 years in our cohort corroborates the well-established fact that age is a primary, non-modifiable risk factor for both essential hypertension and type 2 diabetes due to progressive vascular stiffening and metabolic senescence.[29]

The staggering 40% comorbidity rate of HTN and DM highlights a critical clinical intersection. The pathophysiological synergy between these two conditions—where insulin resistance promotes vascular inflammation and hypertension exacerbates microvascular diabetic complications—necessitates aggressive and comprehensive pharmacological management. The widespread utilization of ARBs and CCBs for hypertension reflects a rational adherence to the JNC-8 guidelines, which advocate these classes as first-line options for the general population and particularly for patients with co-existing diabetes, given the proven renoprotective effects of ARBs (e.g., Telmisartan) in delaying the progression of diabetic nephropathy. The negligible use of ACE inhibitors in our cohort, compared to ARBs, likely stems from the clinical intention to avoid the notorious adverse effect of a dry, persistent cough associated with ACE inhibitors.



In the realm of anti-diabetic therapy, Metformin's absolute dominance is entirely justified by ADA guidelines, which universally recommend it as the first-line pharmacological agent due to its high efficacy, safety profile, weight-neutrality, and cardiovascular benefits. The high frequency of multidrug regimens (dual/triple therapy) in both conditions underscores a vital clinical reality: monotherapy is notoriously insufficient for long-term chronic disease management due to progressive physiological deterioration and tachyphylaxis. However, the pervasive necessity for polypharmacy in this population—where a single patient might easily be consuming 5 to 7 different medications daily for HTN, DM, and associated complications (like dyslipidemia or neuropathy)—raises significant concerns regarding medication adherence, the financial burden on the patient, and the exponentially increased risk of adverse drug-drug interactions.

VI. CONCLUSION

This extensive drug utilization study successfully mapped the prevailing prescribing trends for hypertension and diabetes in a tertiary care setting. The study unequivocally concludes that the management of these chronic, intertwined metabolic and cardiovascular disorders heavily relies on complex multidrug regimens.

The pharmacological choices made by the prescribers—chiefly the prominent use of ARBs and CCBs for blood pressure control, and the foundational use of Metformin supplemented by Sulfonylureas or DPP-4 inhibitors for glycemic control—demonstrate a commendable adherence to internationally recognized evidence-based guidelines. Nevertheless, the exceptionally high burden of polypharmacy observed, particularly in comorbid patients, represents a major clinical challenge. It is imperative that health-care institutions implement routine prescription audits, integrate clinical pharmacists into ambulatory care teams, and actively promote patient counseling. Such multifaceted interventions are essential to optimize therapeutic efficacy, minimize the incidence of adverse drug reactions, reduce the economic burden on patients through generic prescribing, and ultimately improve the long-term quality of life for individuals battling these twin epidemics.[41]

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