Saudi Arabian retinopathy of prematurity national telemedicine program: Achievements and challenges

Saleh A. Al Amro[1,2], Sami M. Al Ghamdi[1], Marwan A. Abouammoh[3], Fahad Al Aql[4,5], Khabir Ahmad[1], Sulaiman M. Alsulaiman[6]

Access this article online

Quick Response Code:

Website: www.saudijophthalmol.org

DOI: 10.4103/sjopt.sjopt_93_22

Abstract:

The Saudi Arabian Retinopathy of Prematurity National Telemedicine programme (SAROP) is a product of the National Committee for Retinopathy of Prematurity (ROP). The program includes ROP telescreening, diagnosis, and management of cases requiring treatment. Digital retinal images and filled ROP software requests were uploaded from 20 level-3 neonatal intensive care units (NICU) in the Kingdom of Saudi Arabia (KSA) to the King Khaled Eye Specialist Hospital server and the ROP telemedicine website. The data were accessed and reported by qualified retinal and pediatric ophthalmologists. Currently, retinal wide-angle digital cameras are available in 20 of the 31 level-3 NICUs of the Ministry of Health, Kingdom of KSA. This telemedicine approach is practical and effective in detecting and managing ROP cases. In the first 2.5 years, encouraging results were noticed with no unfavorable outcomes in the participating NICUs. Technical challenges were resolved promptly to ensure that the program ran smoothly. Therefore, this ideal state-of-the-art ROP telemedicine program could be also applied to similar and neighboring countries.

Keywords:

Retinopathy of prematurity, Saudi Arabia, telemedicine, telescreening

Introduction

Retinopathy of prematurity (ROP) is a vasoproliferative disease affecting the growing retinal vasculature of premature infants, which can lead to extraretinal fibrovascular proliferation and tractional retinal detachment (TRD), resulting in blindness. It affects 25%56% of infants with a birth weight (BW) of ≤1500 g.[1,2] The incidence increases with a decrease in BW. Most cases resolve spontaneously; however, a few, if left untreated, typically result in TRD and blindness in both eyes. ROP is the leading cause of noninherited bilateral childhood blindness.[3] Fortunately, ROP blindness can be prevented when the condition is detected and treated promptly before TRD develops. Therefore, screening at-risk infants in the neonatal intensive care unit (NICU) is crucial to achieving this goal.

Conventionally, ROP screening is performed at the bedside with dilated fundus examination using a binocular indirect ophthalmoscope (BIO). However, this can only be accomplished by an ophthalmologist trained in the retinal examination of premature infants, and qualified ophthalmologists are not readily available, particularly in peripheral hospitals.

A newer retinal imaging modality introduced more than two decades ago, which has improved over time, is the wide-field digital pediatric retinal camera. These portable handheld cameras are easy to use with premature infants in the supine position. Therefore, NICU nurses and ophthalmic photographers should be trained to capture the images of the retinal periphery of these infants using this method.

In a large country such as the Kingdom of Saudi Arabia (KSA), with an area of 2.15 million km^2 and a population of 34.8 million distributed in widely scattered cities, there is a lack of well-trained ophthalmologists for ROP screening in peripheral cities, though good information technology (IT) and internet infrastructure, as well as excellent electronic government

[1]Research Department, King Khaled Eye Specialist Hospital, [2]Retina-Vitreous Division, The Eye Consultants Specialist Center, [3]Department of Ophthalmology, College of Medicine, King Saud University, [4]Former Head, Neonatal Services Improvement Program, Ministry of Health, [5]Consultant Neonatologist, Care National Hospital, [6]Vitreoretinal Division, King Khaled Eye Specialist Hospital, Riyadh, Saudi Arabia

Address for correspondence:
Prof. Saleh A. Al Amro, King Khaled Eye Specialist Hospital, P. O. Box 7191, Riyadh 12329, Saudi Arabia.
E-mail: samro@kkesh.med.sa

Submitted: 08-Jun-2022
Revised: 30-Sep-2022
Accepted: 30-Sep-2022
Published: 14-Oct-2022

How to cite this article: Al Amro SA, Al Ghamdi SM, Abouammoh MA, Al Aql F, Ahmad K, Alsulaiman SM. Saudi Arabian retinopathy of prematurity national telemedicine program: Achievements and challenges. Saudi J Ophthalmol 2022;36:278-82.

programs, are available. It is ideal to use telemedicine for ROP screening to ensure timely examination, detection, and management of treatment-warranted cases.

Formation of the National Committee for Retinopathy of Prematurity

To control ROP blindness in the KSA, the Minister of Health agreed to the formation of "the National Committee for ROP" hosted at the King Khaled Eye Specialist Hospital (KKESH), Riyadh, KSA, on August 1, 2018. A seven-member committee was formed, comprising experienced ophthalmologists, neonatologists, NICU nurses, and an IT engineer.

Goals of the Committee

1. To study the status of ROP in the KSA, develop a national plan for the treatment of diagnosed cases in the hospitals of the Ministry of Health (MOH), and prevent blinding sequelae from the disease
2. Establish and supervise a retinal screening program for premature infants and ensure the comprehensiveness and high quality of the services provided
3. To establish a database for premature infants with ROP in MOH hospitals, ensure that the appropriate service is provided, and include all hospitals in the Kingdom at a later stage
4. To ensure proper training and qualification of doctors and nursing staff in the screening and treatment of ROP.

The committee reviewed published data on ROP in the KSA.[4-7] Considering Saudi Arabia's practical guidelines for screening and treating ROP, it was decided to adopt a telemedicine program for ROP screening, that reached and included all premature infants at risk.[8] The guidelines have been solicited and endorsed by both the Saudi Ophthalmological Society and the Saudi Neonatology Society. The program is aimed to cover all 31 level-3 NICUs in the KSA.

Therefore, the committee established the National Saudi Arabian ROP telemedicine program (SAROP) and chose to adopt the use of wide-field digital retinal cameras and a telescreening approach, as this method proved to be as good as the bedside BIO examination in detecting treatment-warranted ROP, with the added benefit of being less stressful to the neonate.[9,10] The established plan was to provide a digital camera at every level-3 NICU in the MOH. Currently, 20 of the 31 NICUs are equipped with cameras, and the rest will be provided soon. The SAROP was executed in collaboration with the Neonatal Service Improvement Program of the MOH.

The committee approved the use of laser ablative surgery and intravitreal anti-vascular endothelial growth factor (anti-VEGF) injections as modalities for managing treatment-warranted ROP. However, to prevent the delays in treatment and minimize referrals, the committee decided to administer anti-VEGF injections as the first-line treatment in these patients, as they are easy to apply and have a shallow learning curve. Nonetheless, the patients that received this treatment required longer follow-up periods to exclude the possibility of late reactivation.

Telemedicine in the KSA could ensure proper screening of all targeted premature infants and timely treatment of all indicated cases onsite, without the need to transfer these premature babies to a distant hospital.

Program Components

To execute the SAROP and ensure an optimal implementation rate and continuous enrolment of all to-be-screened infants, the following components were made available before the initiation of the program:

Program director

The program director is the main organizer of the SAROP program. In addition to participating in the establishment and launching of the program, he/she manages the daily tasks of the program, follows its performance, and submits weekly, monthly, quarterly, and annual reports to the head of the National ROP Committee.

In addition, he/she keeps track of infants who need treatment and ensures that it is delivered on time. Moreover, the program director is the link between the screening centers and the national committee, and he sets the training plans, launches the service in these centers and follows their key performance indicators (KPIs). Due to the increasing number of tasks of the program director, an assistant director will also be appointed.

Wide-angle digital pediatric fundus cameras and high-speed internet connection

These cameras are intended to screen premature infants by imaging their retinas while lying supine. A Retcam (Natus, CA, USA) with a 130° wide fundus lens and another portrait anterior segment lens was used and placed in each NICU. A high-speed Internet connection is required to upload the images to the KKESH server and telemedicine website.

Server

The digital cameras were connected remotely to a server hosted by a virtual reading center (KKESH). The three-terabyte servers receive images from the screening centers through the Retcam Review Software (RCRS).

Saudi retinopathy of prematurity software

The telemedicine website was developed by the IT team at the KKESH, with inputs from ophthalmologists and neonatologists as reporting software. This contains demographic and medical data and is filled by NICU nurses. A completed request was sent along with the retinal photographs of each patient and updated at every visit. Each screener and reader had an account on the portal.

Photography instructor

An experienced retinal photographer/angiographer certified by the Ophthalmic Photographers' Society trained the NICU nurses using digital fundus cameras for ROP screening.

Screeners

NICU nurses (optometrists in some centers) were trained using a digital fundus camera to image the infants' eyes. They can become qualified ROP photographers after completing a 2-day didactic and hands-on course on how to take state-of-the-art, high-quality retinal and anterior segment images in premature infants according to the Saudi Arabian ROP imaging protocol. They were taught how to upload the retinal images to the RCRS and server, and the completed requests of the Saudi Arabian ROP software to the KKESH telemedicine website. The training course was conducted by experienced photography instructors and retraining was performed if deemed necessary. The SAROP protocol uses six images: one for the anterior segment, one for the posterior pole centered on the optic disc, and one for each peripheral quadrant (superior, inferior, nasal, and temporal). Each NICU had a nurse coordinator who acted as a liaison with the program director.

Readers and treaters

These are consultant ophthalmologists specializing in retina or pediatric ophthalmology, whose role is to read the images sent from the screening centers to the KKESH server/RCRS and file a diagnostic report and plan of treatment on the Saudi Arabian ROP software on the KKESH telemedicine website within 48 hours, and to provide treatment when needed, such as intravitreal anti-VEGF injections or laser ablative surgery. A team, called the flying squad for the treatment of ROP (FST-ROP), was formed. The main goal of FST is to deliver prompt treatment within 72 h of diagnosing treatment-warranted ROP in areas devoid of qualified treaters. Treatment is generally performed on weekends, and airplanes are used to reach these peripheral cities.

Supplies

Requirements that are needed for performing screening or treatments:

a. Pupil dilating drops (phenylephrine 2.5% and tropicamide 1%)
b. Infant size eyelid speculum
c. Coupling lubricant gel
d. Topical anesthetic drop (tetracaine or proparacaine)
e. Pediatric scleral rotator/depressor.

Workflow

The workflow is illustrated in Figure 1.

Program Statistics

The total number of patients observed from the start of the program in April 2019 until the end of 2021 was 2188, and ROP was observed in 566 infants (26%). Table 1 shows the number of patients and the enrolment date of each hospital. Some NICUs only refer critical patients, giving a falsely high prevalence of ROP in these NICUs. The different stages of ROP for each eye are illustrated in Figure 2. Stages 1 and 2 constituted most the cases. Treatment was administered to 169 infants (29.7% of ROP patients and 7.7% of all patients). Anti-VEGF injections were administered to 144 infants and laser ablative surgery was performed in 25 infants.

Table 1: The number of patients and date of enrollment of each hospital (note that some neonatal intensive care units only refer critical patients)

Screening center (Hospital name)	All patients	ROP patients	Enrolment date
Hafer Al Batin MCH	342	92	April 2, 2019
Hail MCH	82	9	September 17, 2019
Al Madinah MCH	182	25	November 17, 2019
Makkah MCH	207	107	November 19, 2019
Abha MCH	167	49	December 19, 2019
Al Ahssa MCH	80	14	January 13, 2020
Arar MCH	97	19	February 18, 2020
King Fahad Hospital, Al Baha	41	2	February 24, 2020
KSMC, Riyadh	342	107	March 11, 2020
Hera Hospital, Makkah	124	45	March 19, 2020
King Fahad Central Hospital, Jaizan	23	5	June 17, 2020
Al Jouf MCH	116	11	June 18, 2020
King Faisal Medical Complex, Taif	11	9	October 27, 2020
Najran MCH	51	15	December 01, 2020
King Khaled Hospital, Tabuk	30	11	December 10, 2020
East Jeddah Hospital	21	4	December 29, 2020
Buraydah MCH	48	28	January 27, 2021
Al Yamamah Hospital, Riyadh	19	9	April 08, 2021
Dammam MCH	74	8	September 21, 2021
King Salman Hospital	3	0	June 29, 2021

ROP: Retinopathy of prematurity

Details of these results will be presented in a future publication, as this article describes the logistics of the program itself.

Achievements

1. Implementation of the Kingdom-wide telemedicine program for the ROP is one of the largest worldwide. This program was designed to screen, diagnose, and treat ROP. Currently, it covers 20 referral maternity and children's hospitals under the MOH (level-3 NICUs), which will gradually increase to include all level-3 NICUs in the KSA to achieve the main goal of the program eradicate ROP blindness
2. The program succeeded in proving the effectiveness of the examination using wide-angle digital retinal cameras and telemedicine technology, making it an efficient alternative to clinical bedside examinations
3. No cases of advanced ROP or blindness were observed in the participating NICUs. However, before the initiation of the SAROP program and based on previous data, 29 infants with advanced ROP were recorded in some hospitals of the MOH in Saudi Arabia between January 2012 and January 2019.[11] In another report, over a period of 1-year duration (2016), 58 patients with ROP were referred to King Abdulaziz University Hospital ER in Riyadh, which is the main hospital managing patients with ROP in the

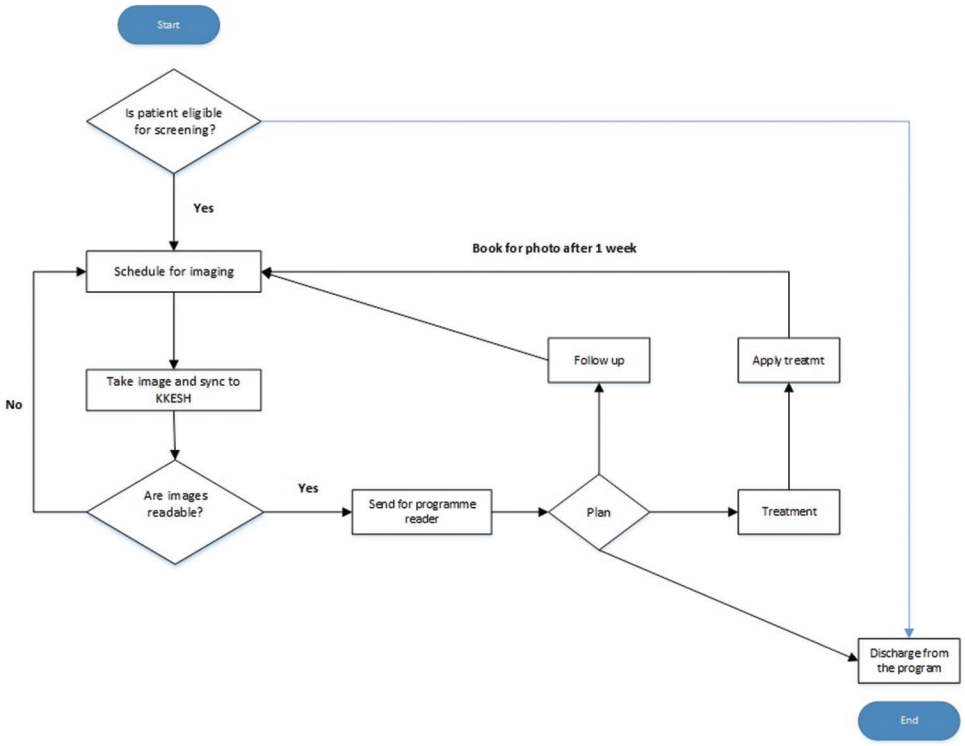

Figure 1: Work flow chart

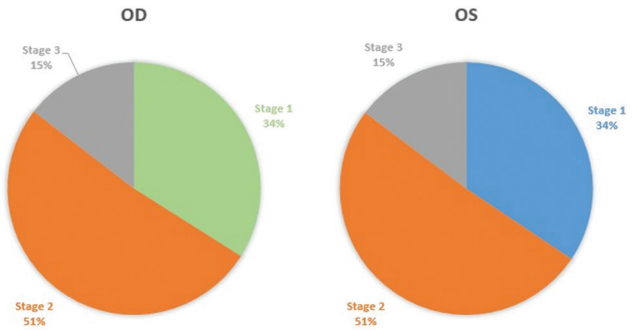

Figure 2: Retinopathy of prematurity (ROP) stage prevalence for each eye

KSA. However, of these, nine patients (15.5%) had TRD and were practically blind owing to inadequate screening and late referral (presented at the Saudi Ophthalmology Conference, 2017). In 2021, 1.5 years after the start of the SAROP program, the same hospital received 36 patients with ROP and only one patient with stage 5 ROP in both eyes, who were referred from a private hospital

4. Based on these encouraging results, we believe that the program can be expanded to include all at-risk neonates in all governmental and private sector hospitals to become a national program.

Challenges

One of the biggest challenges is ensuring that treatment is promptly provided because ROP is a time-sensitive disease. Many hospitals under this program provide treatment to patients with qualified ophthalmologists. However, in some hospitals, particularly in the periphery, the situation is more challenging owing to the lack of ophthalmologists specializing in ROP. Therefore, other treating doctors from the FST-ROP team need to travel to deliver treatment. Another option is to refer these patients to the nearest tertiary care hospital for treatment, which the program attempts to avoid.

The program was mainly based on photographing patients, which is the job of trained nurses. However, many trained nurses left the program, their jobs, or the KSA after they had mastered photographing patients. The comments were that this was cumbersome extra work, without any incentives. This aspect must be considered because of its importance in program continuity. In addition, training and retraining are required. Each NICU has two to three trained nurses to ensure good coverage in case of vacations or sickness.

As mentioned, 20 hospitals were included in the first phase of the program. However, some hospitals do not follow the SAROP meticulously. Some hospitals are also struggling to properly implement the program. To ensure the effective activation of the program, the MOH should address hospital administrations and stress the need to adhere to the program and be more committed.

The program requires the availability of consumables and tools for imaging and treatment. Most of the hospitals enrolled in the program are mainly maternity and children's hospitals, where they do not have ophthalmology departments. Providing these consumables and tools, such as dilating drops, speculums,

and treatment injections, is time-consuming and requires extraarrangements.

In addition, the program has been temporarily discontinued in some hospitals because of a broken lens caused by the mishandling of the camera handpiece. The lens is expensive and the process of purchasing a replacement lens takes a lot of time, which may extend up to several months. Backup lenses are important to ensure program continuity.

As the program is essentially a telemedicine program, there are greater technical challenges. The quality of cloud storage, data transmission, and maintenance of the telemedicine website should be considered, and any technical problems should be managed without delay to avoid interrupting the program or making it as short as possible. In addition, there should be a contingency plan to continue ROP screening by BIO bedside examinations during these off-time periods.

Program Monitoring

The program performance was monitored through KPIs on a monthly, quarterly, and annual basis. These indicators serve to monitor hospital performance in terms of commitment to timely imaging, image quality, number of turned-down images, and requests for repeat imaging. In addition, the performance of readers and their commitment to reporting the cases during a period of 48 h from the receipt of SMS and email alerts were monitored. New performance indicators are being considered and will be added soon to improve program monitoring.

Conclusion

The SAROP is an ambitious telemedicine program that covers all 31 MOH level-3 NICUs that are widely scattered in the KSA. This program proved to be practical and effective in identifying and managing all patients with ROP that required treatment. No cases of unfavorable outcomes were observed in the patients of the participating NICUs. Technical challenges were resolved promptly to ensure that the program ran smoothly. During the first 2.5 years of the program, highly encouraging results were observed. Therefore, this ideal state-of-the-art program could be also applied in similar and nearby countries.

Acknowledgment

The National Committee for ROP would like to thank Deputyship for Therapeutic Services in Saudi MOH and Dr. Abdulaziz Al-Rajhi, CEO of KKESH for their unlimited support for SAROP kingdom-wide telemedicine program.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Reisner SH, Amir J, Shohat M, Krickler R, Nissenkorn I, Ben Sira I. Retinopathy of prematurity: Incidence and treatment. Arch Dis Child 1985;60:698-701.
2. Palmer EA, Flynn JT, Hardy RJ, Phelps DL, Phillips CL, Schaffer DB, *et al*. Incidence and early course of retinopathy of prematurity. The Cryotherapy for Retinopathy of Prematurity Cooperative Group. Ophthalmology 1991;98:1628-40.
3. McNamara JA, Moreno R, Tasman WS. Retinopathy of prematurity. In: Tasman W, Jaeger EA, editors. Duane's Clinical Ophthalmology. Philadelphia (PA): Lippincott-Raven; 1996.
4. Al-Amro SA, Al-Kharfi TM, Thabit AA, Al-Mofada SM. Retinopathy of prematurity at a University Hospital in Riyadh, Saudi Arabia. Saudi Med J 2003;24:720-4.
5. Binkhathlan AA, Almahmoud LA, Saleh MJ, Srungeri S. Retinopathy of prematurity in Saudi Arabia: Incidence, risk factors, and the applicability of current screening criteria. Br J Ophthalmol 2008;92:167-9.
6. Amer M, Jafri WH, Nizami AM, Shomrani AI, Al-Dabaan AA, Rashid K. Retinopathy of prematurity: Are we missing any infant with retinopathy of prematurity? Br J Ophthalmol 2012;96:1052-5.
7. Waheeb S, Alshehri K. Incidence of retinopathy of prematurity at two tertiary centers in Jeddah, Saudi Arabia. Saudi J Ophthalmol 2016;30:109-12.
8. Al Amro SA, Al Aql F, Al Hajar S, Al Dhibi H, Al Nemri A, Mousa A, *et al*. Practical guidelines for screening and treatment of retinopathy of prematurity in Saudi Arabia. Saudi J Ophthalmol 2018;32:222-6.
9. Chiang MF, Melia M, Buffenn AN, Lambert SR, Recchia FM, Simpson JL, *et al*. Detection of clinically significant retinopathy of prematurity using wide-angle digital retinal photography: A report by the American Academy of Ophthalmology. Ophthalmology 2012;119:1272-80.
10. Dai S, Austin N, Darlow B, New Zealand Paediatric Ophthalmology Interest Group, Newborn Network, Fetus and Newborn Special Interest Group, *et al*. Retinopathy of prematurity: New Zealand recommendations for case detection and treatment. J Paediatr Child Health 2015;51:955-9.
11. AlBathi L, Abouammoh N, AlSwaina N, AlBalawi HB, Al Qahtani AA, Talea M, *et al*. Pitfalls of advanced retinopathy of prematurity presentation: A content analysis of medical records. Risk Manag Healthc Policy 2021;14:3873-82.