






# Exploring critical factors in referral systems at different health-care levels

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## Abstract

**Background:** A consistent referral system and patient patronage are the primary connections between the three tiers in the healthcare delivery system. Patients were scheduled to visit primary care clinics for the first time. Subsequently, patients are moved to more distinguished healthcare facilities to receive additional care.

**Objectives:** This study aims to investigate the reasons behind patients' transfer from primary and secondary care to tertiary care, as well as the critical factors that influence these referrals.

**Methods:** This study employs a mixed-methods approach to explore factors determining referral service provision across primary, secondary, and tertiary healthcare levels. Along with conducting semi-structured interviews with healthcare professionals, we systematically examined a wealth of retrospective data on 1331 referred patients from 130 health facilities, including patient records, demographics, referral status, and clinical presentation. All statistical analysis was processed in R, and Corel Draw 12 was also used for graphical illustration.

**Results:** Healthcare facilities referred most emergencies to several departments, including the cardiac care unit, medical, urology, intensive care unit/emergency, obstetrics and gynaecology, children's, orthopaedic, and psychiatry. The percentage of all cases referred is displayed ward-by-ward; the intensive care unit/emergency wards have a high referral ratio of 65.51%, while the

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obstetrics and gynaecology wards have an 18.40% referral ratio.

**Conclusion:** There is a need for increased government investments to strengthen the capacity, human resources, and availability of equipment in primary, secondary, and tertiary public health facilities to deliver quality services in order to reduce the patient referral ratio.

#### KEYWORDS

health inequalities, health system, primary care, referral patients, secondary care

#### Key Points

- Formalizing and institutionalizing the referral system and retraining all health-care professionals.
- Reduce the epidemic's negative effects on social services, health systems, and the economy.
- Physicians must diligently perform systematic treatment for referral cases.

## INTRODUCTION

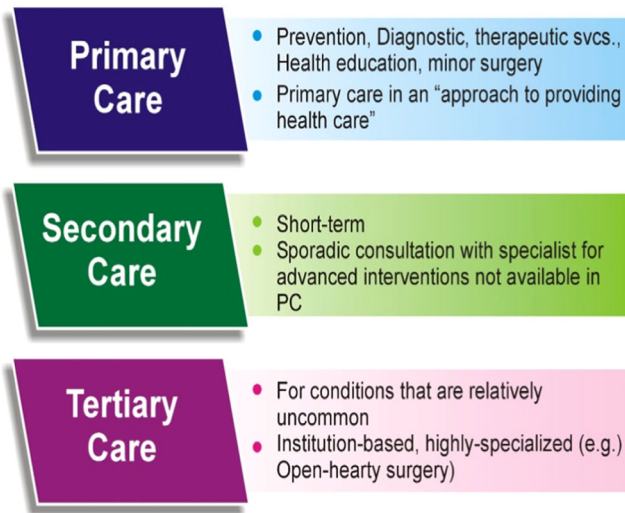
Primary, secondary, and tertiary cares are the three levels of treatment for patients under the international health-care system (Ojifinni & Ibisomi, 2022; Vieira-Meyer et al., 2022). Each of these components performs in coordination to ensure the provision of the most comprehensive services possible pertaining to patient treatment (Wisdom et al., 2012). To serve as a first point of contact for patients, primary health-care centers were established (Islam et al., 2023). In the event of an emergency, some patients are admitted to the hospital immediately, while others are recommended to the hospital by a physician, nurse, or another member of the medical staff to get more effective treatment (Heydari et al., 2022). It is more common for patients to refer themselves to secondary and tertiary care health facilities than it is for medical experts to make recommendations to these health facilities (Azagba et al., 2022). The referral system is one method that may be used to maximize the effective use of hospitals in accordance with many other tertiary health-care services (Foster et al., 2022). However, it is essential for all patients to first see a primary care physician, who will assess the need for a referral (Homburg et al., 2022; Struyf et al., 2022; Wu et al., 2022). The primary care clinics will provide medical treatment to those who demonstrate responsible self-care practices, (Hong et al., 2021) while the referral system will promptly direct individuals unable to get care to the closest appropriate health-care facility. Incentives offered by the corporate hospitals and privately run hospitals and mismanagement at government hospitals also influence the referral pattern and eventual choice of the patients to choose their health-care provider (Rastogi et al., 2023).

Three main levels of care structure the organization of the health-care system in Pakistan: primary, secondary, and tertiary. Primary care health facilities included the basic health unit (BHU), government rural dispensaries, rural dispensaries (RDs), mother and child houses, rural health centers (RHCs), and tehsil headquarter hospitals (THQ). These facilities provide essential and preventive health-care services to local communities. Tertiary care and district headquarters hospital (DHQ) health facilities are higher-level secondary health-care facilities that offer more specialized and advanced medical services. These secondary and tertiary care facilities serve as referral centers that receive patients from the primary care level when their needs exceed the capabilities of the initial point of contact. The design of this tiered system of health-care delivery

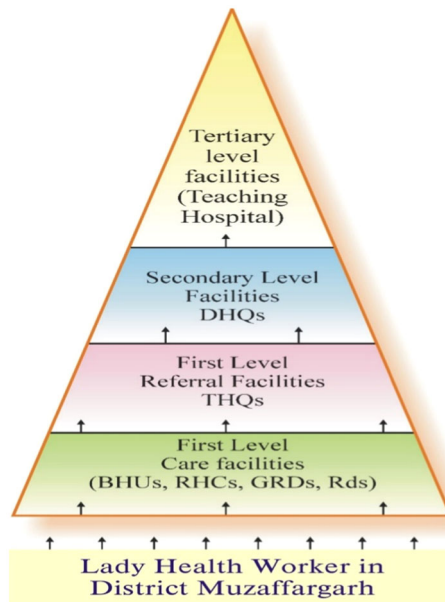


ensures that patients receive an appropriate level of care according to the complexity of their medical conditions. To further illustrate the level of care and service infrastructure of international health facilities shown in Figure 1, the patient flowchart from a first-level referral facility to a secondary-level facility in Pakistan is shown in Figure 2 (Hassan et al., 2024; Hassan, Ameerq, et al., 2023; Hassan, Tahir, et al., 2023; Hussain et al., 2006; Shahbaz et al., 2022; Siddiqi et al., 2001; World Health Organization).

## LEVELS OF CARE



**FIGURE 1** International patients' levels of care.



**FIGURE 2** Patients level of care flow in Pakistan. BHU, basic health unit; DHQ, district headquarters hospital; GRD, government rural dispensaries; Rds, rural dispensaries; RHC, rural health centers.



In the United States, United Kingdom, China, and India, the prevalence of overweight or obese pregnant women aged 12–38 was 11%–40%, 33%, 16%, and 8%, respectively (Chen et al., 2018). Every year, over 4.5 million children succumb to acute respiratory infections, mostly in underdeveloped nations. Pneumonia, unrelated to measles, is responsible for 70% of these fatalities. The illnesses most often mentioned include cardiovascular disorders, diabetes, respiratory diseases, and cancer. Referrals may be established based on the intricacy of the patient's illness, the need for more tests, or the necessity for specialized treatments.

For smooth functioning, the referral system requires collaboration between the primary and secondary health-care facilities. Human resources and equipment must be available at both the levels. Unfortunately, primary to secondary health care neglect refers to patients with various diseases, including noncommunicable conditions, such as obesity, hypertension, and diabetes. This lapse leads to delays in the diagnosis and treatment of these diseases (Caggiano et al., 2017). The referral system may also be insufficient in areas with insufficient resources and infrastructure to detect infectious diseases like tuberculosis (TB) and hepatitis (Hitchings et al., 2022).

With more than 5000 RHCs and BHUs supported by higher-level facilities, Pakistan's health-care system is an intricate structure of primary, secondary, and tertiary care facilities (Siddiqi et al., 2001). However, primary health-care efforts have not contributed to the anticipated enhancements in health status, especially among rural population areas, partially due to an inefficient referral system. By directing patients to other, similarly situated or even higher-level facilities with more resources, Pakistan's referral system guarantees that even when primary care physicians are unable to provide optimal treatment, patients still have the best chance of recovery (Seyed-Nezhad et al., 2021). However, the referral system in Pakistan faces several challenges, including dissatisfaction with the quality of care, the nonavailability of physicians, and long travel distances to reach health-care facilities. These issues often lead patients to bypass primary and secondary care facilities and directly seek treatment at tertiary care hospitals, overburdening these facilities and affecting their ability to provide quality care (Kakakhel et al., 2023).

The critical factors influencing patient referrals across health-care levels in South Punjab, Pakistan warrant this study. By identifying these factors, this study aimed to contribute to the strengthening of the health-care system, ultimately improving patient care and health outcomes. The findings will serve as a proposal for a referral system that aims to reduce unnecessary hospital admissions and enhance timely access to health care. This is crucial for the successful implementation of a referral system in Pakistan. It focused on understanding patient flow and referral patterns between primary, secondary, and tertiary health-care facilities. It identifies the most influential referral diseases and challenges that patients face during the referral process.

## MATERIALS AND METHODS

### Study design

Secondary data was gathered from the Statistical Officer in the Chief Executive Office of the District Health Authority Muzaffargarh (covering rural and urban areas of four subdistricts: Subdistrict-A, Subdistrict-B, Subdistrict-C, and Subdistrict-D). Patient-documented files on which all detailed notes were written by a consultant/charge-nurse of the relevant department. Data was also collected from the Statistical Officer of DHQ Hospital Muzaffargarh. In this research, we did not include patients whose dates were missing on record file. To maintain data integrity, we excluded three (30%) out of 10 patient files from the analysis due to missing dates. The analysis made up for this by censoring patients who were not the outcome on the last day of follow-up (LAMA cases), particularly in the pediatrics, gynecology, and emergency wards. All of the cases that were referred to other hospitals from the Coronary Care Unit (CCU), Medical, Surgical, ICU/

Emergency, Gyni/Obs, Pediatrics, TB/Chest, Ortho, and Psychiatry department were included. A total of 1716 male, female, and child patients were referred from DHQ Hospital Muzaffargarh, out of 1331 patient files examined.

## Study settings

Muzaffargarh district had a population of approximately 4.3 (Census-2017, 2017) million people, with an urban-to-rural ratio of 83:17. It had five tehsils (subdistricts), namely Muzaffargarh, Kot Addu, Ali Por, Jatoi, and Chowq Sarwar Shaheed. There were seven categories of health facilities operating in the district, with 130 public-sector health-care facilities operational. In the primary health-care facility 39 BHUs, THQs, and RHCs were observed 24/7 functional. The district's total hospital bed capacity was 689, with isolation beds, high-dependency units, intensive care units (ICUs), emergency beds, blood banks, and functional ventilators. In the district of Muzaffargarh, the total number of OPD, COD, and indoor patients during the last 4 years (2019–2022) was 10776136, 1,141,741, and 657,095, respectively. In our study, among 130 health-care facilities, DHQ hospital referred 1716 cases to tertiary care hospitals, excluding 579 deaths. The bed occupancy rate remained high from January 2022 to December 2022, except in July 2022.

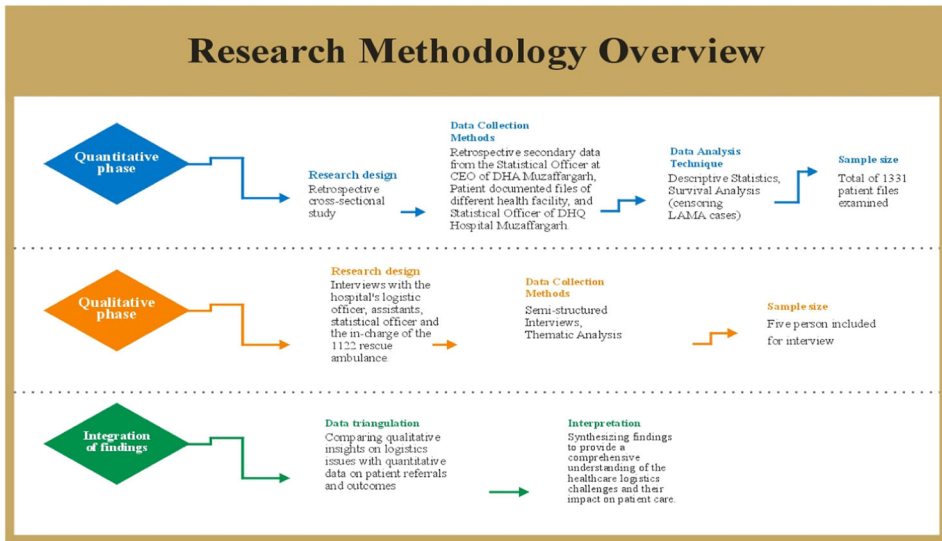
The research methodology overview is shown in Figure 3. In Punjab, over 5000 BHUs and 650 RHCs are part of the primary health-care system. Most health-care facilities remain inoperable, under-equipped, and under-staffed. These provincially funded health-care facilities are linked to over 700 hospitals, including DHQs and THQs (Caggiano et al., 2017). District Muzaffargarh is a pyramid-shaped district in Pakistan's Punjab province, sandwiched between two rivers (more than 300 km in length). It has a scattered population, a low literacy rate, poor socioeconomic, and sanitary conditions, 22 river-in UCs, poor health infrastructure, and desert areas designated as “security compromise areas” (World Health Organization).

In the qualitative phase, interviews were done with the hospital's logistic officer, assistants, statistical officer, and the in-charge of the 1122 rescue ambulance about the availability and nonavailability of all equipment, and details of logistics were obtained by those who transferred the patient from primary to secondary care as detailed in Figure 3. This article duration study started from January 2022 and concluded in February 2023; data collection concluded in December 2022. All statistical analysis was processed in R and SPSS-26, and Corel DRAW 12 was also used for graphical illustration.

## RESULTS

### Demographics of referred patients

The demographics of the referred patients in this study, including gender, age, place of residence, and socioeconomic status, are detailed in Table 1. The analysis of gender distribution indicated that 39.06% of the participants were identified as male, whereas 60.93% were identified as female. This disparity in gender proportions was found to be statistically significant ( $p=0.000$ ). The age distribution exhibited diverse percentages across distinct age groups, spanning from 7.36% to 34.25%. Notably, there were significant disparities observed in relation to age ( $p=0.011$ ). With regard to the geographic location of residence, it was observed that 38.69% of individuals hailed from rural areas, while the remaining 61.30% resided in urban regions. This discrepancy in patient distribution was found to be statistically significant ( $p=0.010$ ). The examination of socioeconomic status revealed that 35.91% of individuals belonged to the middle-income category, whereas 64.08% had lower incomes. These findings



**FIGURE 3** Research methodology overview of referral patents.

highlight significant disparities in income distribution ( $p = 0.022$  and  $p = 0.020$ , respectively). The understanding of demographic insights plays a crucial role in comprehending the patient population being studied and its implications for health-care delivery and targeted interventions.

### Disease-wise referral patterns

In (Table 2) and (Figure 4), there were a lot of patients flow from ICU/emergency, obstetrics and gynecology, and medical and surgical wards to tertiary care for disease-specific referrals. Road traffic accidents (Li & Zhao, 2022), cerebral vascular accidents (CVA) (Ledford et al., 2022), prematurity in cave (Mouler et al., 2022), myocardial infarction (MI) (Hammad et al., 2022), acute gastrointestinal (GI) bleeding (Xia et al., 2022), placenta previa with rupture uterus (Jauniaux et al., 2022), and chronic obstructive pulmonary disease (Thompson et al., 2022) were the high-influence referral diseases, according to the results.

Information collected during interviews with the hospital's logistic officer, assistants, statistical officer, and the in-charge of the 1122 rescue ambulance, inappropriate referrals, poorly organized referral letters, slow responses from hospitals, ineffective hospital management, and a dearth of necessary equipment and supplies, such as ventilators, laparoscopes, bronchoscopes, magnetic resonance imagings (MRIs), neurosurgeries, chemotherapy, continuous positive airway pressure (CPAP) machines, nasopharyngeal masks, and limited hospital beds, are all factors to consider.

### Thematic analysis

#### Operational efficiency

Smooth coordination among departments is crucial for efficient hospital logistics. We have implemented streamlined processes to ensure timely procurement and distribution of supplies.

**TABLE 1** Demographic of referral patients.

Characteristics	Value (%), total = 1331
Gender	–
Male	520 (39.06)
Female	811 (60.93)
Age	–
Less than 1–12	104 (7.81)
12–24	98 (7.36)
24–36	257 (19.30)
36–48	456 (34.25)
48–60	278 (20.88)
60–72 and above	138 (10.36)
Area	–
Rural	515 (38.69)
Urban	816 (61.30)
Subdistrict-A (Muzaffargarh)	709 (53.26)
Subdistrict-B (Kot Addu)	200 (15.02)
Subdistrict-C (Ali Por)	285 (21.41)
Subdistrict-D (Jattoi)	137 (10.29)
SES	–
Patients with middle-income	478 (35.91)
Patients with poor income	853 (64.08)
Road traffic accident	159 (11.94)
Cerebrum vascular accident	103 (7.73)
Prematurity in cave	32 (2.40)
Myocardial infarction	69 (5.18)
Acute gastrointestinal bleeding	36 (2.70)
Placenta previa + rupture uterus	96 (7.21)
Chronic obstructive pulmonary disease	28 (2.10)
Severity with COVID-19 vaccination	21 (1.27)
Severity without COVID-19 vaccination	28 (2.10)
CVD	19 (1.42)

Abbreviations: CVD, cardiovascular disease; SES, socioeconomic status.

Maintaining an optimized inventory management system has been key to minimizing waste and meeting the dynamic needs of our healthcare facility. However, we still face challenges in aligning the procurement processes across different units, which can sometimes lead to delays and inefficiencies.

Logistic Officer

**TABLE 2** Disease-wise referred cases from DHQ hospital to tertiary care.

Disease name	N (%)	Disease name	N (%)	Disease name	N (%)
Acute gastritis	11 (0.83)	Major degree placenta previa	19 (1.42)	Wheat pills intake	34 (2.55)
Hernia	10 (0.82)	Surgery opinion	6 (0.45)	Ectopic pregnancy	10 (0.75)
Chronic kidney disease	44 (3.30)	Head injury	27 (2.02)	Acute respiratory infections	8 (0.60)
Fracture	8 (0.60)	Eclampsia	52 (3.90)	Oncologist opinion	2 (0.15)
Vascular surgery encompasses	7 (0.52)	Liver disease	2 (0.15)	Bone marrow	2 (0.15)
Severe anemia	60 (4.50)	Ventilator	3 (0.22)	Kidney is nonfunctional refer to NHM	15 (1.12)
Wellness syndrome	2 (0.15)	Cerebrum vascular accident	103 (7.73)	Snake bite	3 (0.22)
Acute limb ischemia	1 (0.07)	Burn	15 (1.12)	Eye trauma	8 (0.60)
Ventilator care	2 (0.15)	Ante partum hemorrhage	28 (2.10)	Hypertension	10 (0.75)
Road traffic accident	159 (11.94)	Epilepsy	13 (0.97)	Fire arm	25 (1.87)
Neurosurgeons opinion	15 (1.12)	Placenta previa + rupture uterus	96 (7.21)	Birth sepsis	18 (2.10)
Renal failure	6 (0.45)	Need ICU	7 (0.52)	Chronic obstructive pulmonary disease (Muneeb Hassan et al., 2023)	28 (2.10)
Twin pregnancy	3 (0.22)	Chronic lung disease	22 (1.65)	Acute abdomen	13 (0.97)
Blunt trauma	1 (0.07)	Stevens-Johnson syndrome	10 (0.75)	Endoscopy	12 (0.90)
Pyrexia of unknown origin	6 (0.45)	Diabetes mellitus	13 (0.97)	Acute diarrhea	32 (2.40)
Deep vein thrombosis	3 (0.22)	Chronic renal failure	8 (0.60)	Angioplasty	13 (0.97)
Non-ST-elevation myocardial infarction	2 (0.15)	Shortness of breath SOB	8 (0.60)	Suspected dengue	1 (0.07)
Wheat pills intake	11 (0.83)	Metastatic thyroid	3 (0.22)	Ischemic heart disease	16 (1.20)
Acute gastrointestinal bleeding	36 (2.70)	Prematurity in cave	32 (2.40)	Cardiac disease	40 (3.00)
Meningitis	32 (2.40)	Myocardial infarction	69 (5.18)	Human immunodeficiency virus	2 (0.15)
Respiratory tract infections	7 (0.52)	Sever pneumonia	21 (1.57)	Purified protein derivative	3 (0.22)
Magnetic resonance imaging	6 (0.45)	Birth asphyxia	2 (0.15)	Chest pain	3 (0.22)





TABLE 2 (Continued)

Disease name	N (%)	Disease name	N (%)	Disease name	N (%)
Medico-legal cas	0 (0)	Postpartum hemorrhage	8 (0.60)	Toka machine injury	1 (0.07)
Multidisciplinary care	23 (1.72)	Addict	8 (0.60)	Bed not available	2 (0.15)

Abbreviations: DHQ, district headquarters hospital; ICU, intensive care unit.

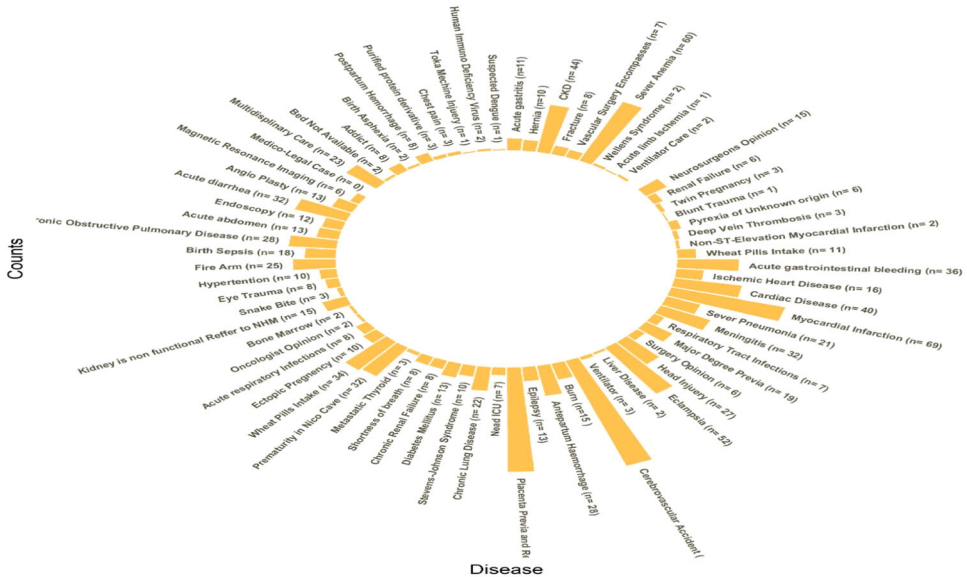


FIGURE 4 Disease-wise referred patient's status in DHQ hospital Muzaffargarh (January 2022 to December 16, 2022). DHQ, district headquarters hospital.

As assistants, we play a vital role in supporting the logistical operations of the hospital. Our attention to detail and proactive approach help us address any bottlenecks in the system.

Occasionally, we encounter communication gaps between the logistics team and the clinical departments, which can hinder our ability to respond promptly to emerging needs.

Assistants

### Data-driven decision making

Data analysis plays a vital role in identifying trends and improving healthcare services. We closely monitor key performance indicators to make informed decisions and optimize resource allocation.

The data analysis reveals clear patterns in the referral rates across different hospital wards and departments. This quantitative insight helps us understand the key drivers behind the high utilization of tertiary care services.

Statistical Officer



## Emergency response

Quick and effective emergency response is the cornerstone of ambulance services. We are constantly working to improve our response times and ensure the availability of well-equipped vehicles and trained personnel.

Coordinating with the hospital's emergency department is crucial for seamless patient handovers and continuity of care. We maintain open communication channels to enhance the overall emergency care system.

Occasionally, we encounter challenges in accessing certain areas due to traffic congestion or infrastructure limitations, which can impact our ability to reach patients in a timely manner.

In-charge of 1122 Rescue Ambulances

## DISCUSSION

In Pakistan, private medical care is easily accessible nationwide. Private services have a much superior reputation and are more extensively used compared to public services, mostly due to the perception of their higher quality. The primary deficiencies include insufficient oversight by health-care practitioners and deliberate avoidance by patients. Some of these problems may be attributed to the inadequate planning and training of the facility providers and their respective teams. The validity of these assumptions is further demonstrated by the very low rates of service utilization, as well as the deplorable state of pertinent records and problematic diagnoses considered at all levels of care. The purpose of the research presented here is to draw attention to commonly encountered problems in the referral system used by the public sector. It is important to point out a number of important limitations of this study before going into a discussion of the results (Caggiano et al., 2017). Private medical care is offered in every region of Pakistan, and this includes not just the country's cities and semicities but also its more outlying and rural settlements.

The results of the study provide important insights into the factors influencing referral service provision at the primary-to-secondary health-care levels. The total number of OPD, COD, and indoor patients during the last 4 years indicates a high burden of disease in the region, which may contribute to the high number of referrals to tertiary care hospitals. The study found that health facilities referred 1716 cases to tertiary care hospitals, excluding 579 deaths. The consistently high bed occupancy rates observed throughout the study period point to a notable scarcity of beds within secondary health-care facilities, potentially contributing to the necessity for referrals to tertiary care hospitals. The analysis of incoming calls, spanning a spectrum of specialty wards encompassing CCU, Medical, Urology, ICU/Emergency, Obstetrics and Gynecology, Pediatrics, Orthopedics, and Psychiatry, was meticulously conducted on a ward-specific basis. There is a clear need to improve the capabilities of these specialized units in both primary and secondary health-care facilities, as an interesting trend emerged showing that the most referrals were from the ICU/emergency and obstetrics and gynecology departments.

This research effectively identified a diverse range of high-impact referral cases, extending from road traffic accidents to cerebral vascular events (CVAs), neonatal prematurity, MIs, GI hemorrhages, incidents of placenta previa coupled with ruptured uteruses, and instances of chronic obstructive pulmonary disease. These insightful findings carry



significant implications for health-care provider training within the region, highlighting the critical need for equipping them with the requisite knowledge and expertise to effectively manage such conditions at both primary and secondary health-care levels.

In related research of the referral patterns of emergency obstetrics and gynecological patients at a tertiary hospital in northwest Ethiopia, it was found that only 28% of cases were submitted with a standard referral letter, 70% of which were referred directly from basic health-care units to a tertiary hospital, and only 5% of referred cases had a complete time of referral. Among those surveyed in Nigeria, 67.7% were happy with the treatment they got after being referred; however, only 53.2% were satisfied with the referral process itself (Guddu & Demissie, 2022). Based on the results of this survey, 57.1% of patients at Deberbirhan Referral Hospital would recommend the facility to others. Patient satisfaction was found to be 74%, which is lower than the 84%, 94%, 2%, 99.6%, and 68% reported in studies performed in Trinidad and Tobago, Nigeria, Kuwait, and Bangladesh (Mezemir, 2014).

Implementing an effective referral system is notoriously challenging and complex. Some are the result of incompetent management, while others are caused by a lack of resources and infrastructure necessary to deliver adequate treatment. Recent findings by other researchers confirmed the existence of the problem and identified some of the factors that contribute to it.

In the qualitative phase, we emphasized streamlined procurement and distribution processes for equipment, but we noted challenges across health facilities. There is a deficiency of necessary equipment and supplies, such as ventilators, laparoscopes, bronchoscopes, MRIs, neurosurgery, chemotherapy, CPAP machines, nasopharyngeal masks, and hospital beds. Rescue ambulance service officers have worried about the importance of quick emergency responses and efforts to improve response times, especially in rural areas. These findings underscore the need to address operational inefficiencies and ensure effective emergency response to improve patient outcomes.

The approach adopted by the research is problematic due to its limited scope in the public sector and its inability to include the significant role of the private medical care sector in Pakistan's health-care system. The lack of comprehensive research limits the identification of the underlying factors responsible for the region's elevated illness burden, which significantly contributes to the excessive utilization of tertiary care facilities. The research does not address the actual implementation elements of a referral system by offering specific solutions to the identified concerns.

Within this framework, it is necessary to provide further training for all health-care practitioners and establish a formal and institutionalized referral system. Any enhanced system must recognize that referral is a bidirectional communication mechanism. Initiating communication should be the responsibility of the referring physician at the primary care level, and it should be concluded with appropriate input from the referee, who is usually a consultant physician at a hospital. Furthermore, it is essential to simultaneously implement standardized protocols, accurate record-keeping, enough transportation options, and prioritized care for the referred patient. In countries like India, where multiple health-care systems are officially operational, it becomes more difficult to choose the appropriate health-care system for ultimate referral. This may not be the problem with countries having only allopathic systems of health care, but since the acceptance of CAM therapies is increasing gradually, this factor needs timely consideration.



## CONCLUSION

According to our results, most patients with road traffic accidents, CVAs, prematurity in caves, MI, GI bleeding, placenta previa with ruptured uterus, and chronic obstructive pulmonary diseases were referred. The highest referral ratio observed in the ICU/emergency and obstetrics and gynecology wards with a 65.51% and 18.40%. The nonavailability of advanced technological equipment, human resources, and emergency-handling situations (criteria and training) of referral were ignored by the higher authorities for all hospital staff. Due to the high number of referrals and LAMA cases in emergency, medical, obstetrics and gynecology, children's, and TB/chest wards, the government should remove obstacles that patients face during treatment. The government should priorities removing these obstacles by improving resource allocation, staff training, and upgrading technological equipment. Future research should focus on evaluating the effectiveness of these interventions in reducing referral rates and improving patient outcomes.

## AUTHOR CONTRIBUTIONS

Farrukh Jamal's research process involved the conceptualization of the idea, formulation of the theoretical framework, implementation of coding, creation of graphical representations, execution of computational analyses, and the final endorsement of the version intended for publication. Abdullah Ali H. Ahmadini performed the tasks involved in this paper include editing, proofreading, interpreting data, writing, and granting final approval for publication. Muhammad M. Hassan tasks involved in this paper include editing, proofreading, interpreting data, writing, and granting final approval for publication. Waqas Sami tasks involved in this paper include conceptualization, editing, proofreading, interpreting data, writing, and granting final approval for publication. Muhammad Ameerq's research process involved the conceptualization of the idea, formulation of the theoretical framework, implementation of coding, creation of graphical representations, execution of computational analyses, and the final endorsement of the version intended for publication. Areeba Naeem tasks involved in this paper include editing, proofreading, interpreting data, writing, and granting final approval for publication. All authors contributed to interpreting data, drafting the manuscript, and critically revising the manuscript for intellectual content; all authors approved of the published version.

## ACKNOWLEDGMENTS

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available on request from the third author, Muhammad M. Hassan. The data are not publicly available due to restrictions on their containing information that could compromise the privacy of research participants. The corresponding author can provide access to the data, models, and code that support the findings of this study.

## ETHICS STATEMENT

The department issued a letter of ethical approval on November 15, 2022 with reference No. 1265-71/DHQ by Statistical Officer in-charge of ethical committee in DHQ Hospital Muzaaffargarh, Punjab, Pakistan.

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