

Canadian Blood
Services

TISSUE EXPERT COMMITTEE: WHAT IS THE ROLE OF CANADIAN ALLOGRAFT PROCESSING IN THE FUTURE?

CONTENTS

1. Scope	3
2. Tissue Processing Models	4
3. Ocular	6
4. Skin	8
5. Cardiac	9
6. Tendons and Soft Tissues	10
7. Musculoskeletal Base Tissues, Machined and Demineralized Grafts	11
8. Appendices	13

1. Scope

WHAT IS THE ROLE OF CANADIAN ALLOGRAFT PROCESSING IN THE FUTURE?

This paper is intended to generate discussion about the role of Canadian tissue banks in the production of allografts to meet demand for ocular, skin, cardiac, tendons and musculoskeletal tissue. This paper briefly outlines the Canadian, US and UK models for tissue processing and the similarities or differences between those systems. Each tissue type (ocular, skin etc) is presented with an overview of the current state of processing and demand in Canada. Market trends for the use of this type of tissue are described, and a number of questions are posed to generate discussion about the future role of Canadian tissue banks with respect to processing this type of tissue.

Direction and advice from the Tissue Expert Committee is sought to identify what the Canadian production role should be and what would be required to support that role. Should the Canadian capacity be maintained or expanded or should alternative production strategies be explored? Given market trends with respect to new product types will there continue to be demand for the types of tissue being produced in Canada? Can new types of tissue be produced to adjust to any changes in these demands? Discussions should take into account the principals of quality, safety, equitable access, efficacy and efficiency.

Surgical bone banking and the supply of donor tissue are addressed in separate papers. Discussions are based on an assumption of an increased supply of Canadian donor tissue.

2. Tissue Processing Models

Canada

The majority of Canadian eye and tissue banks are located within the hospital environment as a program within surgical or laboratory services. The competition for limited resources within the hospital environment has been identified as a barrier to supporting growth and best practices.¹ The cost of allografts are assigned to cost centres within hospitals or covered by private insurance (dental). The use of allografts within the hospital environment may be limited by budgetary restrictions. Some Canadian tissue and eye banks recover costs for allografts distributed external to their host institution.

In 2008 there were a total of 29 eye, tissue and surgical bone banks in Canada², including 4 banks in Quebec and 2 islet cell programs. Excluding the islet programs and the banks in Quebec, the other 23 banks can be categorized as;

- 3 Comprehensive Tissue Banks
- 1 Recovery Bank with Processing Partnerships
- 7 Surgical Bone Banks
- 7 Tissue Specific Banks; 5 Musculoskeletal, 1 Cardiac and 1 Skin
- 5 Stand Alone Eye Banks

The overall production of allografts by Canadian tissue banks (excluding Quebec) for 2008 is 9,663.³ A comparative analysis of Canadian tissue banks between 2002 and 2008 indicate significant changes in the production numbers of some types of tissue allografts, which are detailed in this paper.

Canadian tissue banks produce an average of 21 allografts per donor (yield).⁴ Cost efficiencies have previously been demonstrated within centres with higher donor volumes and within centres that process multiple tissues.⁵ Data from the 2009 CBS survey indicates that there is significant variation between programs in allograft production per million population and that higher allograft yields are achieved by comprehensive tissue banks.

A 2006 review indicated emerging technologies including synthetics, xenografts and gene and stem cell therapy in orthopedics would not displace traditional tissue banking within the next ten years, but may have the potential to reduce demand.⁶

¹ Canadian Blood Services. Environmental Scan of the Canadian Tissue Community, Report in Development.

² Canadian Blood Services. Supply of Human Allograft Tissue in Canada Preliminary Data Analysis. October 2009.

³ Canadian Blood Services. Environmental Scan of the Canadian Tissue Community, Report in Development.

⁴ American Association of Tissue Banks. Report on the 2007 Annual Survey. March 2009.

⁵ Canadian Council for Donation and Transplantation. Human Tissue Banking in Canada; Costing and Economic Analysis, September 16, 2003.

⁶ Canadian Council for Donation and Transplantation. Tissue Banking Innovation Practices August 2006.

Production and utilization data is presented in this report with the exclusion of Quebec activity.

United States

The US tissue system is a competitive private-sector market. Not-for-profit and for profit organizations provide a range of products for the US market, and also export products into Canada. A 2007 survey of 109 US tissue banks identified 32 facilities which processed 49,000 donors with an average production yield of 49 allografts per donor and distribution of 2,141,452 allografts and tissue devices.⁷ The Eye Bank Association of America identified 86 accredited recovery programs, eye banks and distribution organizations supporting a 2007 distribution of 50,122 corneas.⁸

United Kingdom

In the late 1990's the 4 largest multi-tissue banks amalgamated into a single service within the National Health Service Blood and Transplant (NHSBT). The amalgamation was driven by the potential for operational efficiencies and to take advantage of existing support services with the National Blood Service. The NHSBT Tissue Service is the major provider of tissue within the UK managing approximately 400 cadaver donor recoveries annually. The tissue service competes with other UK banks and international suppliers for market share and currently captures 100% of skin, 70% of base bone products, 50% of surgical bone and 10% of the heart valve market. Eye banking is distinct from the tissue service.⁹ Advanced tissue products such as DBM and machined bone drafts are sold into the market by commercial organizations, and are not manufactured by the NHSBT Tissue Service.

⁷ American Association of Tissue Banks. Report on the 2007 Annual Survey. March 2009.

⁸ Eye Bank Association of America. Retrieved from www.restoresite.org December 1, 2009.

⁹ Helen Gillian. Manager Liverpool Tissue Facility, NHSBT Tissue Service, Personal Communication September 8, 2009.

3. Ocular

Current State: Canadian eye banks have identified 65 ophthalmologists currently transplanting corneas.¹⁰ Transplants are generally scheduled electively. Factors resulting in cancellations of surgeries have been identified to be:¹¹

- tissue availability (75% 21/28)
- a medical condition in patients (32% 9/28), and
- operating room time shortage (14% 4/28).

There is significant variation between eye banks in the cornea production per million population (median of 113, range 34-158). Wait time for transplantation between provinces vary widely (median of 18 months, range 7-36 months) and 11% of transplanted corneas are imported from other provinces.¹² Hema-Quebec is currently engaged in an initiative to decrease their ocular waiting list by importing corneas from both US and Canadian eye banks. Historically, Canadian eye banks have not employed cost recovery for ocular tissue (except sclera); this has been identified as a barrier to inter-provincial distribution.¹³ The Quebec importation initiative would support a cost recovery methodology for participating programs, including Canadian eye banks. A comparative analysis indicates that ocular tissue processing increased 14% from 2002 to 2008. In 2008 two stand-alone Canadian eye banks were amalgamated into existing tissue programs. Hema-Quebec is currently in the process of incorporating existing eye programs into their organization.

Figure 1.0 2008 Canadian Ocular Supply and Demand

Allograft Product	2008 Production ¹⁴	2008 Utilization ¹⁵	Waiting List ¹⁶	Median Waiting Time Months ¹⁷
Corneas PK, DALK, DSAEK	2,404	1,976	2,348	18 (range 7-36)
Sclera 1/8,1/3,1/4,1/2, full globe	1,019	988	None	Not applicable
Amniotic Membrane	200	Unknown	None	Not applicable

Market Direction: Since 2005, there has been an increase in the number of partial thickness corneal transplant procedures such as DSAEK (Descemet’s Stripping Automated Endothelial Keratoplasty) and DALK (Deep Anterior Lamellar Keratoplasty) from 2.4% to 36.1% of all transplants.¹⁸ In a penetrating keratoplasty the recipient’s entire cornea is removed. In partial thickness transplants the recipient’s healthy

¹⁰ Canadian Blood Services. Ocular Tissue Banks Survey: Analysis of Survey Data. November 2009.
¹¹ Mahta Rasouli. Efficacy of Routine Notification and Request on Reducing Corneal Transplantation Wait Times in Canada. Can J Ophthalmology – Vol. 44, No. 1. 2009.
¹² Canadian Blood Services. Ocular Tissue Banks Survey: Analysis of Survey Data. November 2009.
¹³ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Report in Development.
¹⁴ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Preliminary Data Analysis. October 2009.
¹⁵ Canadian Blood Services. Ocular Tissue Banks Survey: Analysis of Survey Data. November 2009.
¹⁶ Canadian Blood Services. Ocular Tissue Banks Survey: Analysis of Survey Data. November 2009.
¹⁷ Canadian Blood Services. Ocular Tissue Banks Survey: Analysis of Survey Data. November 2009.
¹⁸ Dr. Alan Slomovic. Evolving Surgical Techniques and Indications for Corneal Transplantation in Ontario. Unpublished abstract.

endothelium is left intact and used to host donor tissue from which the endothelium is removed reducing the potential for rejection and improving outcomes. This advanced processing procedure is commonly performed in US eye banks and has been implemented by two Canadian eye banks. While still infrequently used in Canada, DMEK (Decemet Membrane Endothelial Keratoplasty) is becoming more common in the US. DMEK is commonly performed in the operating room and leaves the patient's cornea closer to its original condition than other techniques.¹⁹ There is a significant corneal discard rate (30%) with this procedure, increasing the demand for corneal tissue.

Questions for Consideration:

- What is required to address the significant disparity of waiting times and support the equitable distribution of corneas across provincial boundaries?
- What is required to support the emerging demand for partial thickness grafts?

¹⁹ Cornea Research Foundation of America, Retrieved from www.cornea.org on December 8, 2009.

4. Skin

Current State: Skin grafts produced by Canadian tissue banks support the 14 burn treatment centres in Canada. Skin allografts are also used by the dental industry but there is no Canadian skin processing activity directed to the dental market. Four Canadian tissue banks identify as skin banks with two Alberta programs producing 71% of the total Canadian supply. The remaining programs produce 27% and 2% of the total Canadian supply. A comparative analysis indicates that skin allograft production by Canadian tissue banks decreased by 65% between 2002 and 2008. One tissue program is supplying unprocessed tissue to US processors and this allograft production is not captured within the Canadian production data. In the United States, a 2007 survey of 109 tissue banks identified 14 skin processing centres processing and distributing a total of 312,000 allografts from 17,000 skin donors.

Figure 2. Skin Allografts Supply and Demand

	2008 Canadian Production ²⁰	2002 Estimated Surgical Utilization ²¹	Est. 2002 Canadian Supply %	2008 Utilization	2008 Canadian Supply %
Skin	768	1,513	50%	Unknown	Unknown

Market Trends: Human skin is used to cover wounds/burns to provide a barrier to infection and a matrix for colonization by the patient's own cells. Autologous skin grafts achieve wound coverage without risk of rejection and are used when graft sites are available. Emerging practice includes growing autografts in the laboratory by culturing the patient's donated skin cells. Commercially available products incorporating both human (Alloderm), cultured human (Dermagraft) or xenograft (Integra) tissue sources are available for a variety of surgical and wound care applications. In the past, burn surgeons obtained the skin allografts they needed from their own hospital tissue banks but recently the trend has been toward ordering skin from commercial US suppliers of allografts.²²

Questions for Consideration:

- Is there sufficient demand for skin allografts to support maintaining or expanding the production of this tissue by Canadian tissue banks?
- Should the exportation of donor tissue to the US for processing and repatriation be maintained or expanded?

²⁰ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Preliminary Data Analysis, October 2009.

²¹ Canadian Council for Donation and Transplantation. Demand for Human Allograft Tissue in Canada. May 2003, Table 27 Medium Range.

²² BCC Research: Organ and Tissue Transplantation and Alternatives. 2008.

5. Cardiac

Current State: Heart valves are regulated as medical devices and the production of valves is a high-cost, low-volume activity. Three Canadian tissue banks process cardiac valves, in addition to Hema-Quebec. Canadian banks produce aortic segments but do not produce vascular tissue (veins and arteries). Current Canadian utilization data on heart valves, conduits and vascular tissue is not available. A comparative analysis indicates that cardiac tissue processing by Canadian tissue banks declined by 58% between 2002 and 2008 which corresponds to the 56% decrease in cardiac tissues recovered over the same period. One tissue program is supplying unprocessed cardiac tissue to US processors, and this allograft production is not captured within the Canadian production data. In the United States a 2007 survey of 109 tissue banks identified 4 cardiovascular processing centres producing and distributing 5,349 cardiac and 3,592 vascular grafts from 8,800 cardiovascular donors. Cryolife provides 65% of the cardiac valve allografts.²³

Figure 3. Cardiac Allograft Supply and Demand

Allograft Product	2008 Canadian Production ²⁴	2002 Est. Surgical Utilization ²⁵	Est. 2002 Canadian Supply %	2008 Utilization	2008 Canadian Supply %
Valves	82	500	16.4%	Unknown	Unknown
Conduits	18	301	6%	Unknown	Unknown
Vascular (Aorta, Veins Arteries)	5	Unknown	Unknown	Unknown	Unknown

Market Trends: At present, there are two principal heart valve types: bioprosthetic made from human or animal tissue, and mechanical valves. The limitation of human bioprosthetic valves is availability while the limitation of mechanical valves is risk of thrombosis. Human allograft valves are utilized in approximately 4% of cardiac valve replacements. Cardiac valves are most commonly utilized in pediatric and young adult cardiac surgical procedures with demand focused on smaller valve sizes. The US heart valve market is projected to increase by 5.2% by 2013.²⁶ Coronary bypass surgeries are normally performed with autologous grafts; however in cases where autologous is not an option allograft can be used.

Questions for Consideration:

- Should the capacity of Canadian tissue banks to process cardiac valves and/or vascular tissue be maintained or expanded?
- Should the exportation of donor cardiac and/or vascular tissue to the US for processing and repatriation be maintained or expanded?

²³ Robert Rigney. American Association of Tissue Banks Report on the 2007 Annual Survey. March 2009.

²⁴ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Preliminary Data Analysis, October 2009.

²⁵ Canadian Council for Donation and Transplantation. Demand for Human Allograft Tissue in Canada. May 2003 Table 26 Low Range.

²⁶ BCC Research. Market Research Report: Organ and Tissue Transplantation and Alternatives, October 2008.

6. Tendons and Soft Tissues

Current State: Tendons are currently produced by five Canadian tissue banks; two also produce fascia and meniscus and one tissue bank also produces pericardium. The attributes and characteristics of the soft tissue grafts vary between programs. Communication channels to end users are underdeveloped.²⁷ Data on tendon and soft tissue allograft utilization is not readily available. In the United States a 2007 survey of 109 tissue banks identified 20 soft tissue processing centres that produced a total of 152,000 allografts from 12,000 tendon, 8,600 ligament, 7,500 fascia and 5,000 pericardium donors.²⁸ A comparative analysis indicates tendon processing increased by 103% while soft tissue processing decreased by 75% between 2002 and 2008 in Canada. One tissue program is supplying this tissue to the US for processing and distribution. This activity is not captured within the Canadian production data.

Figure 4. Tendon and Soft Tissue Supply and Demand

Surgical Grafts	2008 Canadian Production ²⁹	2002 Estimated Utilization ³⁰	Est. 2002 Canadian Supply %	2008 Utilization	2008 Canadian Supply %
Tendons	945	1,232	77%	Unknown	Unknown
Fascia Lata	46	Unknown	Unknown	Unknown	Unknown
Meniscus	30	Unknown	Unknown	Unknown	Unknown
Pericardium	29	Unknown	Unknown	Unknown	Unknown

Market Direction: Tendons are sourced by the orthopedic surgical community with higher use among orthopedic surgeons that specialize in sports medicine. There are 1,181 orthopedic surgeons practicing in Canada. A 2009 survey of Canadian tissue banks identified tendons as high demand products, where often there is not the supply to meet end user requests.³¹ There is a demand for soft tissue (fascia) in the dental market, but there is currently no Canadian production being directed to meet this demand. This market is being served entirely by US commercial suppliers.

Questions for Consideration:

- Should the capacity of Canadian tissue banks to produce tendons or other soft tissues be maintained or expanded?
- Should the exportation of donor tendon and soft tissue to the US for processing and repatriation be maintained or expanded?

²⁷ Canadian Blood Services. Solution Design Paper "How Can the System Best Ensure that Supply is Aligned with Demand". October 2009.

²⁸ American Association of Tissue Banks. Report on the 2007 Annual Survey. March 2009.

²⁹ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Preliminary Data Analysis. October 2009.

³⁰ Canadian Council for Donation and Transplantation. Demand for Human Allograft Tissue in Canada. May 2003. Table 27 Medium Range.

³¹ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Report in Development.

7. Musculoskeletal Base Tissues, Machined and Demineralized Grafts

Current State: Of the six Canadian tissue programs processing cadaver bone, two programs distribute cancellous grafts, small and or large structural grafts to hospitals outside of their host institution or region. Two additional programs intend to process cadaver bone increasing the number of bone processing programs to eight. One program (Kingston) did not respond to the CBS survey; its activity is unknown. The attributes and characteristics of musculoskeletal products vary between programs. Communication channels to end users are underdeveloped. In 2008, there was no production by lyophilized, demineralized or machined products within Canada. However, one program has recently initiated the production of lyophilized products.³² Data on Canadian bone allograft utilization is not readily available and demand forecasting is not established practice within Canadian programs.³³ A comparative analysis indicates that the Canadian processing of ground cancellous bone increased by 100% between 2002 and 2008 while the processing of small structural grafts and large structural grafts decreased by 67% and 41% respectively during the same time period. One program is currently supplying cadaver bone to the US for processing and distribution. The processing that is occurring in the US is not captured within the Canadian production data. In the United States a 2007 survey of 109 tissue banks identified 24 bone processing centres, 15 of which process demineralized bone. These centres processed a total of 23,000 donors, producing and distributing 1,166,969 musculoskeletal grafts and 501,559 tissue devices including machined screws, dowels and bone cages.³⁴ Musculoskeletal allografts are purchased as a medical supply within the Canadian surgical and dental communities. These communities include 1,181 orthopedic surgeons, 239 neurosurgeons, 355 oral and maxillofacial surgeons, 230 periodontists and 19,000 dentists.

Figure 5. Musculoskeletal Base Supply Utilization Alignment

Surgical Grafts	2008 Canadian Production ³⁵	2002 Estimated Utilization ³⁶	Est. 2002 Canadian Supply %	2008 Utilization	2008 Canadian Supply %
Surgical Bone	1,271	Unknown	100%	820	100%
Cancellous	1,838	3,313	55%	Unknown	Unknown
Small Structural	139	2,762	5%	Unknown	Unknown
Large Structural	869	2,418	36%	Unknown	Unknown

³² Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Report in Development.

³³ Canadian Blood Services, "How Can the System Best Ensure that Supply is Aligned with Demand". October 2009.

³⁴ American Association of Tissue Banks. Report on the 2007 Annual Survey. March 2009.

³⁵ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Preliminary Data Analysis. October 2009.

³⁶ Canadian Council for Donation and Transplantation. Demand for Human Allograft Tissue in Canada. May 2003. Cancellous Table 27 Medium Range, Small/Large Struc/Soft Tissue Table 26 Low Range.

Surgical Grafts	2008 Canadian Production ³⁷	2002 Estimated Utilization	Est. 2002 Canadian Supply %	2008 Utilization	2008 Canadian Supply %
Machined Grafts	0	Unknown	0	Unknown	0

Surgical and Dental Grafts	Estimated 2005 Total Canadian Utilization ³⁸	2008 Utilization	2008 Canadian Supply %
Demineralized Bone Products	64,004 cc	Unknown	0%

Market Direction: A 2009 survey of Canadian tissue banks identified cancellous and small structural grafts as high demand products where often there is not the supply to meet end user requests.³⁹ Demand for orthopedic biomaterials is primarily being driven by an aging, yet active population that requires greater care and maintenance of their joints. Newer products featuring innovative developments such as stem cell incorporation are garnering awareness and helping to drive adoption.⁴⁰ Three types of products account for bone allograft sales revenue in the United States; base tissues (48%), demineralized bone matrix (26%) and machined implants (26%). Base tissue is losing market share as the industry moves toward more specialized products to meet specific needs.⁴¹ Utilization of autologous grafting in orthopedic and spinal procedures is decreasing with greater use of substitutes including demineralized bone, collagen based products, and synthetics.⁴² A review of 3 large US based processors revealed a range of 200 to 650 different products and size-differentiated allografts. By 2013 the US market is projected to increase by 5% for base tissues, 12.5% for demineralized bone and 8.5% for machined implants.⁴³ Fresh osteochondral grafts are a high-cost, low-volume allograft utilized in sports medicine and Canadian demand is increasing. US manufacturers provide the use of specialized implantation surgical equipment with the purchase of these products.⁴⁴

Questions for Consideration:

- Should Canadian capacity for base tissues be maintained or expanded?
- Should Canadian capacity for machined products be developed?
- Should Canadian capacity for demineralized products be developed?
- Should the exportation of donor tissue to the US for processing and repatriation be maintained or expanded?
- Given the breadth of products offered to Canadian end users by US processors in a market based competitive environment what product lines should be the focus of Canadian processing?
- Should Canadian processors compete to gain market share from US manufactures in these product lines?

³⁷ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Preliminary Data Analysis. October 2009.

³⁸ Canadian Council for Donation and Transplantation. Market Evaluation of Demineralized Bone Matrix Products. April 2006.

³⁹ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Report in Development.

⁴⁰ Millennium Research Group. US markets for Orthopedic Biomaterials. 2009.

⁴¹ BCC Research. Market Research Report: Organ and Tissue Transplantation and Alternatives, October 2008.

⁴² Spine Arthroplasty Society Journal. Basic Science Symposium 1: Bone Graft Substitutes, Winter 2008 Volume 2 Issue 1.

⁴³ BCC Research. Market Research Report: Organ and Tissue Transplantation and Alternatives, October 2008.

⁴⁴ Dr. Patrick Chin, University of British Columbia, Vancouver Coastal Health Authority, Direct Communication November 20, 2009.

8. Appendices

Appendix A: Canadian Tissue Banks Production Functions

The following chart details the processing functions of Canadian tissue banks. In addition programs who recover tissue for processing at external centres have been detailed.

Figure 6. Bank Functions

	Bank	Type	Location	Surg Bone	Amnion	Ocular	Bone	Skin	Cardiac
1	Southern Alberta Tissue Program	Comprehensive	Calgary	X		X	X	X	Recover
2	Comprehensive Tissue Centre	Comprehensive	Edmonton	X	X	X	X	X	X
3	Regional Tissue Bank	Comprehensive	Halifax		X	X	X	X	X
4	Eye Bank of British Columbia	Ocular	Vancouver			X			
5	Lions Eye Bank of Saskatchewan	Ocular	Saskatoon			X			
6	Lions Eye Bank of Manitoba	Ocular	Winnipeg		X	X			
7	Eye Bank of Canada Ontario Division	Ocular	Toronto			X			
8	New Brunswick Eye and Tissue Bank	Ocular and Surg Bone	St. John	X		X			
9	Saskatoon Health Region Bone and Tissue Bank	Musculoskeletal and Recovery	Saskatoon	X	X		X	Recover	Recover
10	Manitoba Tissue Bank	Recovery	Winnipeg				Recover	Recover	Recover
11	National Capital Regional Bone Bank	Musculoskeletal	Ottawa	X			X		
12	Kingston Tissue Bank	Musculoskeletal	Kingston	X			Status Not Known		
13	Mount Sinai Allograft Technologies	Musculoskeletal	Toronto	X			X		
14	Dr. Donald MacLellan Tissue Bank	Musculoskeletal and Recovery	Moncton	X			Restart 2009	Recover	Recover
15	BC Tissue Bank	Surgical Bone	Vancouver	X					
16	Vancouver Island Health Authority Tissue Bank	Surgical Bone	Victoria	X					
17	Regina Que Appelle Health Region Bone Bank	Surgical Bone	Regina	X					
18	St. Michaels Hospital Tissue Bank	Surgical Bone	Toronto	X					
19	Transfusion Medicine London Health Sciences Centre	Surgical Bone	London	X					
20	Regenmed	Surgical Bone	Thunder Bay	X			Planned		
21	St. Josephs Healthcare	Surgical Bone	Hamilton	X					
22	Sick Children's Hospital	Cardiac	Toronto						X
23	Blood and Tissue Bank Sunnybrooke Health Sciences Centre	Skin	Toronto	X				X	

APPENDIX B: 2008 Canadian Ocular Activity

Figure 7. 2008 Canadian Ocular Activity

Prov	Average Wait Time Month ⁴⁵	Cornea Per Million Population	Cornea ⁴⁶	% of Canadian Production	Sclera	% of Canadian Production	Amniotic Membrane	% of Canadian Production
BC	15	130	570	23.7%	194	19%	0	0
AB	Edm - 18 Cal -36	60	217	9%	198	19.4%	131	65.5%
SK	36	34	34	1.4%	59	5.8%	52	26%
MN	7	113	136	5.7%	36	3.5%	17	8.5%
ON	18	92	1186	49.3%	247	24.2%	0	0
NB	-	158	118	4.9%	82	8%	0	0
NS	12	153	143	5.9%	203	19.9%	0	0
PE	-	0	0	0	0	0	0	0
NL	-	0	0	0	0	0	0	0
Total			2,404	100%	1,019	100%	200	100%

⁴⁵ Canadian Blood Services. Ocular Tissue Banks Survey: Analysis of Survey Data. November 2009.

⁴⁶ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Preliminary Data Analysis. October 2009.

Appendix C: 2008 Canadian Skin Allograft Activity

Figure 8. 2008 Canadian Skin Allograft Processed and Released to Distribution

Province ⁴⁷	Allograft Per Million Population	Skin Grafts	% Total Production
BC	0	0	0
AB*	118	543	71%
SK	0	0	0
MN	0	0	0
ON	1.5	19	2%
NB	0	0	0
NS**	122	206	27%
PE	0	0	0
NL	0	0	0
Total		768	100%

* CTC processes SK donors – per million calculation based on combined populations

**NS processes NB donors – per million calculation based on combined populations.

⁴⁷ Canadian Blood Services. Supply of Human Allograft Tissue in Canada Preliminary Data Analysis. October 2009.

Appendix D: 2009 Canadian Cardiovascular Allograft Activity

Figure 9. 2008 Canadian Cardiovascular Allograft Processed and Released to Distribution

Province ⁴⁸	Allograft per Million Pop	Cardiac Valves and Conduits	% Canadian Production	Pericardium	% Canadian Production	Vascular Tissue	% Canadian Production
BC	0	0	0	0	0	0	-
AB*	3.9	17	16.2%	1	3.4%	0	-
SK	0	0	0	0	0	0	-
MN	0	0	0	0	0	0	-
ON	5.4	42	40%	28	96.6%	0	-
NB	0	0	0	0	0	0	-
NS**	27.3	46	43.8%	0	0	0	-
PE	0	0	0	0	0	0	-
NL	0	0	0	0	0	0	-
Total		105	100	29	100	0	-

* CTC processes SK donors – calculation based on combined populations

**NS processes NB donors – calculation based on combined populations.

⁴⁸ Canadian Blood Services. Supply of Human Allograft Tissue in Canada Preliminary Data Analysis. October 2009.

APPENDIX E: 2008 Canadian Musculoskeletal Allograft Activity

Figure 10. 2008 Canadian Musculoskeletal Allograft Processed and Released for

Province	Surgical Yield per Million Population	Cadaver Yield per Million Pop	Surgical Bone	Cancellous and Ground, Chipped	Small Structural	Large Structural	Tendons	Soft Tissue*	% Canadian Production
BC	44	0	194	0	0	0	0	0	3.8%
AB	185	272	666	282	9	282	364	41	32%
SK	190	75	192	0	0	33	43	0	5.2%
MN**	0	0	0	0	0	0	0	0	0%
ON	11	55	146	281	0	306	119	12	16.8%
NB	98	0	73	0	0	0	0	0	1.4%
NS***	0	1,244	0	1,275	130	248	419	23	40.8%
PE	0	0	0	0	0	0	0	0	0%
NL	0	0	0	0	0	0	0	0	0%
Total			1,271	1,838	139	869	945	76	100%

Distribution⁴⁹

* Pericardium is detailed in the cardiac production. .

** Manitoba exports donor tissue for production

***In 2008 NS processed NB donors – calculation based on combined populations.

Figure 11. 2008 Sampling of Hospital Musculoskeletal Allograft Utilization⁵⁰

	Edmonton Health Region	Fraser Valley	Capital Health Halifax	London Health Science	Moncton Hospital	Regina Que Appelle	St. Michaels	Vancouver Coastal	Total
Orthopedic Surgeons	56	19	21	11	12	11	13	72	215
Neurosurgeons	20	7	9	9	5	5	9	19	83
Femoral Head	162	12	6	36	41	82	40	115	494
Cancellous	0	3	218	383	59	191	5	13	872
Small Structural	10	6	84	15	59	28	4	5	211
Large Structural	89	13	4	2	4	1	17	45	175
Meniscus	0	2	0	4	0	0	0	0	6
Tendons	102	39	169	53	6	0	47	49	465
Soft Tissue	3	0	0	140	0	0	0	0	143

⁴⁹ Canadian Blood Services. Supply of Human Allograft Tissue in Canada: Preliminary Data Analysis. October 2009.

⁵⁰ Canadian Blood Services, Environmental Scan, Report in Development 2009.