

# External Vs Internal e-Referrals: Results from a Nationwide Epidemiological Study Utilizing Secondary Collected Data

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**Background:** E-referral systems, streamlining patient access to specialists, have gained global recognition yet lacked a comparative study between internal and external referrals in Saudi Arabia (KSA).

**Methods:** This retrospective study utilized secondary data from the Saudi Medical Appointments and Referrals Centre system. The data covers 2020 and 2021, including socio-demographic data, referral characteristics, and specialties. Logistic regression analysis was used to assess factors associated with external referrals.

**Results:** Out of 645,425 e-referrals from more than 300 hospitals, 19.87% were external. The northern region led with 48.65%. Males were 55%, and those aged 25–64 were 56.68% of referrals. Outpatient clinic referrals comprised 47%, while 61% of referrals were due to a lack of specialty services. Several significant determinants are associated with higher rates of external referral with (p-value <0.001) and a 95% Confidence interval. Younger individuals under 25 exhibit higher referral rates than those aged 25–64. Geographically, compared to the central region, in descending order, there were increasing trends of external referral in the northern, western, and southern regions, respectively (OR = 19.26, OR = 4.48, OR 3.63). External referrals for outpatient departments (OPD) and dialysis services were higher than for routine admissions (OR = 1.38, OR = 1.26). The rate of external referrals due to the lack of available equipment was more predominant than other causes. Furthermore, in descending order, external referrals for organ transplantation and oncology are more frequent than for medical specialties, respectively (OR = 9.39, OR = 4.50).

**Conclusion:** The study reveals trends in e-referrals within the KSA, noting regional differences, demographic factors, and types of specialties regarding external referrals, benefiting the New Model of Care for the 2030 Vision. Findings suggest expanding virtual consultations to reduce external referrals. Strengthening primary care and preventive medicine could also decrease future referrals. Future studies should assess resource distribution, including infrastructure and workforce, to further inform healthcare strategy.

**Keywords:** e-referrals, health policy, epidemiology, public health

## Background

Referrals form a large part of both inpatient and outpatient services. Timely access to specialized facilities and personnel is necessary to achieve optimal patient care.<sup>1</sup> The traditional paper-based referrals have been shown to cause delayed treatment due to potentially missing information as well as inconvenience to patients. Literature shows that the use of e-referral systems forces the standardization of information and communication as part of the referral process, hence improving waiting times and efficiency.<sup>2</sup> Given these reported benefits, it is naturally expected that more countries are adopting e-referral systems such as Canada, Norway, England, and Denmark.<sup>3–6</sup>

In the Kingdom of Saudi Arabia (KSA), the Saudi Medical Appointments and Referrals Centre (SMARC), formerly known as Ehalati, operates and manages e-referrals across the country.<sup>7</sup> The SMARC system manages both internal and external referrals. Internal referrals represent any referral of patients from one health institution to another within the same administrative area, whereas external referrals represent the referral of patients to healthcare institutions outside of that referring administrative area. Although internal referrals are preferred, they are sometimes insufficient to meet patients' healthcare needs due to the variability of healthcare services between areas. Referrals involved within the SMARC system include those for inpatient as well as outpatient services, ie, where beds are required.<sup>8</sup> Variations in healthcare services and resources, including hospitals, physicians and equipment, between regions within a country are well documented and known worldwide.<sup>9,10</sup> Thus, to meet the aim of the referral concept, which is to move a patient from a place that has insufficient resources such as equipment and specialized healthcare providers to another facility, external referrals are also available within the SMARC e-referral system.<sup>7,11</sup>

External referrals are likely to be more complicated to manage and costly than standard internal referrals. The Ministry of Health (MoH) in the KSA provides flight tickets and daily living expenses to patients and their fellows when they are referred externally.<sup>12</sup> Also, in some cases according to patients' conditions, external referrals may include transferring patients using ground or air ambulance services, which consequently increases both complexity and cost. However, external referrals are essential to ensure high-quality care for all people across the country. Nevertheless, it is difficult to draw conclusions between internal and external referrals, due to the lack of studies in the literature.

The concept of internal vs external referrals between regions, defined in this study, is not investigated yet in the literature. The published studies had used other definitions of internal vs external referrals, according to the purpose of each conducted study. For example, Merlo et al<sup>13</sup> defined external referrals as any referral outside the healthcare center where the study was conducted while Porter et al<sup>14</sup> defined it as any referral outside the investigated specialty (eg, family medicine) in their study. Other definitions were also noted.<sup>15,16</sup> This creates a knowledge gap in the literature concerning the internal vs external referrals between regions on a national level.

To our knowledge, no study has yet investigated the differences between internal and external referrals using similar nationwide secondary collected data. Exploring and understanding the pattern of internal and external referrals as well as identified factors associated with external referrals can provide insight on the structural and functional capacities within and between regions and subsequently inform public health policy.

## Methods

### Study Design and Setting

A retrospective analytical study is used to analyze secondary data acquired from the SMARC e-referral system of the KSA which covers 300 hospitals. This system which began formal national operations through a unified referral system in 2019 covers all 13 administrative areas of the country. Any referral whether internal, ie within the administrative area itself or external, ie across the border of a specific administrative area, will have been registered within the system. The current study encompasses data for both 2020 and 2021.

### Ethical Considerations

The study complies with the ethical principles of the World Medical Association Declaration of Helsinki.<sup>17</sup> The MoH central institutional review board and the Imam Abdulrahman Bin Faisal University's institutional review board have both approved the study (IRB log No: 23–77 E and IRB-2023-01-305). The data did not include any personally identifying information, and the data was secured and used only for the purposes of this research.

### Study Variables

The data included demographic variables of patients such as age, sex and nationality, as well as referral characteristics which included the date of the visit which facilitated the extraction of the seasons of referrals, the region of the visit according to the five business units (BUs),<sup>18</sup> bed types that have been requested during the referral, the type of the referral itself, the reasons for referrals, the specialties for which the referral is requested and finally, whether the referral is internal or external.

## Data Analysis

The main dependent variable in this study was internal vs external referrals. They are defined as whether an e-referral has been requested to another hospital within any of the administrative areas or outside an administrative area. Descriptive statistics were given through frequencies and percentages. Cross tabulations were performed, and p-values were computed by means of a series of chi-squared tests. A binary logistic regression analysis was performed to obtain Odds Ratios (ORs) and their related 95% Confidence Intervals (CIs). The level of significance was set at 0.05, and the Stata Statistical Software version 16 was used for all analyses.<sup>19</sup>

## Results

### Sociodemographic Characteristics According to Internal Vs External Referral Requests

As shown in Table 1, the data included 645,428 referral requests. Of those, 80.13% were internal and 19.87% were external. Of the total population, adults aged between 25 and less than 65 years old had the highest number of requests, followed by the geriatric population (56.68% and 13.44% respectively). Among the external requests across all age groups, infants were observed to be the highest (24.91%), followed by children aged between 1 and <14 years of age (21.90%). With regard to sex, even though males had more requests than females in total (55.42%), females were higher in terms of external referrals when compared to males (21.40% and 19.12% respectively). Saudis also had higher requests compared to non-Saudis and were also higher in external requests (84.89% and 21.25% respectively). The

**Table 1** Sociodemographic Characteristics of Patients According to Internal Vs External Requests Across the Kingdom of Saudi Arabia

Characteristics	Total N (%) 645,428 (100)	Internal N (%) 517,182 (80.13)	External N (%) 128,246 (19.87)	P-value
<b>Age (Years)</b>				< 0.001
< 1	38,380 (5.95)	28,818 (75.09)	9562 (24.91)	
1 – 13	84,829 (13.14)	66,249 (78.10)	18,580 (21.90)	
14 – 17	20,705 (3.21)	16,410 (79.26)	4295 (20.74)	
18 – 24	48,902 (7.58)	38,910 (79.57)	9992 (20.43)	
25 – 65	365,837 (56.68)	296,154 (80.95)	69,683 (19.05)	
> 65	86,775 (13.44)	70,641 (81.41)	16,134 (18.59)	
<b>Sex</b>				< 0.001
Males	357,696 (55.42)	289,304 (80.88)	68,392 (19.12)	
Females	287,732 (44.58)	226,157 (78.60)	61,575 (21.40)	
<b>Nationality</b>				< 0.001
Non-Saudi	97,543 (15.11)	85,718 (87.88)	11,825 (12.12)	
Saudi	547,885 (84.89)	431,464 (78.75)	116,421 (21.25)	
<b>Year</b>				< 0.001
2020	282,731 (43.81)	230,127 (81.39)	52,604 (18.61)	
2021	362,697 (56.19)	287,055 (79.14)	75,642 (20.86)	

(Continued)

**Table 1** (Continued).

Characteristics	Total N (%) 645,428 (100)	Internal N (%) 517,182 (80.13)	External N (%) 128,246 (19.87)	P-value
<b>Business units</b>				< 0.001
Central	97,877 (15.16)	92,748 (94.76)	5129 (5.24)	
Eastern	71,131 (11.02)	67,004 (94.20)	4127 (5.80)	
Western	225,762 (34.98)	183,061 (81.09)	42,701 (18.91)	
Northern	113,637 (17.61)	58,356 (51.35)	55,281 (48.65)	
Southern	137,021 (21.23)	116,013 (84.67)	21,008 (15.33)	

number of both total, internal, and external requests increased during 2021 compared to 2020. Finally, and with regards to the five business units, the Western BU had the highest share of all referral requests, and the Eastern BU had the lowest. However, the Northern BU was the highest in terms of external referrals reaching 48.65%.

## Referral Characteristics According to Internal Vs External Referral Requests

Table 2 presents the results of referral characteristics. The results show that mostly referrals were for outpatient departments (OPDs), hence no beds were required for those specific referrals in 47.05% of all referrals. These were

**Table 2** Patient Characteristics According to Internal Vs External Requests Across the Kingdom of Saudi Arabia

Referral characteristics	Total N (%) 645,428 (100)	Internal N (%) 517,182 (80.13)	External N (%) 128,246 (19.87)	P-value
<b>Bed Types</b>				< 0.001
OPD no bed	303,669 (47.05)	226,614 (74.63)	77,055 (25.37)	
Ward	233,327 (36.15)	197,313 (84.57)	36,014 (15.43)	
Burning Bed	605 (0.09)	519 (85.79)	86 (14.21)	
Isolation	26,042 (4.03)	24,056 (92.37)	1,986 (7.63)	
CCU Bed	17,864 (2.77)	14,424 (80.74)	3440 (19.26)	
NICU	10,729 (1.66)	8845 (82.44)	1884 (17.56)	
ICU	45,393 (7.03)	39,164 (86.28)	6229 (13.72)	
PICU	7799 (1.21)	6247 (80.10)	1552 (19.90)	
<b>Referral Types</b>				< 0.001
Life saving	45,470 (7.04)	39,933 (87.82)	5537 (12.18)	
Routine OPD	304,937 (47.25)	227,462 (74.59)	77,475 (25.41)	
Routine admission	82,619 (12.80)	67,802 (82.07)	14,817 (17.93)	
ER	212,288 (32.89)	181,894 (85.68)	30,394 (14.32)	
Dialysis	114 (0.02)	91 (79.82)	23 (20.18)	

(Continued)

**Table 2** (Continued).

Referral characteristics	Total N (%) 645,428 (100)	Internal N (%) 517,182 (80.13)	External N (%) 128,246 (19.87)	P-value
<b>Reason For Referral</b>				< 0.001
Unavailable subspecialty	397,486 (61.58)	316,598 (79.65)	80,888 (20.35)	
Unavailable physician	110,400 (17.10)	91,632 (83.10)	18,768 (16.90)	
Unavailable machine	86,293 (13.37)	63,684 (73.80)	22,609 (26.20)	
Unavailable Bed	23,410 (3.63)	21,350 (91.20)	2060 (8.80)	
Social	1595 (0.25)	1406 (88.15)	189 (11.85)	
Health crisis	26,244 (4.07)	22,106 (84.23)	4138 (15.77)	

followed by regular ward beds in 36.15% of referrals, and the least requested bed type was burning beds (0.09%). For external referrals, OPDs were also the most common followed by pediatric intensive care (PICU) beds and cardiac care unit (CCU) beds (25.37%, 19.90% and 19.26%, respectively). Also, for referral request types, 47.25% consisted of referrals for routine OPD. This was also the most common for external referral requests (25.41%), and this was followed by patients for dialysis (20.18%) although there were only 114 dialysis patients in total. With regard to the reasons for referral, unavailable specialty was the most commonly reported reason in 61.58% of all referrals. However, specifically for external referrals, unavailability of a machine was the most commonly reported reason in 26.20% compared to all other reasons.

## Distribution of Medical/Surgical Specialties Requested for Referrals

Table 3 presents the distribution of medical and surgical specialties requested for referrals according to internal vs external referrals. Surgery was the leading specialty constituting 26.06% of all referrals followed by medicine and cardiac surgery (22.26–9.69% respectively). With respect to external requests, organ transplantation was the most common reaching 58.96% compared to other specialties, followed by oncology and medical rehabilitation (41.60–34.88%). The least common specialty with external referrals was psychiatry (8.38%).

## Multivariable Analysis of Factors Associated with External Referrals

Table 4 shows the ORs and 95% CI from the multivariable logistic regression analysis of factors associated with external referrals. Firstly, it was observed that infants aged less than 1 year had 21% increased likelihood of receiving external referrals when compared with adults (95% CI = 1.17–1.25), whereas the elderly had a 9% decreased likelihood (95% CI = 0.89–0.93). With respect to the types of referrals and when compared to routine admissions, an increased likelihood was observed for both routine OPD referrals (OR = 1.38, 95% CI = 1.35–1.42) and dialysis patients, however for dialysis it was not significant. Also, for both lifesaving and ER referral types, a decreased likelihood for external referral was observed (OR = 0.91, 95% CI = 0.88–0.95 and OR = 0.82, 95% CI = 0.80–0.84 respectively). Compared to the unavailability of machines as the reason for referral, all other reasons had a decreased likelihood for external referrals; however, social reasons were observed to have the lowest decreased likelihood where the OR was 0.26 (95% CI = 0.21–0.88). Examining the ORs for external referrals by the different specialties, organ transplantation, and oncology had the highest likelihood (OR = 9.39, 95% CI = 8.13–10.83 and OR = 4.50, 95% CI = 4.31–4.71), whereas radiology had the lowest likelihood (OR = 0.39).

**Table 3** Distribution of Specialties According to Internal Vs External Referrals Across the Kingdom of Saudi Arabia

Medical and surgical specialties*	Total N (%) 645,428 (100)	Internal N (%) 517,182 (80.13)	External N (%) 128,246 (19.87)
General surgery	168,217 (26.06)	133,474 (79.35)	34,743 (20.65)
Medicine	143,696 (22.26)	122,703 (85.39)	20,993 (14.61)
Cardiac Surgery	62,560 (9.69)	49,799 (79.60)	12,761 (20.40)
Ophthalmology	50,526 (7.83)	33,487 (66.28)	17,039 (33.72)
Pediatrics	43,886 (6.80)	33,541 (76.43)	10,345 (23.57)
Radiology	42,384 (6.57)	38,771 (91.48)	3,613 (8.52)
Obstetrics and gynecology	36,222 (5.61)	27,669 (76.39)	8553 (23.61)
Ear, nose and throat	29,076 (4.50)	24,082 (82.82)	4994 (17.18)
Dentist	20,935 (3.24)	18,946 (90.50)	1989 (9.50)
Oncology	14,959 (2.32)	8736 (58.40)	6223 (41.60)
Psychiatry	10,241 (1.59)	9383 (91.62)	858 (8.38)
Medical rehabilitation	6586 (1.02)	4289 (65.12)	2297 (34.88)
Dermatology	5623 (0.87)	4657 (82.82)	966 (17.18)
Organ transplantation	1255 (0.19)	515 (41.04)	740 (58.96)
Other	9262 (1.44)	7130 (76.98)	2132 (23.02)

Notes: \*Differences were significant at the <0.001 level.

**Table 4** Adjusted Binary Logistic Regression Analyses for Characteristics Associated with External Referrals

Predictors	Adjusted OR	p-value	95% CI
<b>Age</b>			
< 1	1.21	< 0.001	1.17–1.25
1 - 13	1.00	0.47	0.98–1.03
14 - 17	1.07	0.001	1.02–1.11
18 - 24	1.05	0.001	1.02–1.08
25 - 65	Ref		
> 65	0.91	< 0.001	0.89–0.93
<b>Sex</b>			
Males	Ref		
Females	1.01	0.07	0.99–1.03
<b>Business units</b>			
Central	Ref		
Eastern	0.78	< 0.001	0.74–0.81

(Continued)

**Table 4** (Continued).

Predictors	Adjusted OR	p-value	95% CI
Western	4.48	< 0.001	4.33–4.63
Northern	19.26	< 0.001	18.61–19.93
Southern	3.63	< 0.001	3.50–3.76
<b>Referral types</b>			
Life saving	0.91	< 0.001	0.88–0.95
Routine OPD	1.38	< 0.001	1.35–1.42
Routine admission	Ref		
ER	0.82	< 0.001	0.80–0.84
Dialysis	1.26	0.32	0.79–2.02
<b>Reason for referral</b>			
Unavailable subspecialty	0.65	< 0.001	0.63–0.66
Unavailable physician	0.42	< 0.001	0.41–0.43
Unavailable machine	Ref		
Unavailable Bed	0.38	< 0.001	0.36–0.40
Social	0.26	< 0.001	0.21–0.31
Health crisis	0.84	< 0.001	0.80–0.88
<b>Medical/surgical specialties</b>			
General surgery	1.31	< 0.001	1.28–1.34
Medicine	Ref		
Cardiac Surgery	1.48	< 0.001	1.44–1.53
Ophthalmology	2.36	< 0.001	2.29–2.44
Pediatrics	1.63	< 0.001	1.57–1.69
Radiology	0.39	< 0.001	0.38–0.41
Obstetrics and gynecology	1.74	< 0.001	1.68–1.81
Ear, nose and throat	0.79	< 0.001	0.75–0.82
Dentist	0.42	< 0.001	0.40–0.45
Oncology	4.50	< 0.001	4.31–4.71
Psychiatry	0.48	< 0.001	0.44–0.52
Medical rehabilitation	2.83	< 0.001	2.65–3.01
Dermatology	0.75	< 0.001	0.69–0.82
Organ transplantation	9.39	< 0.001	8.13–10.83
Other	2.84	< 0.001	2.68–3.02

## Discussion

This study is the first of its kind to explore the differences between internal and external referrals at the national level in the KSA utilizing secondary routinely collected data. Furthermore, no study has yet investigated the distribution of external and internal referrals between secondary and tertiary care, an area our research has sought to address. The analyses presented here have been successfully able to highlight potentially problematic areas and inform on health policy issues. Results shed light on areas that need further exploration and assessment to justify the discrepancy in referral characteristics between these regions.

E-referral systems, which integrate part of the referral process via information technology, have undergone various evaluations globally. A recent study examining the patterns and trends of e-referral request acceptances contrasting with the SMARC system in the KSA revealed that the predominant patient demographic consists of middle-aged Saudi males, primarily located in the Western regions. This trend is largely attributed to the absence of specialized physicians or medical specialties in local facilities.<sup>8</sup> In Australia, the US Veterans Administration, and the UK, these systems have been tested, utilized, and assessed, revealing challenges related to coordination, policy, standardization, and mixed outcomes on referral content quality.<sup>20–22</sup> Denmark reports extensive use of e-referrals by general practitioners, leading to substantial cost savings, while Norway highlights the importance of collaboration among clinicians for effective e-referral implementation.<sup>23,24</sup>

The study found that the majority of referrals were internal. This indicates an overall good quality of healthcare services offered in the KSA. While this is largely true, several discrepancies were observed. For example, infants had the highest percentage of external referrals compared to other age categories. Also, referral by bed type exhibited a slightly higher percentage for pediatric intensive care units (PICU) and neonatal intensive care units (NICU) which indicates a need for specialized care for this age group that may not be available in specific administrative areas. Infant services may be undervalued due to the lower density of the population at this age compared to other age groups, especially adults aged between 25 < 65 years and the potentially higher need for services among these relatively older people. In the KSA, the adult population surpasses the number of children, leading to a health system primarily directed towards adults.<sup>25</sup> Also, the high prevalence of chronic conditions among adults necessitates substantial health resources.<sup>26,27</sup> On the other hand, the lower incidence of critical conditions in children is reflected in the higher odds of external referrals among this vulnerable age group for specialized care, compared to adults who receive comprehensive services that are more distributed across regions. This population density resource distribution reflects the demographic and epidemiological realities of the Saudi healthcare landscape. This is similar in the US, where most critical care beds are designated for adults, while only 6% are for pediatrics, highlighting a pronounced shortage in pediatric critical care and trained personnel and emphasizing the disparity in resource distribution between adult and pediatric critical care services.<sup>28</sup> Additionally, international studies have indicated that, due to the scarcity of PICU resources, it is imperative to refer only patients who truly require this service to regional PICUs.<sup>29–32</sup>

We also found that female patients were referred to external medical facilities more than males. Worldwide, an estimated 287,000 women die annually due to maternal causes. The majority of these maternal deaths are a direct result of obstetric causes. Obstetric complications often arise during or shortly after delivery and can quickly become life-threatening.<sup>33</sup> Referral to more advanced medical facilities for maternity-related conditions may be mainly due to complications that require life-saving interventions.<sup>34</sup> This is also evident by the high external referral requests for obstetrics and gynecology found in this study, even though no statistically significant association was found for sex.

The sociodemographic findings also show more external referrals to Saudis compared to non-Saudis. However, statistics reveal that non-Saudis are fewer than Saudi nationals and are primarily located in the capital which offers the best specialized services, and subsequently, less demand for external referrals is needed.<sup>35</sup> In addition, SMARC, under the Saudi MoH, predominantly manages public hospitals that serve citizens who do not require insurance. Meanwhile, non-Saudi workers are provided with private insurance and tend to be treated in private hospitals,<sup>36</sup> which utilizes a different referral system. This results in a higher rate of referrals within the public sector for Saudis. Nonetheless, non-Saudis also benefit from quality healthcare, regardless of the type of hospital.



Although the Western BU was the highest in terms of total referrals, a closer look at the pattern of referrals showed a significant proportion of internal referrals in the Central BU, while the highest proportion of external referrals was in the Northern BU. According to the 2021 edition of the statistical yearbook issued by the MoH, the number of both governmental and private hospitals in the last five years in the Central BU was 111 with a total number of beds equal to 20,515. Whereas the total number of hospitals and beds in the Northern BU was only 46 and 6650, respectively.<sup>37</sup> This regional disparity with lower resources in the Northern BU is consistent with previous studies that examined the variation in the quality of care between the five BUs.<sup>18,38,39</sup> Albeit the confined focus in those studies were COVID-19 patients, they did examine the quality of care from different angles at a national level and have all arrived at the conclusion that the infrastructure and allocated resources in the Northern BU are of concern. This also explains the higher percentage of external referrals in the Northern BU compared to other BUs.

Around half of all referrals had originated from outpatient departments (OPDs), and only around a quarter of those OPD referrals were externally referred. In OPDs, there are often fewer complex cases that can be managed internally and referred easily to other neighboring hospitals. This is also complemented with the finding that routine referrals were the most common also reaching around half of all referral types. Whereas referrals for CCU and PICU were slightly higher than other categories among the external referrals which could reflect deficiency in providing these services for the patients. We also found that only a small proportion of referrals were categorized as lifesaving and only 12.18% being external, indicating the overall good quality of healthcare services when dealing with life-threatening cases.

With regard to the reason of referral, the most common reason for external referrals was a lack of healthcare equipment. This issue is not unique to the KSA, as The United States Food and Drug Administration regularly publishes shortage list of equipment required for a variety of clinical specialties.<sup>40</sup> This shortage has the ability to impact the process of diagnosing a disease as well as patient management and subsequently patients' outcomes.<sup>41</sup> The data indicate the need for this equipment to avoid the cost of external referrals, which may not always be possible due to issues surrounding training and maintenance.<sup>42</sup>

Unavailable specialty and physician were ranked as the second and third most common reasons for external referrals. This issue may have a detrimental effect on the delivery of timely and much needed healthcare services.<sup>43,44</sup> Unfortunately, research predicts that these shortages may become worse within the next decade as the demand for physicians outweighs the supply.<sup>45</sup> This is likely due to the changes in population dynamics, including the growing number of people.<sup>46</sup> In fact, in a very recent study which had examined referrals for emergency cases alone, it was observed that the most common reason for those referrals was also the unavailability of a subspecialized department followed by the availability of a physician.<sup>8</sup> Although the use of telemedicine and the Saudi experience with the Seha Virtual Hospital may compensate for the shortages in some areas, they may not always be applicable.<sup>47-49</sup> Therefore, local initiatives to compensate the shortages in specialties and physicians are recommended.

In recent years, the demand for organ transplants has increased dramatically worldwide and in the KSA as well.<sup>50</sup> Our data clearly demonstrate that organ transplantation is the highest specialty that refers patients externally to major cities where organ transplant centers are located.<sup>51</sup> Several challenging factors make it difficult to develop such centers in all areas of the country. These include complex medical and ethical regulations imposed by the WHO governing the medical practice of organ transplantation as well as the complexity of the multi-step process of these procedures which requires a team of highly qualified professionals, financial barriers, lack of support staff and its major economic burden on the healthcare system.<sup>52,53</sup> Organ transplant was followed by oncology. In the KSA, and as per the MoH's statistical yearbook of 2021, the MoH oversees only four centers, two of which are within the boundaries of the Central BU.<sup>37</sup> Furthermore, the main center for supervising and regulating organ donations known as the Saudi Centre for Organ Transplantation participates in a network of organ sharing with other Gulf countries, hence increases the possibility of external referrals.<sup>54</sup> However, access to oncology remains inadequate worldwide. Similar to the KSA, the United Kingdom applies centralized care to oncology patients which subsequently requires external referrals.<sup>55</sup> Treatment for cancerous patients is among the most expensive and challenging due to a lack of financial and human resources.<sup>56</sup> These realities may explain the need for external referrals to areas equipped with advanced medical facilities and personnel.

The current findings have several health policy implications. Firstly, we strongly recommend hastening the implementation of the unified electronic medical records across all areas of the KSA. The primary objective is to centralize the registration of comprehensive medical information, by increasing convenient healthcare for service users and providers through eliminating unnecessary travel for stable cases, for example, patients that require follow-up. This will allow patients to perform any necessary investigation at the nearest hospital rather than travel externally. It will also allow healthcare providers to be informed of the health status of patients. Secondly, we believe that virtual clinics are an incredible tool that would help keep external and internal referrals at a minimum, thereby reducing costs and easing accessibility to patients. Thirdly, focusing on an advanced primary healthcare system especially with preventive medicine will contribute to a coherent and well-rounded healthcare system. For example, ensuring periodic examination of the patient, early detection of diseases, and reducing disease complications will most probably decrease pressures on hospitals. Finally, enabling interaction and communication among diverse stakeholders, such as the MoH, other governmental organizations, and private medical agencies, through regular meetings is essential to facilitating integration, cooperation, and communication throughout the referral system. A proactive stance strengthens the referral system and effectively addresses existing challenges to ensure all parties are well-informed regarding current and updated protocols and guidelines. By creating a collaborative environment and facilitating knowledge sharing, medical organizations will achieve efficiency and effective referral processes, improving healthcare delivery and thus patient outcomes.

This study is the first to utilize nationally and routinely collected data to explore the predictors of external referrals in the KSA. Nevertheless, there are limitations to consider in this study. First, the retrospective design restricts our ability to establish reliable relationships and draw conclusions. Second, our study lacked detailed information on several crucial factors, including the availability of human and non-human resources in each region. Finally, we are limited to data collected by the SMARC e-referral system.

We propose several approaches to future research to address these limitations and advance the field forward. Firstly, prospective or longitudinal studies could be designed to confirm the predictors identified and explore their causal relationships with external referral rates among regions in the KSA. Secondly, qualitative research exploring healthcare providers' perspectives could reveal additional predictors not captured by the SMARC e-referral system. Lastly, further research could provide a more comprehensive understanding of the referral process by expanding the dataset and integrating additional variables such as socioeconomic status, resource distribution among regions, patient preferences, and detailed clinical outcomes.

## Conclusions

This study is the first to provide the pattern of internal and external e-referrals across the KSA and to identify potential factors predicting external referrals. Patients aged between  $25 < 65$  had the highest referral requests, indicating higher needs of care for this group of patients. Most referral requests were internal, which are suggestive of prevalent high-quality care within the administrative areas and BUs. Infants and younger patients, requests originating from the Northern region followed by the Western and Southern regions, unavailability of machines, referrals for organ transplantation followed by oncology and surgical specialties, were all factors predicting external referrals, highlighting resource allocation concerns. The expansion of virtual clinics, focusing on preventive strategies as well as future research focusing on service provision, referral services, and resource availability across all levels of healthcare is recommended in order to aid in the implementation of the New Model of Care under the new 2030 Vision of the KSA.

## Abbreviations

KSA, Kingdom of Saudi Arabia; SMARC, Saudi Medical Appointments and Referrals Centre; MoH, Ministry of Health; BU, Business unit; OR, Odds Ratio; CI, Confidence interval; PICU, Pediatric intensive care units; NICU, Neonatal intensive care units.

## Data Sharing Statement

The datasets used and analyzed during the current study are available for request from the SMARC system.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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The authors declare that they have no competing interests in this work.

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