

OSN THE YOUNG OPHTHALMOLOGIST

Remote-controlled slit lamp could provide direct eye care services to patients in rural areas, islands

The device was self-financed by a young ophthalmologist who believes that it could be useful wherever specialized ophthalmological services are needed and commuting is difficult.

Access to quality ophthalmic health care is limited in many regions of the world, even within developed Europe. With rapid advances in technology, geographical distance should no longer be a barrier to delivering necessary services. Who better than young ophthalmologists with technical insight and entrepreneurial flair to meet this challenge? **Iordanis Chatziangelidis, MD**, tells us about his self-funded development of a remote-controlled slit lamp, motivated by the lack of eye care delivered to remote parts of Greece.



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by **Iordanis Chatziangelidis, MD**



The financial crisis has had a huge impact on European health care systems and the quality and cost of life in general. This is especially true for Greece, a country with 227 inhabited islands, some with just 100 or 200 people, where primary health care centers do not provide ophthalmological services.

For patients, commuting to specialized eye care centers or hospitals is expensive, time consuming and not possible every day of the week. Boat connections with the mainland are scarce, once every other day in some places, and cancelled in the case of rough sea. Since the beginning of the crisis, the cost of fuel and taxation has been passed to the community, and for people living on a pension of €300, traveling is difficult, particularly if they have chronic health problems.

In response to these needs, I constructed a remote-controlled slit lamp, which allows tele-examination of patients located in remote islands. I did it entirely at my own expense and with my own resources, with the aim of making it available within the National Health System.

Building the device

First of all, I purchased on eBay a secondhand Zeiss slit lamp model 30M and from Advanced Microsystems the motors and controllers for back-forth and left-right movements of the slit lamp and rotation of the lighting column for slit angulation. In the initial phase of construction, only these three axes were motorized, in order to get preliminary data to support further investment. For capturing and streaming of videos, we used two different models of the Apple iPhone, the 4S and 5S, with an advanced adapter with optics.

Two different protocols, Apple FaceTime and Skype HD, were used for streaming. Both of them allow encrypted video streaming of the images from the slit lamp, but also direct communication between doctor and patient during the examination. On the patient end, the iPhone and the motor controllers connect with the Internet through a 3G/4G mobile connection, so no infrastructure is necessary. On the other end, the examining doctor uses a computer to video call the iPhone and a joystick to control the motors.



Iordanis
Chatziangelidis

On video call, the doctor can do the preliminary stages of the visit, interviewing the patient on family, medical and ophthalmological history and present complaints. With the use of the Eye Handbook, a free app for the iPhone, it is possible to examine the patient for near and color vision and to perform Amsler grid testing. At this point, the iPhone is docked to the slit lamp adapter, and slit lamp tele-examination can begin. The presence of a nurse or a general doctor is required at the remote health care center to sit the patient at the slit lamp and for the installation of mydriatics or fluorescein.

Testing the slit lamp

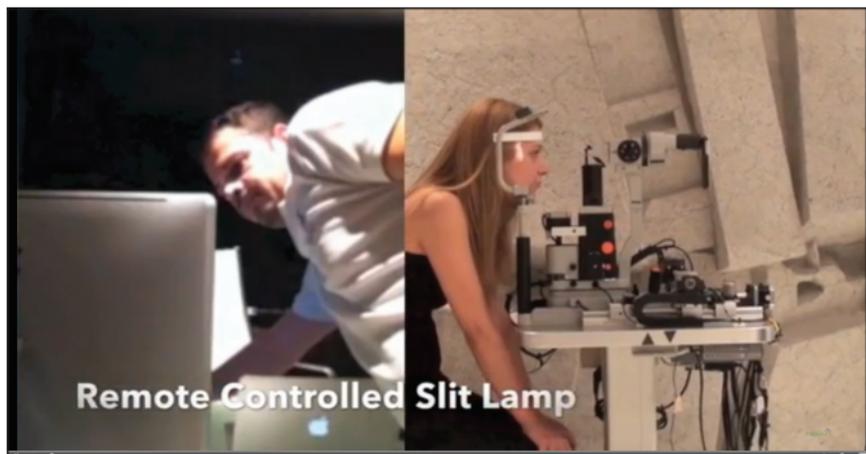
To test the remote-controlled slit lamp, I gathered volunteer patients from the emergency department of our hospital after they had received eye examinations by the physician in service. The findings of the remote-controlled slit lamp were then compared with those of the colleague in the emergency department.

Preliminary data are encouraging. Hyphema, hypopyon, band keratopathy, corneal edema, corneal erosions (with use of fluorescein), corneal filaments, corneal opacification or infiltrations, ectasia and Tyndall effect greater than 2+, as well as disorders of the eyelids, blepharitis and cataract (after mydriasis), can be detected. Fundus examination is possible with the use of the attached Volk Steady Mount and a 75 D lens, but it is time consuming because continuous adjustments of the slit lamp position are needed.

There are still problems to be solved. For example, 4G connections are faster than 3G, but they do not cover the entire territory of Greece. With both streaming protocols, signal stability and strength, and therefore video and audio quality, depend on the bandwidth. Both protocols downgrade video quality automatically when the bandwidth is low, and the user has no option for bandwidth use (for example, to prioritize video quality over frames per second or audio quality).

In the next stage of construction, I am planning to motorize the mag-

 Click on image to view video



In this video, Iordanis Chatziangelidis, MD, shows how his remote-controlled slit lamp works.

nification dial, slit width, height and illumination intensity, giving the ophthalmologist full control over the slit lamp.

I believe that a remote-controlled slit lamp is feasible and an effective solution to provide specialized health care services in remote primary health centers, decreasing the commuting burden for islanders, providing services for tourists and generally improving the quality of life of people living in or visiting our small, beautiful islands. Widening the picture, the service could be used in remote areas around Europe or other parts of the world, in offshore oil drilling platforms, in commercial long-range cruising ships, as an adjunct to the European Space Agency's Concordia base in Antarctica or even at the International Space Station — eventually, anywhere specialized ophthalmological services are needed, and commuting is difficult or impossible.



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