# Simulation as a Training Tool in Retina Training in Latin America (SIMRET Project): Survey (Report Nº 1)

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# Abstract

**Purpose:** To evaluate the situation in Latin America regarding the use of simulation as surgical training in the retina.

**Methods:** An online survey was carried out to determine the resources available in simulated retinal training in Latin America. The survey was shared via email to retina fellows and subspecialists in Latin America between November 2020 and March 2021. The relevant resources for retinal subspecialty surgical training were: biological material (pig / goat eyes); artificial eyes, and virtual reality devices. The survey was divided into five sections: (1) Identification of participants (2) Availability of resources in retinal simulation (3) Types of available resources and types of practice techniques (4) Reliability of resources according to their personal experience (5) Reasons why this type of training is implemented or not.

**Results:** 190 participants were surveyed. The overall response rate was 61.05 %. 96 (82.8%) of the 116 responding did not have access to a retinal simulation training program. Of the 20/116 that did have access (17.2%), the most frequent resource available was biological eyes 32/116 (27.6%), followed by artificial eyes 16/116 (14.0%), and virtual reality devices 15/116 (13.0%). The reasons for lack of simulation resources was

economic (77.1%), followed by the lack of a physical space (17.1 %), and interestingly some participants (5.2%) reported that it did not seem necessary to use simulation to develop new surgical skills.

**Conclusions:** Our work highlights the lack of resources for surgical training in the retina using simulation in Latin America.


# Key Messages

1.The role of surgical training in the retina using simulation is an indispensable tool for the development of new fellows.

2. Most retina specialists and fellows assert that it is very important to have a curricular retina surgical training program.

3.There is a significant lack of surgical training programs that use simulation in Latin America.

4. The main reasons for the lack of resources for surgical training using simulation are: the lack of economic resources and the lack of physical infrastructure as a lack of human resources dedicated to these areas.

**In brief:** This publication provides an overview of current situation of the use of simulation-based surgical retina training in Latin America. The main points evaluated regarding this topic were: The availability of

resources, type of resources, reliability of resources, types of training techniques and the reasons why it has not been implemented.

# Introduction

The clinical practice of ophthalmology varies greatly between different continents and differs between ophthalmic subspecialties.[1]With respect to ophthalmic education, different organizations have aimed to develop a structured and universal ophthalmic training curriculum.[2] Simulation is of vital importance in surgical training so that ophthalmologists have the clinical and surgical skills that meet the expectations of patients and decreases the rate of complications for early-career ophthalmologists while increasing positive visual outcomes. A lack of resources is one of the biggest challenges to developing simulation-based training[3] and the main barrier to improving patient outcomes through simulation-based training is cost. [4]

Most simulation-based studies have focused on cataract surgery.[5] In cataract surgery Rogers showed that structured simulation based training reduced downstream complications. [5,13] There is a significant lack of studies focusing on simulation for vitreoretinal surgery.[14]

Historically, vitreoretinal surgical training has followed an experiential model where skills are acquiring in the operating theatre. This model is frequently unstructured and lacks any outcome based systematic evaluation method. Patient safety concerns and the demand for increased efficiency, are the main factors to developing alternative methods of training.[6] Classically, biological materials (pig or goat eyes) have been used for simulated vitreoretinal surgical training. However, there are no studies to date that measure the impact of the acquisition of surgical skills in retina residents in simulation training, as well as the effects simulated virtreoretinal surgical training has on complication rates and visual/anatomical results in real patients. Similarly, different models have been created for training in vitreoretinal surgery using artificial eyes. To date there are no studies that measure impact despite its use in training centers in Latin America. The most studied simulation model has been virtual reality, the most evaluated work platform has been Eyesi.[7,8] Regarding Eyesi vitreoretinal simulator (VRmagic Holding AG, Mannheim, Germany), some of its modules have been evaluated[7], showing that it is a potential tool for training in this area.To date, in Latin America we do not have information available on simulation-based surgical retina training. That is why we wanted to carry out this study as part of a series of reports (SIMRET project) in which we will disaggregate the current situation of our continent in terms of surgical training in the retina and vitreous.

# Material And Methods

An online survey (Typeform ®, Barcelona, España) was carried out to determine the resources available in simulated retinal training in Latin America. (Figure 1) The survey was shared via email to retina fellows and subspecialists in Latin America between November 2020 and March 2021. This survey was

developed in conjunction with experts in the field of ophthalmic education (TO and JF). The resources assessed as determined to be relevant in retina surgical training were: biological material (pig / goat eyes); artificial eyes, and virtual reality. The survey was divided into five sections: (1) Identification of participants (2) Availability of resources in retinal simulation (3) Types of available resources and types of practice techniques (4) Reliability of resources according to their personal experience ( 5) Reasons why this type of training is implemented or not. Survey respondents provided their nationality, location of their training center, and education or experience level. Participants were asked if they had access to pig / goat

eyes, artificial eyes, or virtual reality simulators. If these resources were available, participants were asked to detail the techniques they practiced on each available resource. Respondents were asked to assess their perception of the reliability of each available resource by defining the resource as: not reliable, not so reliable, and reliable. Unreliable was defined as a resource which did not behave similarly to a human eye (breaks or unravels easily) and did not provide trainees with a realistic surgical experience. Not so reliable was defined as a resource which did behave similarly to a human eye, but it did not feel natural. Finally, reliable was defined as a resource that behaved similarly to a human eye and provided a realistic surgical experience. In the last section, the participants summarized the reasons why retinal simulation training was not performed was asked. It was asked to list if they corresponded to economic reasons, physical space or ignorance.

The results of the survey were analyzed separately by two researchers ( AD and NE) and were grouped in standard data ordering tables. Descriptive statistics were performed using mean and standard deviation (SD) for continuous variables, numbers (No.) and percentages (%) for categorical data, using the StataC© software version 15.1 (StataCorp. 2015, Stata Statistical Software: Release 15. College Station, Texas, US: StataCorp LP.)

## Results

# Demographics

190 participants were surveyed. The response rate was 61.05 %(116/190). 78 (67.2%) male and 38 (32.7%) female.. The average age of the participants was 36.68 (+ 7.71) years. Most of the participants were fully trained retina subspecialists 70/116 (60.34%), followed by ophthalmologists in the first 24/116 (20.68%) and second years 22/116 (18.96%) of retina fellowship training. The nationality of the participants and their place of origin included in the study were from Chile, Argentina, Peru, Venezuela, Colombia, Brazil Ecuador, Paraguay, Bolivia, Uruguay, Costa Rica, the Dominican Republic, Panama and Mexico. Among the graduated retina specialists the average age was 39.84 (+8.13) and the average years of experience was 6.88 (+ 6.91) years. The average age of ophthalmologists in training in the first year and second year was 31.32 (+ 4.21) and 32.79 (+ 2.88), respectively. (Table 1)

Table 1
Demographics

| Demographics | |
|---|---|
| **Study Population** | 116 |
| **Age, Mean (SD), y** | 36.68 (7.71) |
| **Male sex, Nº (%)** | 78 (67.2 ) |
| **Female sex, (%)** | 38 (32.7) |
| **Race/ethnicity, No. (%)** | |
| White | 6( 5.17) |
| African American | 0 |
| Hispanic or latino | 110 (94.82) |
| Asian | 0 |
| Not specified | 0 |
| **First year retina fellowship, Nº (%)** | 24(20.68) |
| Age, Mean (SD), y | 31.32 (4.21) |
| **Second year retina fellowship, Nº (%)** | 22 (18.96) |
| Age, Mean (SD), y | 32.79(2.88) |
| **Graduated retinologist, Nº (%)** | 70 (60.34) |
| Age, Mean (SD), y | 39.84(8.13) |
| Years of experience, Mean (SD),y | 6.88(6.91) |

Table 2
Availability of traning center.

| **Availability of training center** | | |
|---|---|---|
| **Question Nº** | **Yes (Nº/%)** | **No (Nº/%)** |
| 1.Is there a physical space (wetlab / drylab) in your training center for surgical training? | 48/116 (41.7%) | 67/116 (58.3%) |
| 2.Is there in your training center a physical space (wetlab / drylab) destined for surgical training on the retina? | 20/116 (17.2%) | 96/116 (82.8%) |

Availability of resources in retinal simulation and types of available resources.

96 (82.8%) of the participants answered that they did not have access to a simulation training program in their hospital or training center. Of those 20 responding that did have access (17.2%), the most frequent

resource available was biological eyes 32/116 (27.6%), followed by artificial eyes 16/116 (14.0%) and virtual reality 15/116 (13.0%). (Table 3)

Table 3
Type of available resources.

| type of available resources. | | | | |
|---|---|---|---|---|
| **Question Nº** | **Yes (Nº/%)** | **No (Nº/%)** | **Type** | **(%)** |
| 1.Does your training center use any biological material for VR surgery training? | 32/116 (27.6%) | 84/116 (72.4%) | Pig eyes | 23.3% |
| | | | Goat eyes | 0.9% |
| | | | Fruits/Vegetables | 3.4% |
| | | | No access | 72.4 % |
| 2.Does your training center use an artificial eye for VR training? | 16/116 (14.0%) | 98/116 (86.0%) | Bioniko | 11.3% |
| | | | Simuleye | 0.9% |
| | | | Phillips eye | 0.9 % |
| | | | No access | 86.9% |
| 3.Does your training center use Virtual Reality in VR surgery training? | 15/116 (13.0%) | 100/116 (87.0%) | Eyesi | 18.3% |
| | | | Other | 6.1% |
| | | | No access | 75.7% |
| 4.Does your training center use any material for laser training? | 0/116 (0%) | 116/116 (100%) | Retieyes | 0% |
| | | | Artificial retinas | 0% |
| | | | No access | 100% |

# Type of practice techniques

Surgical techniques were most commonly simulated with animal eyes (Figure 4). The steps most commonly simulated with animal eyes were: (1) Insertion of trocars (11.4%); (2) Installation of the instrument display and preparation system (11.4%); Posterior vitrectomy and endolaser (5.3%) and secondary intraocular lens implantation (7.0%). A significant percentage of participants (57.8%) stated that they had no experience using pig eyes for training in vitreoretinal surgery.

Regarding artificial eyes, 32/116 of the participants had experience using them. Of all the artificial eye models utilized, Bioniko eye was the one with the highest percentage (11.3%) Participants reported their experience with Bioniko eyes included the following surgical techniques, in order of frequency: (1) insertion of trocars (12.0%); (2) Installation of the instrument display and preparation system (12.0%), (3) Posterior vitrectomy and endolaser (8.6%); (4) Internal limiting membrane peeling (7.0%) and (5)

secondary implantation of IOL (2.6%). 75.7 % of the participants stated that they had no experience using artificial eyes for training in vitreoretinal surgery.

Experience using virtual reality simulation was reported by only 23.9% of participants, and the techniques practiced using virtual simulation were: (1) Posterior Vitrectomy (19.8%) and ILM peeling (14.7). 76.1 % of the participants had no experience using virtual reality simulators. (Table 4)

Table 4
Surgical Skills

| Sugical Skills | | |
|---|---|---|
| **Question Nº** | **Techniques** | **(Nº/%)** |
| 1.Biological resources | a) Insertion of trocars | 13/116 (11.4%) |
| | b) Installation of the instrument display and preparation system | 13/116 (11.4%) |
| | c) Vitrectomy ( central, peripheral, posterior) | 6/116 (5.3%) |
| | d) Endolaser | 6/116 (5.3%) |
| | e) ILM peeling | 2/116 (1.8%) |
| | f) Secondary intraocular lens implantation | 8/116 (7.0%) |
| | g) No experience | 68/116 (57.8%) |
| 2.Artificial eyes | a) Insertion of trocars | 14/116 (12.0%) |
| | b) Installation of the instrument display and preparation system | 14/116 (12.0%) |
| | c) Vitrectomy ( central, peripheral, posterior) | 10/116 (8.6%) |
| | d) Endolaser | 8/116 (7.0%) |
| | e) ILM peeling | 6/116 (7.0%) |
| | f) Secondary intraocular lens implantation | 3/116 (2.6%) |
| | g) No experience | 87/116 (75.7%) |
| 3.Virtual Reality | a) Insertion of trocars | NA |
| | b) Installation of the instrument display and preparation system | NA |
| | c) Vitrectomy ( central, peripheral, posterior) | 23/116 (19.8%) |
| | d) Endolaser | 13/116 (8.8%) |
| | e) ILM peeling | 17/116 (14.7%) |
| | f) Secondary intraocular lens implantation | NA |
| | g) No experience | 86/116 (76.1%) |

# Reliability of resources according to their personal experience

Participants described pig eye reliability (operational definitions described in methods) as not so reliable 56.2% percent, followed by reliable 35.4% and unreliable 8.4%. On the other hand, regarding artificial eyes, participants described them as as not so reliable 48.4%, reliable 32.2% and unreliable 19.4% respectively. Finally ,the use of virtual

reality was rated as reliable 53.3%, not so reliable 33.3%, and unreliable 13.4%. (Table 5)

Table 5
Reliability of the resources

| **Reliability of the resources** | | |
|---|---|---|
| **Question Nº** | | **(Nº/%)** |
| 1.Biological resources | a) Reliable | 17/48 (35.4%) |
| | b) Not so reliable | 27/48 (56.2 %) |
| | c) Unrealiable | 4/48 ( 8.4%) |
| 2.Artificial eyes | a) Reliable | 10/31 (32.2%) |
| | b) Not so reliable | 15/31 (48.4%) |
| | c) Unrealiable | 6/31 (19.4%) |
| 3.Virtual Reality | a) Reliable | 16/30 (53.3%) |
| | b) Not so reliable | 10/30 ( 33.3%) |
| | c) Unrealiable | 4/30 (13.4%) |

# Reasons why this type of training is implemented or not

The main reason why simulation training had not been implemented in vitreoretinal surgery was economic reasons 77.1%, followed by the lack of a physical space 17.1 %, and finally the minority of the participants (5.2%) reported that it did not seem necessary to use simulation to develop new surgical skills. (Table 6)

Table 6
Reasons why this type of training is implemented or not

| Reasons why this type of training is implemented or not | | |
|---|---|---|
| **Question Nº** | | **(Nº/%)** |
| Reason why, in its training center, there is no retinal simulation training | a) Economic reasons | 74/96 (77.1%) |
| | b) Lack of infrastructure | 17/96 (17.7%) |
| | c) Does not seem important | 5/96 ( 5.2%) |

# Discussion

Our work highlights the absence of simulated retinal training in Latin America. In training centers where simulation resources are available, there are no systematic training models or consistency in resources being utilized.

The use of simulated training materials on the retina has already been evaluated with good results among ophthalmologists in traininig.[7–9] Although most studies focus on cataract surgery training, there is a lack of research with respect to retinal training. Specifically, in Latin America, there are no studies that evaluate the effect of systematic training in ophthalmologists in retinal surgery.

It is important to take into consideration the expectations of the retina training fellows. There are no studies that evaluate the expectations of retina fellows regarding the number and type of surgeries to be performed. Scott et al, in a survey conducted in the USA, found that residents are expected to be able to perform retinal lasers and retinal injections, but not surgical procedures.[10] The use of simulation also opens up a new opportunity to expose not only fellows but also residents in training to performing vitreoretinal procedures.

The most widely used material in Latin America to simulate vitreoretinal surgery is the pig's eye, due to its cost and accessibility.

When evaluating the reliability of the resources available in retinal simulation. It is important to emphasize that to date there is no universal method capable of classifying how reliable or not these resources are. It was not the objective of this work to compare the reliability of the different resources. However, it is important to emphasize that some resources allow you to better reproduce certain steps of the surgery. For example, the use of virtual reality does not allow practicing the insertion of trocars, but it does allow critical steps such as posterior vitrectomy and ILM peeling.[12] The use of artificial eyes has been gaining popularity over time and likewise they have been perfected to give greater realism and versatility to practice not only the classic scenarios of retinal surgery but also complex scenarios such as

intraocular foreign body removal. Studies are required to perform a comparative analysis between the different models available to date.

Evaluating the reasons why a retina surgical training center had or had not been implemented, we found that the main reason was economic. This correlates with what was found by la Cour et al, that the great barrier to performing a simulated retina training is the high costs associated with its implementation and maintenance.[4]

On one hand, the absence of evaluation methods does not allow for quantifying the surgical improvement of ophthalmologists-in-training. Additionally, the absence of evaluation methods does not allow us to provide tools to justify the implementation of new training models. This study highlights the main reasons for the lack of implementation of of retina training in Latin America: the lack of resources allocated for retinal surgical training is an important trend and the main reason for the absence of these resources, such as the absence of trained ophthalmologists to carry out such training following a systematic and standardized training methodology.

The main purpose of this study was to demonstrate in a quantitative way that we must take measures to improve the surgical training of our ophthalmologists in a safe environment before facing a real patient. Through this situational diagnosis of the availability and use of retinal simulation resources in Latin America we will be able to take measures to provide tools in the training of the next generation of retina surgeons. It is extremely important to collect more information on the real effect of a training with this type of resources to evaluate the real impact and its cost benefit. Which we will seek to evaluate in report No. 2 of the SIMRET project.

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