

Strengthening Primary Eye Care through Vision Centres - A 12-month analysis of Refractive Error and Cataract detection in rural Karnataka, India

Venkatram Katti

kattivenkatram@gmail.com

Jayapriya Medical Foundation Hubli, Karnataka <https://orcid.org/0009-0000-0498-5909>

Lakshmi B R

KLE Academy of Higher Education and Research, Hubli, Karnataka, India.

Priya V. Katti

Jayapriya Medical Foundation Hubli, Karnataka

Anuja Desai

Jayapriya Medical Foundation Hubli, Karnataka

Muthulakshmi

Jayapriya Medical Foundation Hubli, Karnataka

Avinash V Prabhu

M S Ramaiah University of Applied Sciences <https://orcid.org/0000-0002-3899-187X>

Research Article

Keywords: Primary Eye Care, Vision Centre, Cataract detection, rural Karnataka

Posted Date: July 14th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10224053/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: The authors declare no competing interests.

Abstract

Visual impairment continues to represent a significant public health challenge, particularly in developing nations where disparities in healthcare access remain pronounced. In India, the burden of avoidable blindness persists despite considerable progress in ophthalmic care delivery and national health initiatives. This study is designed to address the gaps and report the effectiveness by systematically analyzing detection patterns over one year. It focuses on rural Vision Centres, examining the prevalence of refractive errors, frequency of cataract detection, and referral practices. A retrospective descriptive study design was adopted to analyze service delivery data from selected rural primary eye care facilities in Karnataka. The study was conducted across Vision Centres located in Bellatti, Amminbhavi, Nargund, Bankapur, and Annigeri. Over the 12-month study period (January–December 2024), a total of 8,413 patients attended the selected Vision Centres across rural Karnataka. A total of 2,471 patients were provided with spectacles following refraction, resulting in a spectacle conversion rate of 29%. During the study period, 1,720 cataract surgeries were performed following referral from the Vision Centres. An additional dimension of service delivery observed in this study was the integration of systemic disease screening within primary eye care. A total of 2,472 patients underwent blood pressure and blood glucose screening, representing a significant proportion of attendees.

Introduction

Visual impairment continues to represent a significant public health challenge, particularly in developing nations where disparities in healthcare access remain pronounced. In India, the burden of avoidable blindness persists despite considerable progress in ophthalmic care delivery and national health initiatives. Refractive errors and cataract are consistently identified as the leading causes of visual impairment, both of which are largely preventable or treatable through timely intervention.¹ However, the gap between the availability of services and their utilisation remains a critical concern, especially among rural populations.

Refractive errors, including myopia, hyperopia, and astigmatism, constitute one of the most common causes of visual impairment globally. When left uncorrected, these conditions can adversely affect educational attainment, occupational productivity, and overall quality of life. Cataract, defined by opacification of the crystalline lens, remains the leading cause of blindness worldwide and contributes substantially to visual disability in aging populations.² In India, cataract accounts for a major proportion of blindness cases despite the availability of cost-effective surgical treatment, indicating systemic gaps in early detection and service uptake.³ The coexistence of refractive errors and cataract within the same demographic groups highlights the need for integrated and accessible screening services.

To address these challenges, the Government of India has implemented several initiatives under the National Programme for Control of Blindness and Visual Impairment (NPCBVI), which aims to reduce the prevalence of avoidable blindness through comprehensive eye care strategies.⁴ These include mass cataract surgical programs, school eye screening, and the establishment of primary-level eye care

facilities. Among these, Vision Centres have emerged as a cornerstone of rural eye care delivery, functioning as the first point of contact for individuals seeking basic ophthalmic services.

Primary Eye Care Vision Centres are strategically located within rural and semi-urban communities to improve accessibility and reduce barriers associated with distance and cost. Typically staffed by trained vision technicians, these centres are equipped to perform visual acuity assessments, refraction, preliminary diagnosis of ocular conditions, and referral of complex cases to higher-level facilities. Their decentralized nature allows them to reach underserved populations who may otherwise lack access to specialized eye care services.⁵ Over time, Vision Centres have become integral to the broader healthcare system, facilitating early detection and intervention for common eye conditions.

Despite their expanding presence, there remains a need to critically evaluate the performance and effectiveness of Vision Centres in real-world settings. A one-year observational study of refractive error and cataract detection provides valuable insights into patient demographics, disease patterns, and service utilization. Such evaluations are essential for identifying gaps in service delivery, optimizing resource allocation, and enhancing the quality of care provided at the primary level.

Previous studies have demonstrated that Vision Centres significantly improve access to eye care services; however, challenges related to utilization, follow-up adherence, and referral compliance persist.⁶ Factors such as low awareness, financial constraints, cultural beliefs, and limited trust in healthcare systems continue to influence patient behavior. Additionally, disparities in infrastructure, training, and availability of diagnostic equipment across centres may affect the consistency of service delivery. These issues underscore the importance of continuous monitoring and context-specific research to strengthen primary eye care systems.

From a public health perspective, early detection of refractive errors and cataract is critical for reducing the burden of avoidable blindness. Uncorrected refractive errors can be effectively managed with prescription spectacles, while cataract requires timely surgical intervention to restore vision. Delays in diagnosis and treatment not only exacerbate visual impairment but also impose significant economic and social costs on individuals and communities.⁷ Therefore, strengthening primary-level screening and referral mechanisms is essential for achieving equitable eye health outcomes.

This study is designed to address the gaps and report the effectiveness by systematically analyzing detection patterns over one year. It focuses on rural Vision Centres, examining the prevalence of refractive errors, frequency of cataract detection, and referral practices. By capturing real world data from primary care settings, the study aims to provide a comprehensive understanding of the role of Vision Centres in early diagnosis and management of common ocular conditions.

Methods

Study Design and Setting

A retrospective descriptive study design was adopted to analyze service delivery data from selected rural primary eye care facilities in Karnataka. The study was conducted across Vision Centres located in Bellatti, Amminbhavi, Nargund, Bankapur, and Annigeri. These centres function as primary eye care units serving predominantly rural and semi-urban populations, providing essential ophthalmic services including visual acuity assessment, refraction, basic diagnosis, and referral for advanced care. The retrospective design was considered appropriate for evaluating existing service data and understanding patterns of eye care delivery over a defined period.

Data Source and Study Period

The study utilized routinely collected service records maintained at the Vision Centres. Data spanning one year, from January 2024 to December 2024, were extracted and reviewed. These records are part of standard operational documentation and include patient registers, refraction logs, and referral records. The use of secondary data minimized respondent burden and enabled the assessment of real-world service utilization without influencing provider or patient behavior.

Study Variables

The analysis focused on key service delivery indicators relevant to primary eye care such as refractive error correction, cataract identification & surgical referrals. These indicators were selected as they represent the core functions of Vision Centres in addressing avoidable causes of visual impairment.

Data Collection Procedure

Data extraction was carried out systematically using a standardized data abstraction format. Relevant information was retrieved from physical and/or electronic registers maintained at each centre. Variables such as patient counts, diagnoses, and referral outcomes were recorded and compiled into a consolidated database. To ensure consistency, uniform definitions were applied across all centres during data extraction.

Data quality was assessed through cross-verification of entries where feasible. Incomplete or ambiguous records were excluded from the final analysis to maintain data integrity. Since the study relied on routine service data, no direct interaction with patients was involved.

Data Analysis

The collected data were entered into a statistical software package for analysis. Descriptive statistics were used to summarize service indicators across the study period. Frequencies and proportions were calculated for refractive error correction, cataract detection, and referral patterns. Comparative analysis across the five Vision Centres was performed to identify variations in service delivery and utilization.

Temporal trends over the one-year period were also examined to assess fluctuations in patient load and service uptake. The findings were presented in tabular and graphical formats to facilitate interpretation. Given the retrospective and descriptive nature of the study, no inferential statistical tests were applied.

Ethical Considerations

As the study involved secondary analysis of anonymized service data, individual patient consent was not required. However, necessary administrative permissions were obtained from the respective Vision Centres and governing authorities. Confidentiality of patient information was strictly maintained, and no personally identifiable data were included in the analysis.

Results

Over the 12-month study period (January–December 2024), a total of 8,413 patients attended the selected Vision Centres across rural Karnataka. The findings provide a comprehensive overview of service utilization, refractive care outcomes, cataract surgical referrals, and integration of systemic health screening within primary eye care settings.

Discussion

The present study evaluated the utilization and outcomes of Vision Centre services across rural Karnataka over 12 months, encompassing 8,413 patient visits. The findings provide important insights into the role of primary eye care centers in improving access to ophthalmic services, facilitating refractive correction, promoting cataract surgical uptake, and integrating systemic health screening within community-based eye care delivery. Collectively, the results highlight the growing significance of Vision Centres as a decentralized and accessible model for comprehensive eye health services in underserved populations.

A notable finding was the high proportion of new patients (78.5%), indicating that Vision Centres are successfully reaching previously unserved or underserved populations. Similar trends have been reported in community ophthalmology programs across low- and middle-income countries, where primary eye care facilities significantly improve healthcare accessibility by reducing geographical and financial barriers.^{1,5} The relatively lower proportion of follow-up patients may reflect either successful resolution of primary complaints or limited continuity in long-term eye care utilization. Nonetheless, the large influx of new patients demonstrates the expanding acceptance and utilization of Vision Centre-based services within rural communities.

Refractive error services represented a major component of Vision Centre activity. Nearly one-third of all attendees (29%) received spectacles following refraction. This spectacle conversion rate is comparable with findings from previous rural eye care studies conducted in India and other developing regions, where uncorrected refractive errors remain one of the leading causes of avoidable visual impairment.^{8,9} The substantial demand for corrective lenses observed in this study emphasizes the importance of

accessible refractive services at the primary care level. Early detection and correction of refractive errors not only improve visual function but also enhance educational performance, productivity, and quality of life. The findings therefore reinforce the critical role of Vision Centres in addressing preventable visual disability through low-cost optical interventions.

The cataract referral outcomes further highlight the effectiveness of Vision Centres in facilitating surgical uptake. A total of 1,720 cataract surgeries were performed following referral, demonstrating a strong linkage between community screening and tertiary surgical services. Importantly, 64% of surgeries were provided free of cost, while an additional 16% were subsidized. This financial distribution reflects a substantial emphasis on equitable service delivery and reduction of economic barriers to cataract care. Similar outreach-based cataract models have been shown to significantly increase surgical uptake among economically disadvantaged populations.^{10,11} The availability of free and subsidized surgeries likely contributed to improved acceptance of treatment and reduced delays in seeking surgical intervention.

The proportion of paid surgeries (20%) also suggests the presence of a mixed healthcare utilization pattern, where some patients were willing or able to opt for paid services, potentially reflecting confidence in service quality and availability of tiered healthcare models. Previous studies have demonstrated that cross-subsidization mechanisms within community eye care programs can improve financial sustainability while simultaneously maintaining accessibility for low-income populations.¹²

An additional strength of the Vision Centre model observed in this study was the integration of systemic disease screening into routine eye care services. A total of 2,472 patients underwent blood pressure and blood glucose screening, demonstrating the expanding role of primary eye care centers in holistic health assessment. Integration of systemic screening within ophthalmic settings has been increasingly advocated because chronic diseases such as hypertension and diabetes are closely associated with ocular morbidity, including diabetic retinopathy and hypertensive retinopathy.^{13,14} Community-based integrated screening programs may therefore facilitate early diagnosis of systemic diseases while simultaneously improving awareness regarding chronic health conditions.

The findings of the present study align with global recommendations advocating integrated, people-centered eye care systems within primary healthcare frameworks.¹⁵ The Vision Centre approach appears particularly effective in rural settings where specialist access remains limited. By combining refractive services, cataract referrals, and systemic health screening, Vision Centres contribute not only to the reduction of avoidable blindness but also to broader public health objectives.

Overall, the study demonstrates that Vision Centres serve as an effective platform for delivering accessible, affordable, and integrated eye care services in rural Karnataka. The high utilization rates, successful spectacle provision, substantial cataract surgical referrals, and incorporation of systemic disease screening collectively support the growing importance of decentralized primary eye care models in achieving universal eye health coverage.

Conclusion

Vision centres effectively bridge the gap between rural communities and tertiary eye care services.

Over a 12 months, the centres demonstrated a high surgical referral efficiency, with approximately one in five patients screened (20%) undergoing cataract surgery, highlighting the effectiveness of decentralized primary eye care.

A significant proportion of surgical interventions (64%) were provided free of cost, demonstrating the important role of subsidized eye care programs in ensuring equitable access to cataract surgeries among economically vulnerable populations.

Declarations

Ethical Approval: This study involving human participants was reviewed and approved by the Institutional Ethics Committee (IEC) of Karnataka Medical College and Research Institute (Previously KIMS Hubli) Hubballi Ethics committee (Approval No.: ECR/486/Inst/KA/2013/RR-16, 864, Date: 30/03/2023). The research was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (2013 revision) and applicable national ethical guidelines for biomedical and health research involving human participants. Written informed consent was obtained from all participants prior to enrollment. Participant confidentiality and anonymity were maintained throughout the study, and all data were de-identified before analysis.

Disclosure of competing interest

All authors have none to declare.

Acknowledgements

NIL

References

1. World Health Organization. World report on vision. Geneva: WHO (2019) Available from: <https://www.who.int/publications/i/item/9789241516570>
2. Flaxman SR, Bourne RRA, Resnikoff S et al (2017) Global causes of blindness and distance vision impairment 1990–2020. *Lancet Glob Health*. ;5(12):e1221–34. Available from: [https://doi.org/10.1016/S2214-109X\(17\)30393-5](https://doi.org/10.1016/S2214-109X(17)30393-5)
3. Murthy GVS, John N, Shamanna BR, Pant HB (2012) Elimination of avoidable blindness due to cataract: Where do we prioritize and how should we monitor this decade? *Indian J Ophthalmol*.

- ;60(5):438–45. Available from: <https://doi.org/10.4103/0301-4738.100540>
4. Ministry of Health and Family Welfare. National Programme for Control of Blindness and Visual Impairment (NPCBVI). Government of India (2020) Available from: <https://npcbvi.mohfw.gov.in>
 5. Rao GN, Khanna RC, Athota SM, Rajshekar V, Rani PK (2012) Integrated model of primary and secondary eye care for underserved rural areas. *Indian J Ophthalmol.* ;60(5):396–400. Available from: <https://doi.org/10.4103/0301-4738.100531>
 6. Kovai V, Rao GN, Holden B (2012) Key factors determining success of primary eye care centres. *Community Eye Health.* ;25(79–80):66–67. Available from: <https://www.cejjournal.org>
 7. Resnikoff S, Lansingh VC, Washburn L et al (2020) Estimated number of ophthalmologists worldwide. *Ophthalmology.* ;127(5):611–613. Available from: <https://doi.org/10.1016/j.ophtha.2019.12.026>
 8. Resnikoff S, Pascolini D, Mariotti SP, Pokharel GP (2008) Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. *Bull World Health Organ* 86(1):63–70
 9. Dandona R, Dandona L (2001) Refractive error blindness. *Bull World Health Organ* 79(3):237–243
 10. Foster A (2001) Cataract and Vision 2020—the right to sight initiative. *Br J Ophthalmol* 85(6):635–637
 11. Brilliant GE, Lepkowski JM, Zurita B, Thulasiraj RD (1991) Social determinants of cataract surgery utilization in South India. *Arch Ophthalmol* 109(4):584–589
 12. Thulasiraj RD, Diacon SR, Manen A (2017) Managing social and financial sustainability in community eye health care: The Aravind model. *Indian J Ophthalmol* 65(9):803–807
 13. Finger RP, Kupitz DG, Fenwick E et al (2012) The impact of successful cataract surgery on quality of life, household income and social status in South India. *PLoS ONE* 7(8):e44268
 14. International Diabetes Federation (2021) *IDF Diabetes Atlas, 10th edn.* International Diabetes Federation, Brussels
 15. Burton MJ, Ramke J, Marques AP et al (2021) The Lancet Global Health Commission on Global Eye Health: vision beyond 2020. *Lancet Glob Health* 9(4):e489–e551

Figures

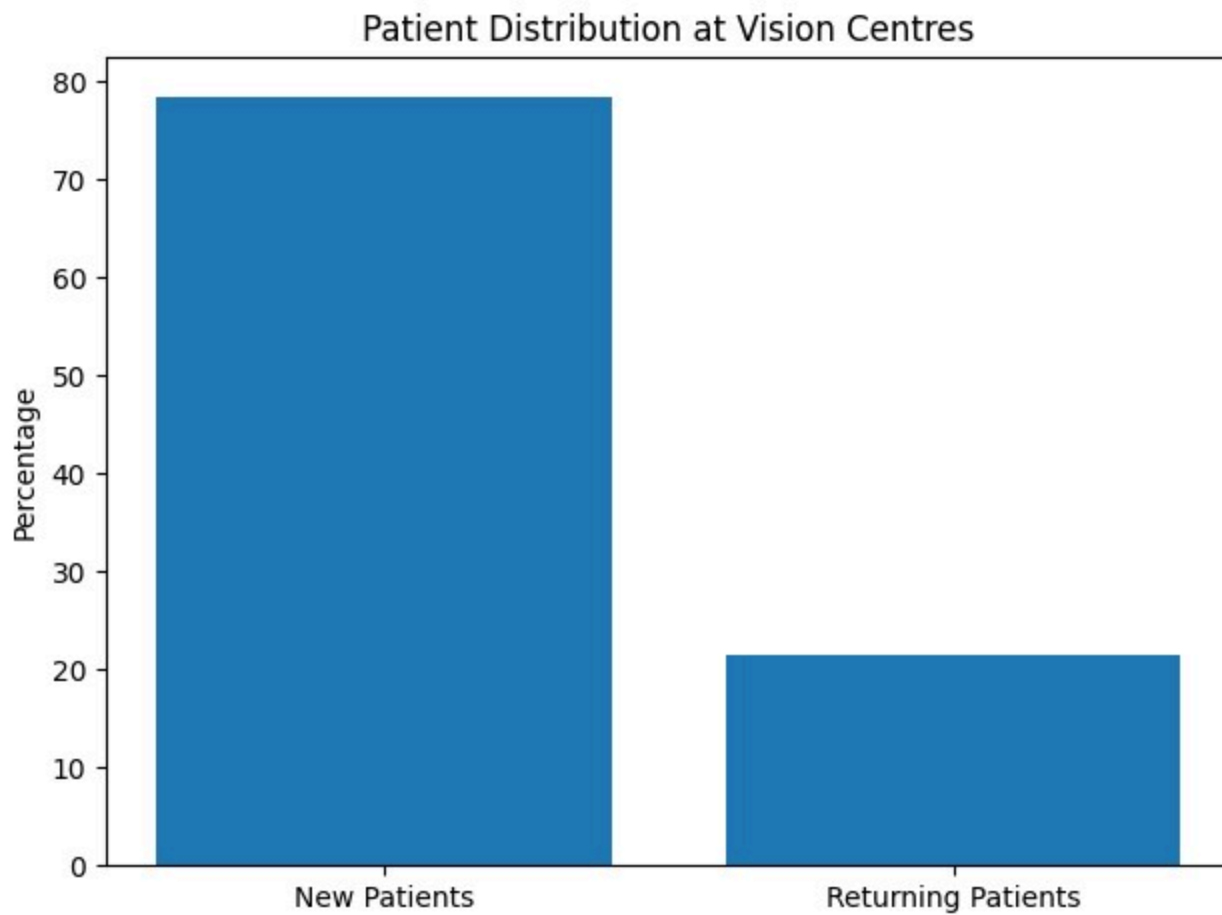


Figure 1

Patient distribution

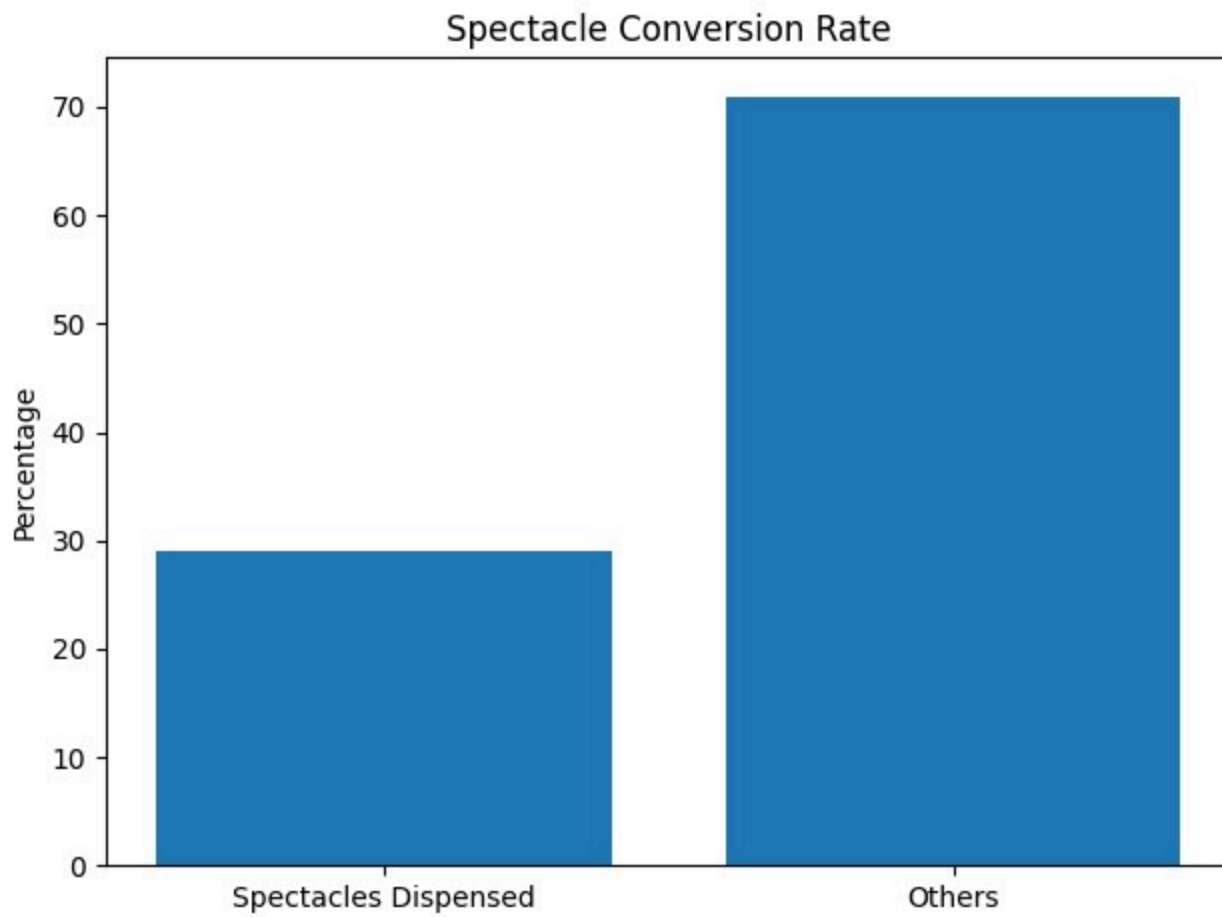


Figure 2

Spectacle conversion

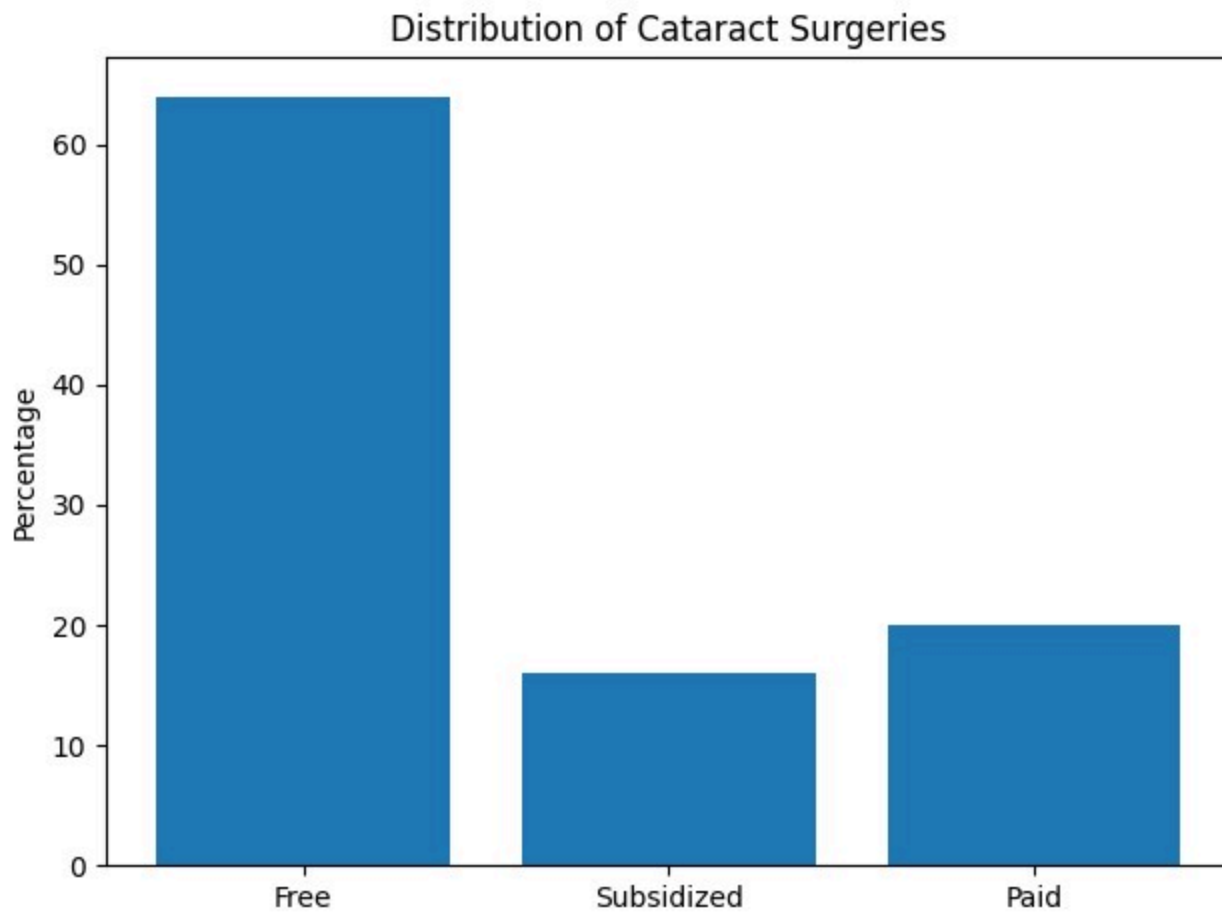


Figure 3

Surgery distribution

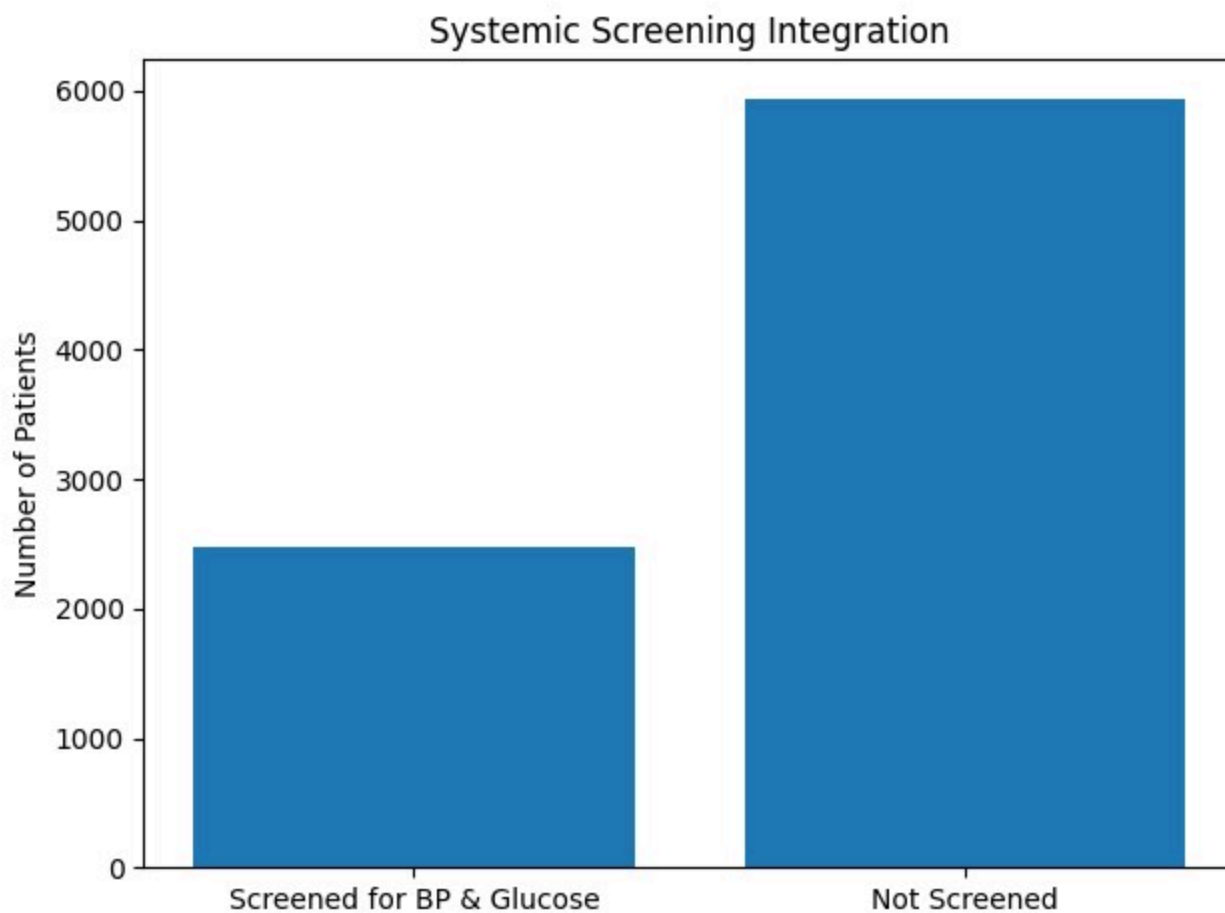


Figure 4
Integration of Systemic Health Screening