The New Zealand National Eye Bank Study 1991–2003

A Review of the Source and Management of Corneal Tissue

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Purpose: To evaluate donor demographics and source, donor tissue processing and storage, biologic contamination, and the utilization and distribution of corneal tissue procured by the New Zealand National Eye Bank.

Methods: As part of a prospective longitudinal study, the electronic records of the NZNEB for the 13-year period 1991–2003 were analyzed for each year with respect to donor demographics, donor source and cause of death, death-to-preservation interval, storage methods, endothelial assessment, biologic contamination, corneal tissue utilization, and distribution.

Results: During the study period, 3221 corneas were retrieved from 1628 donors (69.8% male, 30.2% female), with the mean age of donors 59.4 years (SD 18.3 years) and range 4 to 95 years. No significant correlation was identified between donor age group (using 10-year intervals) and the proportion of corneas suitable for transplantation. Donors were procured from the Coroner's service (67.6%), public hospitals, (23.5%) and multiorgan donors (7.1%). The most common causes of donor death were cardiovascular disease, trauma, and cerebrovascular disease. Average storage duration increased from 3.5 to 11.8 days when organ culture replaced hypothermic storage in 1992. Biologic contamination occurred in 5% of all donor corneas. The most common bacterial and fungal isolates were coagulase-negative staphylococci and *Candida* spp, respectively. A significant decrease in contamination rate over the years of the study was identified. Overall, 79.4% of corneal tissue procured was used for corneal transplantation (75.8% for penetrating keratoplasty, 2.1% for lamellar keratoplasty, and 1.5% for unspecified transplants), and 21.6% was discarded. Most common reasons for discarding tissue were biologic contamination, abnormal serology, and failed endothelial assessment.

Conclusion: Analysis of the NZNEB database provides valuable information in relation to eye banking and corneal transplantation in New Zealand. Significant trends were identified in donor demographics, donor procurement source, improved donor tissue processing and storage, decreased biologic contamination, and increased utilization of corneal tissue.

Key Words: corneal transplantation, eye banking, donor demographics, donor tissue, corneal storage, biological contamination

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The New Zealand National Eye Bank (NZNEB), founded in 1991, is the major supplier of donated ocular tissue for transplantation in New Zealand. Serving a population of 4 million, the NZNEB provides over 200 corneas per year for transplantation. The highest international standards (based on standards of both the Eye Bank Association of America and the European Eye Bank Association) are observed in all areas of NZNEB operation including donor selection and screening, tissue retrieval and storage, testing and evaluation, and transport to transplant centers.

A standard protocol of the NZNEB since 1991 is the maintenance of a comprehensive database, supported by New Zealand ophthalmic surgeons, in which prospective data are collected on all aspects of corneal donation and transplantation. The authors have previously published data in respect to the indications for corneal transplantation in New Zealand,[1] and in this study we have analyzed this database to evaluate the source and management of donor corneal tissue in New Zealand.

METHODS

As part of a longitudinal, prospective study, the electronic records of the NZNEB for the 13-year period 1991–2003 were analyzed for each year with respect to donor demographics (gender, age, and ethnicity), donor procurement source, donor cause of death, death-to-preservation interval, storage methods, endothelial assessment, biologic contamination, corneal tissue utilization, and distribution. Statistical analysis of data was performed in consultation with a medical statistician from the Epidemiology Department of the University of Auckland. Statistical methods used were linear regression analysis to evaluate trends, χ^2 testing to compare proportions, and the Student t test to compare means between groups.

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RESULTS

Donor Demographics

There were 1628 donors during the 13-year study period with the average number per year 125 (SD = 21.7). Donor numbers per year remained constant from 1992 onward with no significant trends being identified (β-coefficient = 0.12, se = 0.45, $P = 0.79$). The gender distribution demonstrated a male preponderance in every year of the study, and overall 69.8% (n = 1137) of donors were male and 30.2% (n = 491) female. Donor numbers and gender distribution for each year of the study are shown in Figure 1.

The age distribution of donors during the study period is illustrated in Figure 2. The largest proportion of donors was found within the 71- to 80-year age group (29.4%, n = 479), followed by the 61- to 70-year age group (24.0%, n = 391). The mean age of donors was 59.4 years (SD = 18.3), the median age was 65.0 years, and the age range was 4 to 95 years. An increase in mean age of donors over the years of the study was identified (β = 0.62, se = 0.23, $P = 0.02$) (Fig. 3). The proportion of donor corneas that were suitable for transplantation was analyzed for different donor age groups (using 10-year intervals). The results ranged from 73.2% for the 31- to 40-year age group to 84.0% in the 51- to 60-year age group. In the oldest age group (81–85 years), 79.5% of donor corneas were suitable for transplantation. Overall, no correlation was identified between donor age group and the proportion of corneas suitable for transplantation (β = 0.57, se = 0.49, $P = 0.29$). Donors aged less than 10 years or greater than 85 years were generally not accepted because of the age criteria set by the NZNEB. The difference in the mean age of donor corneas used for transplantation (59.5 years) versus those that were not used (58.6 years) was not significant ($P = 0.14$).

Ethnicity data have been entered into the NZNEB database since 1993. The majority of donors were European white (89.0%, n = 1283), followed by Maori (1.6%, n = 23), Polynesian (1.1%, n = 16), Indian (0.8%, n = 12), Asian (0.4%, n = 6), with 6.6% (n = 94) either not recorded or unspecified.

Donor Source and Donor Cause of Death

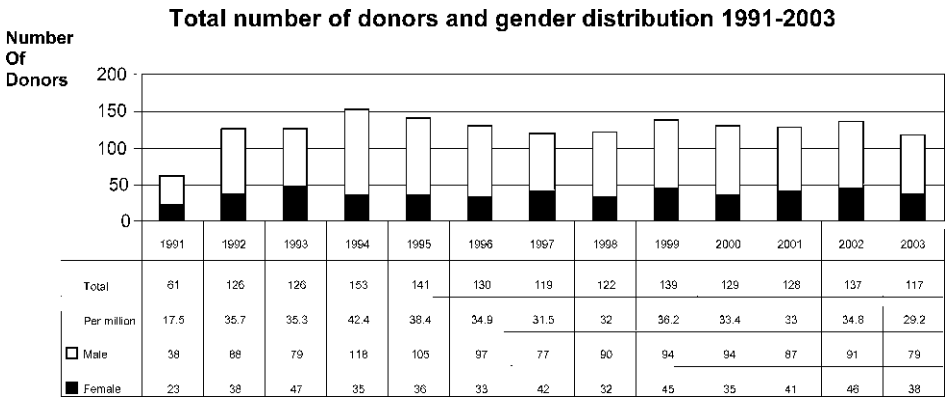
The NZNEB procured corneal donors from the following sources: Auckland Coroner's service (67.6%, n = 1100), public hospitals (23.5%, n = 383), multiorgan donors (7.1%, n = 116), and private hospitals/rest homes (1.8%, n = 24). As illustrated in Figure 4, there has been a trend of fewer donors procured from the Coroner's service since 1994, but a corresponding increase in donors from public hospitals and, to a lesser extent, multiorgan donors.

The most common cause of death of donors was cardiovascular disease (50.5%, n = 820), followed by trauma (12.5%, n = 203), cerebrovascular disease (11.1%, n = 180), respiratory disease (7%, n = 115), and cancer (6.1%, n = 100). Table 1 presents the age, gender, and percentage of corneas transplanted for each cause of death. Of note, there was a higher proportion of corneal tissue transplanted from donors who died of either cardiovascular disease or cerebrovascular disease compared with that from donors who died of other causes ($P < 0.05$).

Donor demographics also varied with donor source. Donors from the Coroner's service had a mean age of 58 years, with 80% male, and the most common cause of death was cardiovascular disease followed by trauma. Public hospital donors had a mean age of 68 years, 72% male, and the most common cause of death was cardiovascular disease followed by cerebrovascular disease. Multiorgan donors had a mean age of 41 years, 55% male, and the most common cause of death was cerebrovascular disease followed by trauma. No significant difference was found in the proportion of corneal tissue suitable for transplantation between the different donor sources.

Death-to-Preservation Interval

The death-to-preservation interval (DPI) is the time from donor death to preservation of donor corneal tissue. The NZNEB generally do not procure tissue if the DPI is greater than 24 hours, except in emergency circumstances or for use in tectonic procedures. The overall mean DPI during the study period was 15.2 hours (SD = 6.2) with the median 15.6 hours. Figure 5 illustrates the trend in DPI from 1991 to 2003. There was a rapid increase in mean DPI from 1991 (6.6 hours, SD = 3.0) to 1994 (14.5 hours, SD = 5.1), associated with the change in criteria from hypothermic to organ culture storage. From 1995 onward the mean DPI remained relatively constant with a range of 14.8 to 17.7 hours. No difference was found in mean DPI between donor corneas that were suitable for transplantation (15.3 hours) and those that were not (15.4 hours, $P = 0.46$). The DPI in relation to donor source was assessed,



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	61	126	126	153	141	130	119	122	139	129	128	137	117
Per million	17.5	35.7	35.3	42.4	38.4	34.9	31.5	32	36.2	33.4	33	34.8	29.2
Male	38	88	79	118	105	97	77	90	94	94	87	91	79
Female	23	38	47	35	36	33	42	32	45	35	41	46	38

FIGURE 1. Bar graph showing total number of donors, donors per million population, and gender distribution, 1991–2003.

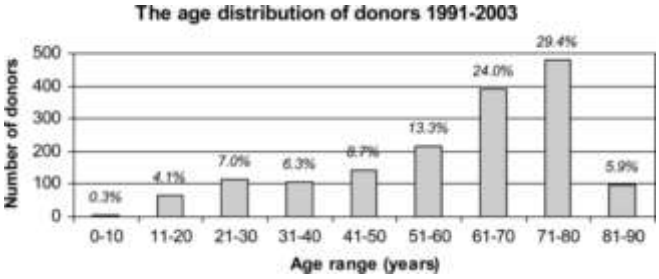


FIGURE 2. Bar graph showing age distribution of donors with corresponding percentage of total, 1991–2003.

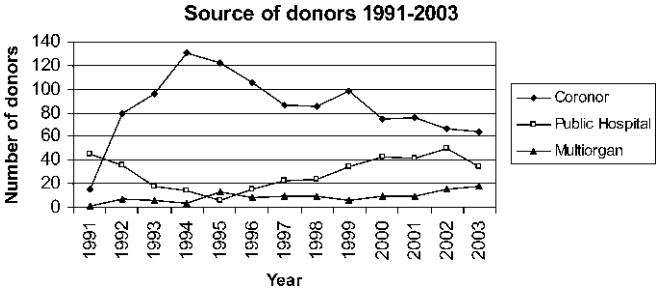


FIGURE 4. Line graph showing trends in donor procurement source, 1991–2003.

highlighting that the mean DPI for donor tissue from the Coroner's service (16.6 hours) was significantly greater than that for public hospitals (12.1 hours) and multiorgan donors (12.7) ($P < 0.001$).

Corneal Storage Methods

The NZNEB protocol for corneal storage changed from the use of Optisol (4°C) (Bausch and Lomb, Rochester, New York) to organ culture storage (34°C) during 1992. In 1991 all donor corneas were stored in Optisol. In 1992 30% were stored in Optisol and 70% stored in organ culture. From 1993 onwards all donor corneas were stored using organ culture. The mean storage duration with Optisol was 3.5 days (SD = 2.0), compared with 11.6 days (SD = 4.3) for organ culture. The corneal utilization rate was significantly higher with organ culture storage (79%) compared with Optisol storage (65%, $P < 0.01$). The mean DPI for corneas stored in Optisol was significantly less than that for corneas stored with organ culture (7.1 versus 15.0 hours, $P < 0.001$).

Endothelial Cell Count of Donor Tissue

The NZNEB uses light microscopy accompanied by intravital staining with trypan blue to assess the endothelial layer. An endothelial cell density greater than or equal to 2500 cells/mm^2 is the threshold required for a cornea to be accepted for transplantation. Of all the donor corneas between 1993 and 2003, 2.6% (n = 84) had an endothelial cell density of less than 2500 cells/mm^2 and therefore were not transplanted. Based on donor age, only 0.8% of donors less than 50 years of age failed endothelial assessment, compared with 2.5% for the 51- to 60-year age group, 3.5% for the 61- to 70-year age group, 3.0% for the 71- to 80-year age group, and 3.6% for the 81- to 85-year age group. A significant correlation was identified between increasing donor age (analyzed using 10-year stratified intervals over the age range 10–85 years) and the rate of failed endothelial assessment ($\beta = 0.55$, se = 0.12, $P < 0.05$). The mean age of donors whose tissue failed endothelial assessment was significantly higher than those whose tissue was suitable for transplantation (64.0 versus 59.4 years, $P < 0.05$). A comparison was also made between phakic and pseudophakic donors, revealing that a significantly higher proportion of pseudophakic donors failed endothelial assessment compared with phakic donors (5.7% versus 2.4%, $P < 0.05$). The rate of failed endothelial assessment was not significantly associated with donor source, donor cause of death, or death-to-preservation interval.

The mean endothelial cell density of transplanted corneas was 3024 cells/mm^2 (SD = 324 cells/mm^2). Corneal tissue from donors less than 20 years of age had a significantly higher endothelial cell density (mean = 3442 cells/mm^2) when compared with all other groups, which had mean endothelial cell densities ranging from of 3175 cells/mm^2 (21- to 30-year age group) to 2917 cells/mm^2 (81- to 85-year age group). A significant correlation was found between advancing donor age and lower endothelial cell density ($\beta = -4.7$, se = 0.8, $P < 0.01$).

Biologic Contamination of Donor Tissue

The NZNEB performs microbiological testing on the corneoscleral rim (CSR) before storage and on the organ culture medium (OCM) before transplantation on all donor tissue. Over the study period, the CSR testing showed significant bacterial growth in 1.7% (n = 54) of all donor corneas, and

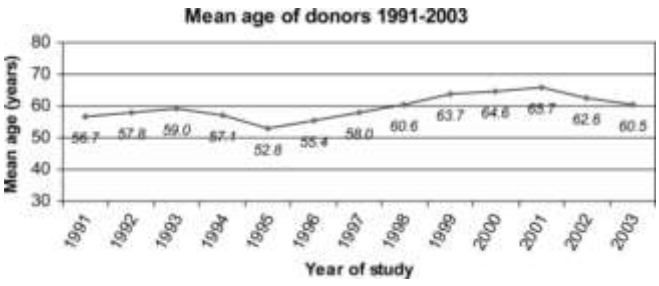


FIGURE 3. Line graph showing mean age of donors for each year of the study.

TABLE 1. Donor Data by Cause of Death

Cause of Death	% of Donors	Mean Age (SD)	% Male	% Transplanted
Cardiovascular disease	50.5	65.0 (14.5)	72.5	82.1
Trauma/multiple injury	12.5	41.0 (21.5)	82.5	72.0
Cerebrovascular disease	11.1	58.9 (17.1)	55.4	83.4
Respiratory disease	7.0	62.8 (18.4)	61.0	74.6
Cancer	6.1	61.4 (16.0)	55.6	73.5
Asphyxiation	2.0	36.2 (19.4)	89.0	71.3
Poisoning	2.0	46.3 (18.3)	77.2	74.0
Other	8.8	57.6 (21.7)	70.0	71.0

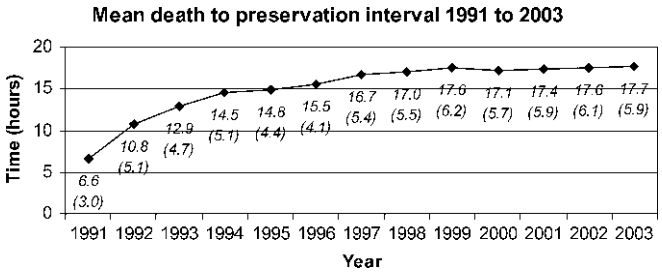


FIGURE 5. Line graph showing mean death-to-preservation interval for each year of the study (SD in brackets).

mycological growth in 0.3% (n = 11). The corresponding figures for OCM testing were 2.0% (n = 63) and 1.9% (n = 58), respectively. Overall, 5.0% (n = 158) of all donor corneas were discarded because of biologic contamination (1.1% from CSR result alone, 3.0% from OCM result alone, 0.9% from both CSR and OCM results). Over the years of the study there was a significant decrease ($\beta = -0.73$, se = 0.14, $P < 0.001$) in contamination rate, as illustrated in Figure 6. Notably, in 2002 only 0.7% (n = 2) of corneas were discarded because of contamination, and in 2003 no donor tissue was discarded for contamination. There was no significant difference between the DPI of donor corneas that were discarded for contamination versus those that were suitable for transplantation (14.9 versus 15.1 hours, $P = 0.29$). The contamination rate for multiorgan donors (2.0%) was significantly less compared with the Coroner's service (5.3%) and public hospital donors (4.8%) ($P < 0.05$).

The most common bacterial isolates were coagulase-negative staphylococci (31%), *Staphylococcus aureus* (14%), *Streptococcus* spp (14%), *Pseudomonas aeruginosa* (11%), *Corynebacterium* spp (7.5%), and *Enterobacteriaceae* (3.5%). The most common mycological isolates were: *Candida albicans* (26%), *Candida glabrata* (19%), *Cryptococcus* spp (5%), *Fusarium* spp (4.5%), and *Penicillium* spp (4.5%). Overall there were 16 different bacterial and 25 different mycological organisms isolated.

The most commonly isolated bacteria from the CSR testing were coagulase-negative staphylococci (27%), *Streptococcus* sp (20%), and *Pseudomonas aeruginosa* (13%), whereas for OCM testing they were coagulase-negative staphylococci (35%), *Staphylococcus aureus* (19%), and *Corynebacterium* (11.6%). The mycological isolates in both CSR and OCM were similar to the overall figures (as above).

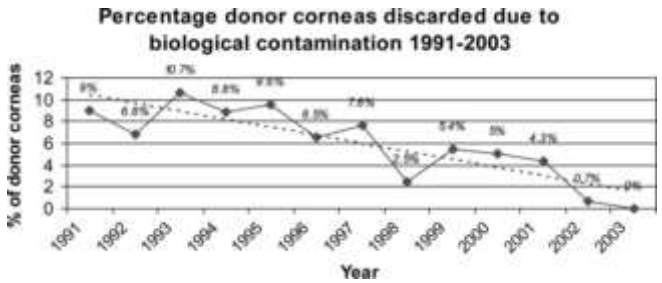


FIGURE 6. Line graph showing percentage of donor corneas discarded because of biologic contamination for each year, 1991–2003.

Utilization and Distribution of Corneal Tissue

The NZNEB received a total of 3221 donor corneas during the study period, of which 79.1% (n = 2547) were transplanted and 20.9% (n = 674) were unsuitable for transplantation. The corneal utilization rate (proportion of donor corneas used for transplantation each year) significantly increased over the years of the study ($\beta = 1.60$, se = 0.38, $P < 0.01$), and in 2003 90.5% of corneal tissue was transplanted. The average number of corneal transplants per year was 204, with a significant increase in transplants per year identified over the years of the study ($\beta = 4.4$, se = 1.3, $P < 0.01$). Overall, 2442 donor corneas were supplied for penetrating keratoplasty, 64 for lamellar keratoplasty, and 48 for unspecified transplants.

Reasons why donor corneas were excluded from transplantation were analyzed; the most common reason was biologic contamination (5.0% of all donor corneas, n = 158) followed by abnormal serology (3.9%, n = 125) and failed endothelial assessment (2.6%, n = 84). Abnormal serology included hepatitis B (3%, n = 98), hepatitis C (0.8%, n = 25), and HIV (0.1%, n =2). There were 55 (1.7%) donor corneas that were deemed suitable and dispatched to the transplant center but were not used. Less common reasons included contraindications in the donors' past medical or ocular history (0.8%, n = 27), storage period greater than the 21-day maximum (0.9%, n = 30), and late harvesting of tissue (collected for emergency or tectonic procedures but not used) (0.7%, n = 27). Unfortunately, a high percentage of reasons were classified as "other" (3.4%) or not recorded (2.7%).

Over the study period the NZNEB supplied most of donor tissue for corneal transplantation in New Zealand. One center, Auckland, received the greatest number of donor corneas (41%), but corneal tissue was widely distributed throughout New Zealand to 12 other centers that received between 0.2% and 12% of all donor tissue. Only 1 center, Christchurch, received donor tissue from other sources during the entire study period (sourced local donor tissue and short-term storage). This center commenced using tissue from the NZNEB in 1996, and over the last 4 years, has subsequently received most of its corneal tissue from the NZNEB. From 1991–1999 it was estimated that the NZNEB supplied at least 85% of donor tissue nationwide.[1] By the same method (based on current usage of tissue supplied to Christchurch, plus unfilled demand in the first 2 years of the study, calculated from donor tissue utilization in year 3 and subsequent years), with extrapolation, it is estimated that the NZNEB has supplied a minimum of 90% of all donor tissue between 1991 and 2003. It is further estimated that over the last 4 years, the NZNEB supplied at least 98% of donor tissue in New Zealand. Of all donor tissue, 67.6% was distributed to public hospitals, and 31.7% to the private sector, with 0.7% unspecified. This 2:1 ratio of public to private distribution remained constant ($\beta = 0.0025$, $P = 0.51$) for each year of the study with the exception of 1991, when 84.1% went to public hospitals.

DISCUSSION

The NZNEB is the major source of donor tissue for corneal transplantation in New Zealand, supplying at least 90%

of all tissue. New Zealand has a population of approximately 4 million, served by 110 ophthalmologists, distributed over a geographic area slightly greater than that of the United Kingdom. Over 200 corneal transplants are now performed each year in New Zealand, and the NZNEB provides an essential service in the procurement of sufficient donor tissue to meet this demand. In addition, the NZNEB also ensures that the quality and safety of donor corneas are maintained according to established and internationally recognized standards and practices and that corneal tissue is distributed in a fair and equitable way.[2] Indeed, currently all corneal transplants can usually be electively booked for surgery within a 2- to 4-month period with guarantee of tissue availability.

The age distribution of donors was comparable to published results from other eye banks,[3] with the majority of donors being over 60 years of age and the greatest proportion between 70 to 80 years of age. We identified no significant difference in the proportion of donor corneas that were suitable for transplantation between different age groups. Notably, even in the oldest age group accepted for transplantation, 80% of corneas were of sufficient standard to be transplanted. Several eye banks have reported lower rates of corneal utilization with advanced donor age: Moyes et al reported a 23% rate in donors aged 70–75 years,[4] Armitage et al reported a 45% rate in donors 80 years and over,[5] and Gain et al reported a 53% rate in donors 85–100 years,[6] with contraindications in medical history the most commonly cited reason for nonutilization of donor tissue. The higher corneal utilization rate of the NZNEB may be explained by the thorough prescreening of potential donors, where those who do not meet donation criteria based on age, ocular, or medical contraindications are generally excluded prior to the procurement of their tissue. This is made possible through the close relationship between the NZNEB and its donor sources, enabling the NZNEB to have greater control over what donor tissue is procured.

The high proportion of corneas suitable for transplantation from donors of advanced age suggests that donor age alone is not indicative of poor tissue quality. Appropriately screened tissue from such donors may therefore be of use, particularly for recipients of similar age, although the NZNEB does not have a specified policy of age-matching tissue. Previous studies have indicated that advanced donor age alone does not have an adverse effect on transplant survival or outcome.[4,7–13] Nonetheless, decreased endothelial cell density and function with advanced age are well documented[14–19]; therefore, tissue from such donors needs a thorough endothelial assessment before approval for transplantation. Our study highlighted the expected correlation between advancing age and higher endothelial assessment failure rate. The NZNEB minimum age of donation is 10 years, which is higher than those of most eye banks.[3] Reasons previously cited for not using infant or young corneas include increased technical difficulties during transplantation (because of its thinness and smaller diameter) and higher postoperative myopia because of the steeper curvature of the cornea.[2,14]

The male preponderance of donors to the NZNEB is similar to results published by other eye banks.[3,20] Statistics published by the New Zealand Health Information Service[21] indicate that men die at a much younger age than women, with the highest proportion of male deaths in the 70- to 79-year age range (30%), compared with that of women with the highest proportion in the 80- to 89-year range (35%). The higher prevalence of male deaths in younger age groups results from higher mortality from trauma and cardiovascular disease. This was reflected in our donor demographic data.

The decreasing supply from the Coroner's service over the years of the study reflects the decrease in the overall number of Coroner's cases requiring autopsy per year over the same time period. The increased supply from public hospitals resulted from the efforts of 1 teaching hospital, Middlemore Hospital, Auckland, whose well-organized donation program contributed 70% of donors in this group. This indicates the potential to increase donor numbers if similar programs are established in other hospitals. The increased supply from multiorgan donors reflects improved efforts from organ donor coordinators and intensivists around the country, although typically there are fewer than 40 multiorgan donors per year in New Zealand.

Donor cause of death in this study differed significantly from overall New Zealand mortality statistics[22] (cardiovascular disease 29%, cancer 27%, cerebrovascular disease 10%, trauma 3%) but was similar to that reported by other eye banks.[3,20] Interestingly, corneal tissue from donors who died of cardiovascular disease and cerebrovascular disease were more likely to be suitable for transplantation than tissue from those who died of other causes. A possible explanation is the high proportion of donors in these groups who died suddenly with less comorbidity.

With the change from hypothermic to organ culture storage as standard NZNEB policy, the storage duration increased from a maximum of 7–10 days to 21 days. This has enabled the more efficient management of corneal tissue, which is of particular importance for the NZNEB, as it is the only supplier of tissue in New Zealand, where surgeons are distributed over a relatively large geographic area. Donor tissue can be supplied when required to ophthalmic surgeons, so that corneal transplantation can be performed as a planned elective procedure, with the postponement rate because of tissue unavailability significantly reduced. The reserve of tissue for emergency procedures has also increased. Increased storage duration also allows additional time for improved microbiological and serologic screening and for tissue compatibility matching if required. There is significant variation in storage methods used by different eye banks around the world, with the United Kingdom and Europe preferring organ culture and the United States and Australia preferring short-term hypothermic storage.[3,19,23–25] Reasons cited for using hypothermic storage over organ culture include decreased cost and the lesser technical complexity required. It has also been suggested that there is decreased initial corneal swelling and increased preservation of endothelial viability with short-term storage.[26] However, several studies have clearly shown that endothelial cell density and morphology are well maintained even up to 35 days of storage with organ culture[14,27,28] and that, postoperatively, survival and eventual corneal thickness were similar compared with short-term storage media.[24]

Postoperative bacterial or fungal endophthalmitis is a serious complication of corneal transplantation and can have

devastating effects on eventual outcome. The reported incidence of postoperative endophthalmitis ranges from 0.1% to 2%.[29–33] Studies have shown a correlation between postoperative endophthalmitis and infection of donor tissue.[32,34] Therefore, donor screening, microbiological screening, and decontamination of donor tissue are priorities of the NZNEB. During the study period 5% of all donor corneas were discarded for biologic contamination. Reported figures from other eye banks in the literature range widely from 12%–39% for hypothermic storage and 0.7%–5% for organ culture storage.[29,31–33,35] Biologic contamination in this study significantly decreased from 10% in 1991 to the current rate of less than 1%. This decrease is thought to be multifactorial and associated with improved facilities and equipment, more experienced and technically skilled staff, and eye bank staff performing all of the retrievals, resulting in more consistent decontamination and handling techniques. Of note, multiorgan donors had significantly lower contamination rates than donors from other sources. This may be related to the protective functions of the living eye and the increase in growth of normal flora associated with cadaveric eyes.[39]

The major bacterial contaminant in this study was coagulase-negative staphylococci, followed by *Staphylococcus aureus* and *Streptococcus* spp. Similar bacterial isolates have been reported in other studies, with coagulase-negative staphylococci the major contaminant in almost all cases.[32,33,35–41] This suggests that most of the contamination is with bacteria derived from normal ocular flora. The same studies report *Candida* spp to be the most common mycological organism isolated. In studies evaluating the organisms found in post–penetrating keratoplasty endophthalmitis, *Streptococcus* spp were the most common bacterial isolate reported, and *Candida* spp were the most common fungi reported.[29,32,34,42,43] No cases of endophthalmitis from contamination of donor tissue were reported to the NZNEB during the study period.

The corneal utilization rate identified in this study (79%) is high when compared with published data from other eye banks with reported rates between 50% and 70%.[44–46] A possible reason for the higher utilization rate is the thorough prescreening of potential donors (for age and medical contraindications) before procurement of tissue, as previously noted. The most common reasons for discarding tissue were microbiological contamination, abnormal serology, and failed endothelial assessment. Advanced age, contraindications in the donor's medical and ocular history, and poor tissue quality were the most common reasons for exclusion of donor corneas reported by other eye banks.[5,17,44–46] The corneal utilization rate increased throughout each year of the study, reflecting improvements in all areas of NZNEB operation, and in particular, corneal storage and decreased microbiological contamination.

The comprehensive database maintained by the NZNEB is an important part of the NZNEB operation, and analysis of this database provides valuable information in relation to all aspects of eye banking in New Zealand. Over the 13-year period analyzed, significant trends were identified in relation to donor demographics, donor procurement source, improved donor tissue processing and storage, decreased biologic contamination, and increased utilization of corneal tissue.

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