

# Eye Banking: Corneal Surgeons' Present and Future Needs

Joel Sugar MD

## Abstract

**Purpose:** To determine unmet present and future corneal surgeons' needs from their eye banks.

**Methods:** On-line six question survey.

**Results:** 61 corneal surgeons responded, 45 from the United States. The most frequent unmet present needs included pre-cut and pre-stripped DSAEK and DMEK tissue, pre-loaded tissue, serum tears, and antifungals in storage media. Lower tissue processing costs and more educational services were also noted. Future anticipated needs included greater demand for processed tissues and new emphasis on eye bank involvement in cellular processing of donor as well as recipient tissues.

**Conclusions:** There are both present and future anticipated needs that eye banks will need to meet as eye banking continues to evolve.

**Key words:** Cornea, endothelium, eye banking, tissue banking

In our field of corneal transplantation the eye bank plays a major role in our ability to provide appropriate care to our patients. While tissue demand worldwide far exceeds supply, in many developed countries eye banks are called upon, in addition to procuring tissue, to provide processing, storage and distribution. In addition newer technologies have added greater expectations as well as greater demands for future developments for eye banks. This study attempts to acquire information on satisfaction with present services, present unmet needs, and future anticipated needs from eye banks.

## MATERIALS AND METHODS

A brief six question survey was sent by electronic mail in January and February, 2017 to the participants in the Kera-Net on-line corneal discussion group (Kera-net@UCDavis.edu). Members of the group were asked to respond directly to the author. Free text responses were collated and summarized.

## RESULTS

61 corneal surgeons responded to the survey out of slightly over 1000 Kera-Net members, not all of whom are active. Of the respondents 45 were from the United States and the remainder were from 11 different countries (*Question 6–In what country do you practice?*).

Regarding satisfaction (*Question 1–How satisfied are you with your present eye bank's ability to meet your needs? Completely, somewhat, not at all?*), 47 respondents (77%) were completely satisfied, 12 (19.7%) were somewhat satisfied, and only 2 (3.3%) were not at all satisfied.

Specifying unmet needs (*Question 2–Are there unmet present needs? If so, what are they?*), 26 (42.6%) had no unmet needs. The most frequent need (16 surgeons, 26%) was for eye bank prepared tissue for DSAEK and DMEK (pre-stripped). Many of these also would prefer that the tissue be pre-loaded by the eye bank in an insertion device. Numerous other needs were expressed by smaller numbers of participants including: processing of serum tears (4, 6.6%), antifungals in storage media (2, 3.3%), didactic courses and community education (3, 4.9%), and lower tissue processing and media costs (2, 3.3%). Single surgeons noted need from their eye banks of amniotic membrane, cell counts, XY matching, compounded medications, back-up tissue, better communication from exporting eye banks, and more financial support for their eye bank. A United States surgeon also complained about ambulatory surgical center reimbursement for tissue for Medicaid patients.

Regarding future needs (*Question 3–What are your future anticipated eye bank needs?*), 31 surgeons (50.8%) expected greater demand for processed DMEK tissue, including pre-loaded tissue (8, 13.1%). They also expected increased demand for serum tears and cultured limbal stem cells as well as endothelial cells (6, 9.8%). Additional needs included more tissue availability (6, 9.8%), with greater need for processing of anterior lamellar donor tissue; antifungals in storage media; and curbing and lowering of eye bank

**Author Affiliations:** University of Illinois at Chicago Eye and Ear Infirmary

fees (3, 4.9%) as well as greater eye bank promotion and education at local, regional, and global levels (3, 4.9%).

Expectations for needs further into the future (*Question 4- What services do you anticipate needing from your eye bank 5 to 10 years from now?*) included all those in the shorter term needs (questions 2 and 3) but with a greater emphasis on eye bank involvement in cellular processing of donor and recipient tissues. These included endothelial cell storage and ex-vivo expansion of autologous endothelial cells and limbal stem cells (5, 8.2%). Rho kinase inhibitors and other cell proliferation enhancers were suggested (2, 3.3%) as well as other bioengineered tissues and genetic engineering of donor cells (3, 4.9%). Single surgeons anticipated need for serum tears, amniotic membrane, pre-cut limbal tissue, and tissue matching. Again assistance by the eye bank in education for incorporation of new technologies into the practice of surgeons and emphasis on the importance of eye banks in continuing innovation was expressed.

The vast majority of respondents (*Question 5- What percentage of your present tissue use is with imported tissue?*) did not import tissue (36, 59%) while the remainder imported tissue from less than 2% up to 100% of the time.

## DISCUSSION

This is a very limited study in that only a small number of corneal surgeons responded to the survey. Also only members of Kera-Net, a computer based list-serv of corneal surgeons, were solicited to participate. Nonetheless the responses appear to likely provide a reasonable representation of the present and future needs of corneal surgeons. This study, by its nature, does not deal with worldwide basic tissue needs, especially in under-developed areas where eye banks are lacking or inadequate to meet needs. That issue has been addressed recently by Gain, et al<sup>1</sup> who demonstrated the wide disparities in corneal tissue and eye bank availability throughout the world.

Concerning eye bank satisfaction, at the present time the surgeons surveyed appear to be reasonably satisfied. Their needs are mostly being met but pre-stripped and loaded tissue, as has been demonstrated for DSAEK by Pallioura and Colby<sup>2</sup> and for DMEK by Tran, et al<sup>3</sup> appears to be greatly desired. Another present need, serum tears, which has been partially met through other sources, is now beginning to be met by eye banks. Going forward near and more distant future needs are in part related to increasing demand for processed tissues with the expectation that many present surgical techniques will continue to be used.

The hope for decreased costs will require processes that will reverse the present trend of increasing costs. Anti-fungals in cold storage media, as are already in use with organ cultured tissue,<sup>4</sup> is being studied but has not yet been clinically instituted.<sup>5</sup>

More distant future needs appear to be predicated on the eye bank becoming a more sophisticated bio-engineering facility. In addition to the need for greater tissue supply, surgeons anticipate eye banks actively participating in culture of recipient as well as donor cells and the use of cell growth enhancers,<sup>6</sup> preparation of biological artificial corneas,<sup>7,8</sup> and genetic engineering of corneal cells.<sup>9</sup> As can be seen from the references all of these are being actively investigated at the present time.

## CONCLUSION

In conclusion, this limited study highlights present and future eye banking concerns of corneal surgeons. While certainly not scientific or encyclopedic, this study should serve the eye banking community by helping us to understand our unmet needs presently and our anticipated future needs.

## REFERENCES

1. Gain P, Julienne R, He Z, et al. Global survey of corneal transplantation and eye banking. *JAMA Ophthalmol* 2016;134:167-173.
2. Palioura S, Colby K. Outcomes of Descemet stripping endothelial keratoplasty using eye bank-prepared preloaded grafts. *Cornea* 2017;36:21-25.
3. Tran KD, Odell K, Galloway J, et al. Evaluation and quality assessment of prestripped, preloaded Descemet membrane endothelial keratoplasty grafts. *Cornea* 2017 doi:10.1097/ICO.0000000000001150 Epub ahead of print.
4. Seiler TG, Tschopp M, Zimmerli S, et al. Time course of antibiotic and anti-fungal concentrations in corneal organ culture. *Cornea* 2016;35:127-131.
5. Layer N, Cevallos V, Maxwell AJ, et al. Efficacy and safety of antifungal additives in Optisol-GS corneal storage medium. *JAMA Ophthalmol* 2014;132:832-837.
6. Okumura N, Sakamoto Y, Fugii K, et al. Rho kinase inhibitor enables cell-based therapy for corneal endothelial dysfunction. *Sci Rep* 2016;6:26113.
7. Lagali N, Fagerholm P, Griffith M. Biosynthetic corneas: prospects for supplementing the human donor cornea supply. *Expert Rev Med Devices* 2011;8:127-130.
8. Zhang C, Du L, Sun P, et al. Construction of tissue-engineered full-thickness cornea substitute using limbal epithelial cell-like and corneal endothelial cell-like cells derived from human embryonic stem cells. *Biomaterials* 2017;124:180-194.
9. Qazi Y, Hamrah P. Gene therapy in corneal transplantation. *Semin Ophthalmol* 2013;28:287-300.