

Umbilical Cord Blood Stem Cells: Issues with Private and Public Banks

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The first successful umbilical cord haematopoietic stem cell transplant was performed in 1988.¹ The realization of the promise of umbilical cord blood (UCB) created an impetus to store this resource, which was for the most part simply discarded after the baby's birth.² While most experts agree that autologous use of UCB is unlikely at this point in time, private companies have realized the lucrative potential of this untapped source and are rapidly targeting expecting parents to persuade them into private storage. This paper presents a brief scientific overview of umbilical cord haematopoietic stem cells and a critical analysis of the ethical and legal quandaries of public and private banking. From a legal standpoint, we argue that if the status of cord blood is uncertain, ownership rights over cord blood stem cells will remain blurred. We also maintain that, absent proper regulation of umbilical cord blood banking and donor solicitation, scientific progress in this field will not translate into better health for society to the extent that it could and should.

I. Scientific Background

Stem cells are undifferentiated, primitive cells that have the ability both to multiply and to differentiate into specialized cell types. As well as forming the human body and its constituent parts, stem cells serve as a sort of repair system for the body. Haematopoietic stem cells (HSCs), found in both umbilical cord blood and bone marrow, can give rise to all the different types of blood cells and provide for all the types of blood cell formation throughout the life of an individual.³ Furthermore, a number of animal studies have demonstrated that HSCs may be able

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¹E. Gluckman *et al.*, "Hematopoietic reconstitution in a patient with Fanconi's anemia by means of umbilical-cord blood from an HLA-identical sibling" (1989) 321 *New Eng. J. Med.* 1174.

²G.B. Burgio, E. Gluckman & F. Locatelli, "Ethical reappraisal of 15 years of cord-blood transplantation" (2003) 361 *Lancet* 250.

³National Institutes of Health (NIH), *Stem Cells: Scientific Progress and Future Research Directions* (Bethesda: Department of Health and Human Services, June 2001), online: NIH <<http://stemcells.nih.gov/info/scireport/PDFs/fullrptstem.pdf>> (date accessed: October 26th, 2004).

to give rise to cell types of completely different lineages,⁴ including neurons, liver cells and heart muscle.⁵

Umbilical cord blood stem cell transplantation provides a means to permanent recovery for a variety of blood-related diseases. For more than a decade, patients suffering from cancers of the blood (leukemia, lymphoma, myeloma),⁶ hemoglobinopathies (Beta-thalassemia, sickle cell anaemia, Fanconi's anaemia),⁷ and immunodeficiencies (Severe Combined immune deficiency and Wiskott Aldrich Syndrome)⁸ have relied on stem cell transplantation to reconstitute their immune systems after chemotherapy and radiotherapy. The recipient's bone marrow is replenished with HSCs of the donor, and the recipient is once again able to produce healthy blood cells, albeit of the type of the donor.

Research is currently investigating whether HSCs can be used as a potential source of cells for transplantation for the support of degenerative diseases (Parkinson's, Alzheimer's, Lou Gehrig's, Multiple Sclerosis),⁹ post-traumatic disorders (post-stroke, spinal cord injuries),¹⁰ and hereditary diseases (Huntington's, Leukodystrophies)¹¹ of the central nervous system. Recent investigations have also demonstrated that UCB is a potentially suitable source of stem cell transplantation for liver injury.¹² UCBSC is also being researched for its potential for gene therapy.¹³

⁴S.J. Forbes *et al.*, "Adult stem cell plasticity: new pathways of tissue regeneration become visible" (2002) 103 *Clinical Science* 355.

⁵C. Holden & G. Vogel, "Stem Cells: Plasticity: Time for a Reappraisal?" (2002) 296 *Science* 2126.

⁶J.N. Barker & J.E. Wagner, "Umbilical-cord blood transplantation for the treatment of cancer" (2003) 31 *Nature Reviews* 541.

⁷L. Krishnamurti *et al.*, "Stem cell donation. Availability of unrelated donors for hematopoietic stem cell transplantation for hemoglobinopathies" (2003) 31 *Bone Marrow Transplantation* 547; F. Locatelli *et al.*, "Related umbilical cord blood transplantation in patients with thalassemia and sickle cell disease" (2003) 101 *Blood* 2137.

⁸C. Antoine *et al.*, "Long-term survival and transplantation of haemopoietic stem cells for immunodeficiencies: report of the European experience 1968-99" (2003) 361 *Lancet* 553; A.P. Knutsen *et al.*, "Umbilical cord blood transplantation in Wiskott Aldrich syndrome" (2003) 142 *Journal of Pediatrics* 519.

⁹R.A. Nash *et al.*, "High-dose immunosuppressive therapy and autologous peripheral blood stem cell transplantation for severe multiple sclerosis" (2003) 102 *Blood* 2364.

¹⁰D.A. Peterson, "Umbilical cord blood cells and brain stroke injury: bringing in fresh blood to address an old problem" (2004) 114 *Journal of Clinical Investigation* 312; Z.M. Zhao *et al.*, "Intraspinal transplantation of CD34+ human umbilical cord blood cells after spinal cord hemisection injury improves functional recovery in adult rats" (2004) 13 *Cell Transplantation* 113.

¹¹N. Ende & R. Chen, "Human umbilical cord blood cells ameliorate Huntington's disease in transgenic mice" (2001) 32 *J Med* 231; M. Sauer, S. Grewal & C. Peters, "Hematopoietic stem cell transplantation for mucopolysaccharidoses and leukodystrophies" (2004) 216 *Klinische Pädiatrie* 163.

¹²S. Kakinuma *et al.*, "Human umbilical cord blood as a source of transplantable hepatic progenitor cells" (2003) 21 *Stem cells* 217.

¹³J.F. Wang *et al.*, "Mesenchymal stem/progenitor cells in human umbilical cord blood as support for ex vivo expansion of CD34(+) hematopoietic stem cells and for chondrogenic differentiation" (2004) 89 *Haematologica* 837.

Cord blood transplants offer a number of advantages over bone marrow stem cell transplants. These include the large donor pool, the immediate availability of the sample once a match is found, the low incidence of transmissible infectious disease, the low incidence of graft versus host disease, and the absence of pain or risk to the donor.

Large donor pool. Since HLA proteins, the proteins which determine whether a given blood sample is a “match” for an individual in need of a HSC transplant, are hereditary, the best way to find a match is to look within a patient’s family or racial group.¹⁴ Existing bone marrow registries consist primarily of Caucasians, thus limiting availability of potential donors for other ethnic groups.¹⁵ Further, bone marrow transplants require a close if not perfect match.¹⁶ It has been reported that only fifty percent of patients are successful in finding an HLA-matched unrelated bone marrow donor,¹⁷ and for those searches which result in bone marrow transplantation, and a median of four months is required to complete the search.¹⁸ In contrast, cord blood has the potential to offer all ethnic and racial groups a better chance at finding a match because the immaturity of UCBSCs permits more liberal HLA matching,¹⁹ and its collection can be performed on a larger and more systematic scale.²⁰

Immediate availability of the sample once a match is found. Because UCB is tested for infectious diseases and cryopreserved before it is found to be compatible for someone in need of a transplant it can be retrieved more easily and rapidly than a bone marrow donor match. This is in contrast to bone marrow, which is removed and tested after it is found to be a match.²¹ In fact, it has been found that the median time to transplantation was four weeks shorter for UCB transplants than for bone marrow transplants.²²

¹⁴ P.G. Beatty, M. Mori & E. Milford, “Impact of racial genetic polymorphism on the probability of finding an HLA-matched donor” (1995) 60 *Transplantation* 778.

¹⁵ National Marrow Donor Program, “NMDP Recruitment Groups”, online:

<http://www.marrow.org/cgi-bin/NETWORK/rec_group.pl> (date accessed: October 26th, 2004).

¹⁶ J.N. Barker *et al.*, “Searching for unrelated donor hematopoietic stem cells: availability and speed of umbilical cord blood versus bone marrow” (2002) 8 *Biology of Blood and Marrow Transplantation* 257.

¹⁷ D.L. Confer, “Unrelated marrow donor registries” (1997) 4 *Current Opinion in Hematology* 408.

¹⁸ C.W. Howe & T. Radde-Stepaniak, “Hematopoietic cell donor registries” in K.G. Blume & S.J. Forman eds., *Hematopoietic Cell Transplantation*, 2nd ed. (Malden: Blackwell Science; 1999) 503.

¹⁹ Y. Cohen & A. Nagler, “Umbilical cord blood transplantation — how when and for whom?” (2004) 18 *Blood Reviews* 167.

²⁰ J.M. Hows, “Status of umbilical cord blood transplantation in the year 2001” (2001) 54 *Journal of Clinical Pathology* 428.

²¹ Canadian Blood Services, “Donor Preparation”, online: <http://www.bloodservices.ca/CentreApps/Internet/UW_V502_MainEngine.nsf/page/Donor+Preparation?OpenDocument> (date accessed: October 26th, 2004).

²² V. Rocha *et al.*, “Comparison of outcomes of unrelated bone marrow and umbilical cord blood transplant in children with acute leukemia” (2001) 97 *Blood* 2957.

Low incidence of transmissible infectious disease. The risk of transmission of infectious diseases such as cytomegalovirus (CMV) and Epstein-Barr virus (EBV), is very low for UCB transplantation.²³ About two thirds of adults in the United States, for instance, have been exposed to CMV. CMV generally remains contained and persists in latent form. In individuals with weakened immune systems, the disease can be virulent.²⁴ EBV, a herpes virus that infects the majority of the human race, generally remains latent. However, for individuals with weakened immune systems, a potentially lethal lymphoma may develop.²⁵ Because CMV affects only about one percent of newborns in the United States,²⁶ and EBV affects essentially none,²⁷ cord blood is less likely than bone marrow to transmit infectious diseases to recipients whose immune systems are weakened, such as those undergoing chemotherapy.

Low incidence of graft versus host disease. Graft versus host disease (GVHD) is a condition which occurs when the transplanted tissue (the graft) attacks the recipient (the host) and causes damage leading to organ failure.²⁸ Transplantation between a donor and recipient with perfectly matched HLA proteins, such as autologous transplantation or transplantation between identical twins, eliminates the possibility of GVHD. The next best possible match would come from a sibling. The higher the degree of mismatch the higher the incidence of GVHD when transplanted.

GVHD is less likely from cord blood donors than from bone marrow donors of equivalent degree of mismatch.²⁹ This is due to the immaturity of the white blood cells in UCB, which are responsible for mounting an immune response.³⁰

Absence of pain or risk to the donor. Harvesting bone marrow cells is a painful and time-consuming procedure for the donor.³¹ There are also risks associ-

²³R. Traineau & L. Dal Cortivo, "Banques de sang de cordon — greffes en situation non-apparentées" (1998) 5 *Transfusion Clinique et Biologique* 56.

²⁴C.A. Janeway *et al.*, *Immunobiology: The immune system in health and disease*, 5th ed. (New York: Garland Publishing, 2001) at 384.

²⁵*Ibid.* at 448-449.

²⁶National Marrow Donor Program, "Patient Fact Sheet on Umbilical Cord Blood Transplantation", online:

<http://www.marrow.org/PATIENT/patient_fact_sheet_umbilical_cord_blood_transplantation.html> (date accessed: October 15th, 2004).

²⁷B. Fields & D. Knipe, eds., *Fundamental Virology*, 2nd ed. (New York: Raven Press, 1991) at 1947.

²⁸J.L. Ferrara & H.J. Deeg, "Graft-versus-host disease" (1991) 324 *New Eng. J. Med.* 667.

²⁹*Supra* note 22; V. Rocha *et al.*, "The Eurocord and International Bone Marrow Transplant Registry Working Committee on Alternative Donor and Stem Cell Sources, Graft-Versus-Host Disease in Children Who Have Received a Cord-Blood or Bone Marrow Transplant from an HLA-Identical Sibling" (2000) 342 *New Eng. J. Med.* 1846;

³⁰S.S. Grewal *et al.*, "Unrelated donor hematopoietic cell transplantation: marrow or umbilical cord blood?" (2003) 101 *Blood* 4233.

³¹N.C. Briggs *et al.*, "On willingness to be a bone marrow donor" (1986) 26 *Transfusion* 324. Bone marrow transplantation requires that the donor stay at the hospital for 2 or 3 days. The donor needs to undergo many tests to ensure that he/she is disease free. The actual harvest of bone marrow is performed

ated with general anaesthetic.³² Collection of UCB, on the other hand, is a painless and non-invasive procedure.³³

There are, however significant limitations to the utility of cord blood transplantation, the most important being the limited number of cells harvested and the increased risk of transmission of genetic diseases.

Limited number of cells. The most significant disadvantage of cord blood as a source of haematopoietic stem cells for clinical transplantation is the low number of HSCs, relative to the number of HSCs harvested from adult bone marrow.³⁴ This limitation results in higher graft failure rates and slower time to engraftment compared to bone marrow transplantation.³⁵ Chances of failure of graft engraftment increase with the weight of a person. The lower number of haematopoietic progenitor stem cells in cord blood compared with bone marrow, as well as the lower volume available, usually limit cord blood transplantation to children or young adults weighing less than 40kg.³⁶ Engraftment of cord blood is slower than that of stem cells derived from bone marrow. It takes bone marrow on average 18 days to engraft, while median engraftment time for cord blood is 26 days.³⁷

A number of methods for overcoming cell dose limitations are currently being investigated, including simultaneous transfusion of two UCB units from different donors, ex vivo expansion of cord blood stem cells, and in vivo stimulation of UCB stem cells using growth factors.³⁸

Transmission of genetic diseases. There is the possibility of transmission of a genetic disease, not detected at the time of cryopreservation and quarantine of cord blood, which may become apparent only as the donor matures. The probability of transmitting a genetic disease is much lower for bone marrow transplantation, as the older the donor the more reliable the donor's medical history is in showing

under general or spinal anaesthesia during which a large needle is inserted into the pelvic bone about 200 times. This procedure will cause the donor to experience soreness in the pelvic region for days to weeks after the collection.

³² L. Massimo, "Ethical problems in bone marrow transplantation in children" (1996) 18 Bone Marrow Transplantation 8.

³³ J.E. Wagner *et al.*, "Successful transplantation of HLA-matched and HLA-mismatched umbilical cord blood from unrelated donors: analysis of engraftment and acute graft-versus-host disease" (1996) 88 Blood. 795; G.J. Annas, "Waste and longing — The legal status of placental-blood banking" (1999) 340 New Eng. J. Med. 1521.

³⁴ *Supra* note 6.

³⁵ *Supra* note 19.

³⁶ Aplastic Anemia & MDS International Foundation Inc., "Acquired Aplastic Anemia: Basic Explanations", online: <<http://www.aplastic.org/pdfs/ACQUIRED-APLASTIC-ANEMIA-BASIC-EXPLANATIONS.pdf>> (date accessed: October 26th, 2004).

³⁷ R.C. Wadlow & D.L. Porter, "Umbilical cord blood transplantation: where do we stand?" (2002) 8 Biology of Blood and Marrow Transplantation 637.

³⁸ *Supra* note 19.

an absence of inherited mutations.³⁹ An adult marrow donor who has been diagnosed with a genetic disease can easily be excluded from donating marrow.⁴⁰

Although there are clear benefits to UCB transplantation, ethical and legal questions remain. Many issues relating to transplantation of UCB arise because, unlike bone marrow, which remains in the body of the potential donor until it is needed for transplantation, UCB must be stored. Both the public and the private sectors have undertaken storage.

Public banks seek to serve a given community's needs in terms of allogeneic HSC transplants. They have been set up in many countries, including Canada,⁴¹ Finland,⁴² Italy,⁴³ and the United States.⁴⁴ There has also been movement to set up international registries to aid people worldwide who are in need of transplants.⁴⁵

Private banks charge parents a fee to store their newborn's cord blood exclusively for uses the parents choose: usually, in case the newborn or any of its siblings ever need an HSC transplant.

In the following section, we will be analyzing some of the issues and concerns which have surfaced as a result of private and public banking activities.

II. Public and Private banks: Ethical and Legal Quandaries

The issues raised by the possibility of banking UCB must be addressed. The legitimacy of private banks should not be taken as a given. If a country does consciously decide to allow them, legislation or regulations are needed to prevent potential abusive practices. Determining the status of the umbilical cord blood is important to establish who has rights over stem cells derived from cord blood.

³⁹K. McMilin, "Allogeneic hematopoietic stem cell transplantation and the risk for transmission of heritable malignancy" (2002) 42 *Transfusion* 495.

⁴⁰Satkiran S. Grewal *et al.*, "Unrelated Donor Hematopoietic Cell Transplantation: Marrow or Umbilical Cord Blood?" (2003) 101:11 *Blood* 4233.

⁴¹Alberta Cord Blood Bank, online: <www.acbb.ca> (date accessed: October 26th, 2004); Héma-Québec, online: <http://www.hema-quebec.qc.ca/F/presse/com170604_01.htm> (date accessed: October 26th, 2004).

⁴²European Haemovigilance Network, "Blood centres and mobile units", online: <http://www.ehn-org.net/national_menus/finland_pages/finland_page2.asp> (date accessed: October 26th, 2004).

⁴³Milano Cord Blood Bank, online: <<http://www.milancord.org/>> (date accessed: October 26th, 2004).

⁴⁴See e.g. UCLA Umbilical Cord Blood Bank, online: <<http://www.cordblood.med.ucla.edu/>> (date accessed: October 26th, 2004). In the United States, a Bill entitled "Cord Blood Stem Cell Act of 2003" was introduced in the House of Representatives. If enacted, the Bill would establish a national cord blood stem cell bank network to prepare, store and distribute human umbilical cord blood stem cells for the treatment of patients and to support peer-reviewed research using such cells.

⁴⁵See e.g. Bone Marrow Donors Worldwide, online: <<http://www.bmdw.org/>> (date accessed: October 26th, 2004).

Adequate safety measures must also be provided to guarantee product safety. Finally, donor solicitation and advertising methods require oversight to ensure that prospective parents receive accurate and balanced information before deciding what to do with their newborn's cord blood.

a) The Legitimacy of Private Banks for Autologous Use

The value of private cord blood banks is debatable, and these banks have received significant criticisms from both a therapeutic and ethical standpoint.

First of all, current clinical uses of UCB are rather limited. Estimates of the probability of autologous use of UCB in a family with no history of blood disease are approximately 1 in 20 000 for the first 18 years of life.⁴⁶ Also, it is not known whether cord blood stem cells remain viable after fifteen years of storage.⁴⁷ Furthermore, for cancers of the blood, relapse is more common after autologous transplants.⁴⁸ Finally, autologous cord blood grafts are not recommended for inherited disorders as the banked UCB carries the same mutation and would therefore not cure the patient.⁴⁹

Moreover, private storage for autologous use costs anywhere from \$300 to \$1,650 US, plus an annual storage fee of \$75 to \$125,⁵⁰ a prohibitive amount for many expectant parents. It has been suggested that autologous cord blood banks represent a discriminatory practice based on wealth, are an impediment to societal solidarity, and jeopardize justice and equity.⁵¹

There are two main criticisms, then, of private banking for autologous use. The first relates to its lack of scientific utility. This position is evident in policy

⁴⁶ American College of Obstetricians and Gynecologists, "Routine storage of umbilical cord blood for potential future transplantation" (1997) 58 *International Journal of Gynaecology and Obstetrics* 257; G.R. Burgio & F. Locatelli, "Transplant of bone marrow and cord blood hematopoietic stem cells in pediatric practice, revisited according to the fundamental principles of bioethics" (1997) 19 *Bone Marrow Transplantation* 1163; Annas, *supra* note 33.

⁴⁷ H.E. Broxmeyer *et al.*, "High-efficiency recovery of functional hematopoietic progenitor and stem cells from human cord blood cryopreserved for 15 years." (2003) 100 *Publications of the National Academy of Sciences* 645, online: <www.pnas.org/cgi/doi/10.1073/pnas.0237086100> (date accessed: October 26th, 2004).

⁴⁸ J.E. Talmadge, "Hematopoietic stem cell graft manipulation as a mechanism of immunotherapy" (2003) 3 *International Immunopharmacology* 1121; *Supra* note 6; France, National Consultative Bioethics Committee. *Umbilical cord blood banks for autologous use or for research*. Opinion No. 74, December 2002; online: Comité Consultatif National d'Ethique pour les sciences de la vie et de la santé <http://www.ccne-ethique.fr/english/avis/a_074.htm> (date accessed, October 27th, 2004).

⁴⁹ *Supra* note 7; European Group on Ethics in Science and New Technologies (EGE), *Opinion no. 19 — Umbilical cord blood banking*. (Brussels, 2004) at 2.1, online: <http://europa.eu.int/comm/european_group_ethics/docs/avis19_en.pdf> (date accessed: October 27th, 2004);

⁵⁰ F. Verter, "Summary of company features and pricing" online: <<http://www.parentsguidecordblood.com/summary.html>> (date accessed: October 26th, 2004).

⁵¹ France, *supra* note 48.

documents, which would consider revising their position regarding private storage if the therapeutic uses of autologous cord blood increased through scientific progress.⁵² The second concerns the societal inequities that result from private banking operations, which are evident in documents such as Opinion 19 of the European Group on Ethics in Science and New Technologies.⁵³ This criticism leads to the conclusion not only that public banks currently be encouraged to ensure fair access to healthcare services for all (2.9, 2.10), but also that should science evolve to the point where the use of one's own cord blood cells may be of significant therapeutic value, the public sector should take over the responsibility of storage to maintain fair access to healthcare services for all (2.11).

In contrast, public banks provide transplant material to all who need it, including ethnic and racial minority groups.⁵⁴ Further, public registries give all individuals worldwide equitable access to stored UCB, regardless of the financial means of parents to afford costly storage fees, or of countries to set up and maintain their own public banks.

This having been said, Italy is the only European country to have legislated against the creation of private umbilical cord banks. Based on the belief that therapies using stem cells from umbilical cord blood are still under study, the Ministry of Health published several ordinances regarding cord blood in the official government announcements in February 2003. The ordinances state that cord blood banking is authorized only as a public conservation structure; that private banking is forbidden; that each bank is subject to approval by the regional government of its locality; and, that the Ministry of Health must authorize the import or export of cord blood.⁵⁵ Belgium is following suit: two draft laws are under discussion at the Belgian Parliament; both of which propose to ban private banking.⁵⁶ Even though there are no laws explicitly forbidding private cord blood banks in France, such banks seem to be in contradiction with the rules set by the Code of public health (art. L1243-1). Indeed, there are currently no private cord blood banks operating in France.

⁵² See e.g. *Ibid.*

⁵³ EGE, *supra* note 49

⁵⁴ *Supra* note 20.

⁵⁵ Italy, Ordinance of December 30th, 2002, online: <<http://www.cittadinolex.kataweb.it/Article/0,1519,22470|99,00.html>> (date accessed: October 26th, 2004).

⁵⁶ A draft bill submitted on March 13th, 2001 aims to prohibit this type of bank. Due to the fact that the particular status of umbilical cord blood is not defined in the law on blood and derivatives of human blood, a new article is needed for the creation of an exception to that law. Article 6 of the same law stipulates that the Minister sets the price at which blood and blood derivatives are used and delivered in order to exclude any kind of profitable activity. This draft bill has yet to be voted upon.

Many organizations and professional associations, located in Europe,⁵⁷ the UK,⁵⁸ France,⁵⁹ and even the U.S,⁶⁰ do not endorse private banks. If a country decides to allow private banking, it is of the utmost importance to adequately regulate the industry in all areas.

Two areas that call for proper regulation are: safety measures, and donor solicitation. But before embarking on these issues, let us first examine why it is important to define the status cord blood stem cells.

b) Status of the Umbilical Cord Blood: Classification and its Consequences

In many countries, the status of UCB, and as a result the applicable legislation, regulations and guidelines are confused and unclear. Historically, the umbilical cord was classified as “waste.” However, this classification is no longer appropriate, as we now know that UCBSs have therapeutic and research uses. Treating it as we do a waste product is not ethically acceptable, as this would negate the requirement of obtaining consent for its collection and use.⁶¹ That said, its legal status is still that of waste in certain jurisdictions.⁶²

Often, it is categorized as tissue,⁶³ but this classification is not without its difficulties. For example, the Human Tissue Act of 1983 in New South Wales

⁵⁷ EGE, *supra* note 49.

⁵⁸ Royal College of Obstetricians and Gynaecologists — Scientific Advisory Committee (RCOG), *Umbilical Cord Blood Banking*. Opinion paper no. 2, London, 2001, online: <<http://www.rcog.org.uk/mainpages.asp?PageID=430>> (date accessed: October 27th, 2004); Leukemia Research Fund, “Cord blood banking in the UK”, online: <<http://www.lrf.org.uk/en/1/discbbstd.html>> (date accessed: October 27th, 2004).

⁵⁹ France, *supra* note 48; Académie Nationale de Médecine, *Les banques de sang de cordon autologue*, Rapport au nom de la Commission I (Biologie — Immunologie — Génétique), Paris, 2002, online: <http://www.academie-medecine.fr/upload/base/rapports_114_fichier_lie.rtf> (date accessed: October 27th, 2004).

⁶⁰ American Academy of Pediatrics (AAP). Work Group on Cord Blood Banking, “Cord blood banking for potential future transplantation: subject review” (1999) 104 *Pediatrics* 116.

⁶¹ D. Vawter *et al.*, “A phased consent policy for cord blood donation” (2002) 42 *Transfusion* 1268.

⁶² Académie Nationale de Médecine, *supra* note 59.

⁶³ EC, Directive of 2004/23/EC of the European Parliament and of the Council of 31 March 2004 on setting the standards of quality and safety for the donation, procurement, testing, processing, preservation, storage and distribution of human tissues and cells, [2004] O.J.L 102/48, online: <http://europa.eu.int/eur-lex/pri/en/oj/dat/2004/l_102/l_10220040407en00480058.pdf> (date accessed: October 27th, 2004); Council of Europe, *Additional Protocol to the Convention on Human Rights and Biomedicine concerning Transplantation of Organs and Tissues of Human Origin*, European Treaty Series, No. 186 (2002) at 2.2, online: <<http://conventions.coe.int/Treaty/en/Treaties/Word/186.doc>> (date accessed: October 27th, 2004); Canada, Standing Committee on Health, *Organ and Tissue Donation and transplantation: A Canadian Approach*, Ottawa, 1999 (Chair: Joseph Volpe), online: <<http://www.parl.gc.ca/InfoComDoc/36/1/HEAL/Studies/Reports/healrp05-e.htm#toc>> (date accessed: October 27th, 2004). Canadian Standards Association, Health Products and Food Branch, *Guidance Document — Basic Safety Requirements for Human Cells, Tissues and Organs for Transplantation*, Ottawa, 2003, online: <http://www.hc-sc.gc.ca/hpfb-dgpsa/bgtd-dpbtg/cto_guidance_doc_e.pdf> (date

(Australia) explicitly states that “tissue” includes blood;⁶⁴ however, this was not intended to cover UCB, as it was not yet widely known in 1983 that UCB had therapeutic uses. An April 2002 “Review of the Human Tissue Act 1983 Report” of NSW Health suggests that regulating cord blood donation fits better under organ and tissue donations, and not within the area of blood donations.⁶⁵ The Review ultimately concludes that “the status of [cord blood], and rights which can be exercised over [it], are unclear at law.”⁶⁶ Despite the non-requirement under the Human Tissue Act to obtain the mother’s consent to removal of cord blood, the Review states that there are strong ethical and legal reasons for obtaining consent.⁶⁷

Another interesting example is the United States, where the Code of Federal Regulations explicitly provides that umbilical cord blood is included in the definition of human cells, tissues, or cellular or tissue-based products (HCT/Ps).⁶⁸ If minimally manipulated and intended for homologous use, as is UCB stored for autologous use, HCT/Ps are regulated under section 361 of the *Public Health Services Act*,⁶⁹ and must be registered with the FDA. In contrast, umbilical cord blood from unrelated allogeneic donors falls under the biological product category, and is treated like a drug.⁷⁰ Consequently, public banks that store UCB for allogeneic use are subject to either an appropriate biologics licence application, or an Investigational New Drug (IND) exemption.⁷¹ Regulatory burdens were made less stringent on cord blood intended for autologous use because risk of disease transmission is minimal.

A third approach is that taken by France, where UCB is governed by the “Arrêté du 16 décembre 1998 portant homologation des règles de bonnes pratiques relative au prélèvement, au transport, à la transformation, y compris la conservation, des cellules souches hématopoïétiques issues du corps humain et des cellules mononucléées sanguines utilisées à des fins thérapeutiques.”⁷² The document states

accessed: October 27th, 2004); U.K., Department of Health, *A Code of Practice for Tissue Banks Providing Tissues of Human Origin for Therapeutic Purposes* (London: Department of Health, 2001), online: <<http://www.dh.gov.uk/assetRoot/04/03/42/63/04034263.pdf>> (date accessed: October 27th, 2004).

⁶⁴ *Human Tissue Act 1983* (N.S.W.) s. (2A)(aa).

⁶⁵ Austl., N.S.W., New South Wales Health, *Review of the Human Tissue Act 1983 — Blood Donation and the Supply of Blood and Blood Products*, (Report), 2002, at 11. Online:

<<http://www.health.nsw.gov.au/csd/llsb/legislation/BloodReport.pdf>> (date accessed: October 27th, 2004).

⁶⁶ *Ibid.* at 12.

⁶⁷ *Ibid.*

⁶⁸ 21 C.F.R. § 1271 (2002); US Food and Drug Administration, “Questions and Answers for Roll-Out of Donor Eligibility Final Rule and Draft Guidance”, online:

<<http://www.fda.gov/cber/rules/suitdonorq&a.htm>> (date accessed: October 27th, 2004).

⁶⁹ *Public Health Services Act*, 42 U.S.C. § 264 (1999).

⁷⁰ U.S., Food and Drug Administration, *Draft Document Concerning Regulation of Placental/Umbilical Cord Blood Stem Cell Products for Transplantation or Further Manufacture Into Injectable Products*, (S. Doc. No. 96N-0002) (Rockville, MD: Food and Drug Administration, 1995).

⁷¹ *Supra* note 69.

⁷² *Arrêté du 16 décembre 1998 portant homologation des règles de bonnes pratiques relatives au*

very clearly that it applies to umbilical cord blood: “Les présentes règles de bonnes pratiques s’appliquent à tous les cellules souches hématopoïétiques issues du corps humain quelle que soit leur origine... [et] quel que soit le statut juridique du produit cellulaire final.”⁷³ (Author’s translation: these best practice rules apply to all haematopoietic stem cells originating from the human body, regardless of their origin and regardless of the legal status of the final cellular product) There is a complete section dealing specifically with umbilical cord stem cells.

The classification is not without significant consequences, even beyond the determination of which legislative documents apply. For example, in the US context, it appears that if a court were to treat UCB as it does peripheral blood, and the sale of UCB as the provision of a service, UCB would likely be exempted from tort liability in cases where injuries were caused by a defective unit. However, if a court treats UCB as an organ or tissue, a bank which provides a defective unit is more likely to be held liable.⁷⁴

Clarifying the status of UCB is important also with regards to ownership. What happens to the stored blood sample if the parents can no longer pay the annual fee? What happens if the company declares bankruptcy? Can children hold their parents liable for choosing not to store their cord blood? Providing answers to the above questions will require determining which property rights exist with respect to UCB, and to whom those rights can be attributed.

It is generally uncommon that human body, organs, blood and tissues be subject to proprietary rights. However, since it seems that there are limited property rights over UCB,⁷⁵ the matter must be addressed, and interested parties must know their legal rights and obligations with respect to banking, using, buying or selling cord blood.

Many private banks use property language, for example, holding that “Client agrees to be the custodian of the cord blood cells until the child reaches the age of 18 years, whereupon the child will have ownership claims to the cord blood cells.”⁷⁶ Ironically, this same private bank holds that

In the event that client fails to pay any required fees within thirty days of the payment due date, [we] may in [our] absolute and unfettered

prélèvement, au transport, à la transformation, y compris la conservation, des cellules souches hématopoïétiques issues du corps humain et des cellules mononucléées sanguines utilisées à des fins thérapeutiques, J.O., 30 December 1998, 19824.

⁷³ *Ibid.*

⁷⁴ S. R. Munzer & F. O. Smith, “Limited property rights in umbilical cord blood for transplantation and research” (2001) 23 *Journal of Pediatric Hematology/Oncology* 203.

⁷⁵ *Ibid.*

⁷⁶ Stemciences Inc, “Client Services Agreement and Acknowledgement to store cord blood”, online: <<http://www.stemciences.com/EN%20%20REG%20FORM%20JAN2004.pdf>> (date accessed: October 27th, 2004).

discretion, terminate this agreement... Upon termination of this agreement for non-payment, all rights to the cord blood cell deposit will be retained by [us] and there will remain no further obligations between the client and [us].⁷⁷

Presumably, the bank wishes to be able to sell the unit. This is not the case with all private banks; some discard the unit upon termination of the agreement for non-payment.⁷⁸ Still, other private banks reserve the right to “cede and assign its rights and obligations under this agreement to a third party after prior written notice in writing to the guardian.”⁷⁹

c) Adequate Safety Measures

Centralized, reliable regulation of private cord blood banks is variable between countries. For example, the Canadian Standards Association recently formalized Health Canada’s Draft Canadian General Standard on the Safety of Cells, Tissues and Organs intended for Transplantation, and the subset standard for haematopoietic stem cells.⁸⁰ The proposed regulations will fall under Canada’s new health protection legislation intended to replace the *Food and Drugs Act*.⁸¹ Minimum safety requirements for acceptable performance with respect to donor selection, cell collection, processing, packaging, testing, labelling, storage, recall, record keeping, adverse event reporting and traceback are anticipated.

In January 2003, Health Canada released a directive to advise all establishments and individuals handling and/or processing human cells, tissues and organs of the importance of adhering to the basic standards of safety with respect to the manufacture and use of these products for transplantation.⁸² The directive is an interim measure to ensure that safety standards are met prior to the final implementation of the new regulatory framework, intended for 2005. However, neither the directive nor the proposed regulations apply to UCBSs that have been banked for autologous use. They thus exclude private banks from the scope of their application.⁸³

⁷⁷ *Ibid.*

⁷⁸ See e.g. California Cryobank Stem Cell Services Inc, online: <<http://www.mycordblood.com>> (date accessed: October 10th, 2004) [on file with the author].

⁷⁹ As described on the Cryoclinic UK Limited private cells bank consent form which is not available on the website but can be requested directly from the bank.

⁸⁰ Canadian Standards Association, *supra* note 63.

⁸¹ See: Health Canada, “Health and Safety First: A Proposal to Renew Federal Health Protection Legislation”, online: <[⁸² Health Canada, *Directive — Technical Requirements to address the Safety of Cells, Tissues and Organs for Transplantation*, \(Ottawa, 2003\), online: <\[http://www.hc-sc.gc.ca/hpfb-dgpsa/bgt-dpbtg/cto_directive_e.html\]\(http://www.hc-sc.gc.ca/hpfb-dgpsa/bgt-dpbtg/cto_directive_e.html\)> \(date accessed: October 27th, 2004\).](http://www2.itssti.hc-sc.gc.ca/HPCB/Policy/LegislativeRenewal.nsf/0/ED5B120DED25284B85256D3B006FFD76?OpenDocument&L=E&#Section4.2.>.</p>
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⁸³ *Ibid.*

In the United States, certain states require that cord blood banks be licensed in order to operate within the State. For example, the New York State Council on Human Blood and Transfusion Services Hematopoietic Progenitor Cell Committee's guidelines for UCB banking stipulate good practice techniques for donor evaluation, cord blood collection and processing procedures, and release of UCBSs.⁸⁴

All countries in the European Union will have to comply with the EU Tissue Directive by 2006.⁸⁵ This Directive sets standards for the donation, procurement, testing, processing, preservation, storage and distribution of human tissues and cells across the E.U.⁸⁶ Although there is no specific mention of commercial private cord blood banks, the Directive provides that commercial establishments may be accredited as cell and tissue establishments as if they comply with the standards.

In jurisdictions without mandatory licensing, there is the possibility of voluntarily seeking accreditation from non-governmental organizations which have created an accreditation system. Netcord, for instance, together with the Foundation for Accreditation of Cellular Therapy (FACT) (formerly the Foundation for Accreditation of Haematopoietic Cell Therapy) has developed a detailed set of standards for cord blood banking that are meant to facilitate exchange of cord blood among the various banks and ensure product quality.⁸⁷ These are the most widely followed cord blood banking guidelines in the world, and cord blood registries participating in Bone Marrow Donors Worldwide (BMDW) are expected to adhere to the Netcord/FACT standards.⁸⁸

The American Association of Blood Banks has also published standards for haematopoietic progenitor cells. The AABB accreditation procedure is rigorous; it involves a review and inspection of the bank's laboratory and administrative procedures to compliance with AABB's standards. Many private cord blood banks in the US are AABB accredited. The problem with voluntary standards relates not to their rigour or adequacy as standards, but to their voluntary nature. If the only standards regulating an industry are optional the public is not sufficiently protected, as there is nothing to prevent an unaccredited and unacceptable bank from entering the market.

⁸⁴New York State Council on Human Blood and Transfusion Services Hematopoietic Progenitor Cell Committee, Subcommittee on Cord Blood Stem Cells Guidelines, *Guideline for Collection, Processing and Storage of Cord Blood Stem Cells*, 1997, section I-A, online: <http://www.wadsworth.org/labcert/blood_tissue/cord.htm> (date accessed: October 27th, 2004).

⁸⁵EC, *supra* note 63 at 31(1).

⁸⁶*Ibid.* at 1.

⁸⁷Foundation for the Accreditation of Hematopoietic Cell Therapy/Netcord, *Standards for hematopoietic cell collection, processing and transplantation*, 2nd ed. (Omaha, NE: FACHT Accreditation Office, University of Nebraska Medical Center, 2001).

⁸⁸See: Bone Marrow Donors Worldwide, "Memorandum of Understanding with stem cell donor registries", online: <<http://www.bmdw.org/RegInfo/Memorandum.pdf>> (date accessed: October 27th, 2004).

d) Solicitation

Ensuring the provision by private banks of accurate information to expectant parents in the process of advertising and solicitation is another area needing increased oversight. Portraying private storage as a “once in a lifetime opportunity,”⁸⁹ stating their commitment “to help parents realize their dreams of raising healthy children,”⁹⁰ and presenting extremely long lists of “conditions currently being treated with stem cells” including breast cancer, heart attacks and strokes,⁹¹ private companies tend to over-represent the probability of an individual or family member needing a transplant.⁹² They tend also to emphasize the rapidity of progress in the area of stem cell research, claiming that “the list of diseases treated with stem cells is growing daily.”⁹³

That genetic diseases cannot be cured by an autologous transplant is not commonly mentioned. Private companies also frequently fail to make a distinction between umbilical cord stem cells and other types of stem cells (e.g. embryonic) when discussing the uses of stem cells.

Not surprisingly, private companies do not want to be legally bound by their marketing claims: “we make no assurance or guarantee about the effectiveness of preservation nor the benefits or utility derived from cord blood” is a common refrain in their consent forms.⁹⁴

A recent issue of *Maclean's* magazine stated, “umbilical cord blood [can] fight off leukemia or ... genetic disorder[s] [and] scientists are on the brink of a host of new applications — such as using stem cells to repair heart tissue or to create insulin in diabetics ... [Private storage of umbilical cord blood is] an extra insurance cost for those first, already expensive childhood years, but one that could well be worth the premium.”⁹⁵ If a reputable and respected news magazine has been

⁸⁹ See: Cells for Life, online: <<http://www.cellsforlife.com/>> and California Cryobank Stem Cell Services Inc, “Cord Blood Banking”, online: <<http://www.mycordblood.com/cordbloodbanking.html>> (date accessed: October 27th, 2004).

⁹⁰ See: California Cryobank Stem Cell Services Inc, “About Us”, online: <<http://www.mycordblood.com/aboutus.html>> (date accessed: October 27th, 2004).

⁹¹ See: Cord Blood Bank of Canada, “Medical Uses”, online: <<http://www.cordbloodbankofcanada.com/diseases1.htm>> (date accessed: October 27th, 2004).

⁹² “The odds that a child will need to use his or her own stem cells by age twenty-one for current treatments are about 1:2,700, and the odds that a family member would need to use those cells are about 1:1,400”. See: Baby Chord, “Cryogenic Cord Blood Stem Cell Storage”, online: <<http://www.babychord.com>> (date accessed: October 27th, 2004).

⁹³ *Supra* note 91.

⁹⁴ See SecuraCell Inc, Client agreement, online: <<http://www.securacell.com/enroll1.asp>> (date accessed: October 27th, 2004).

⁹⁵ K. Marley, “Umbilical cord — Genetic Insurance” *Maclean's* (6 September 2004) 81, online: http://www.macleans.ca/topstories/health/article.jsp?content=20040906_87993_87993# (date accessed: October 27th, 2004).

misinformed by the information provided by the private industry, how can we expect soon-to-be parents, who are in a vulnerable phase wanting to do everything for their child, to be able to piece together a balanced and accurate picture?

e) **The Blurring of the Public/Private Allogeneic/Autologous Boundary**

Apart from public registries and private banks that store for autologous use, a new type of private bank is starting to emerge in the US. Some cord blood storage facilities store cord blood from mothers/parents who wish to donate their child's UCB, but who do not have the option of donating to a public bank. The donation is made at no cost to the donating mother/parents and later sold to individuals in need of stem cell transplants or to research companies at more than \$15 000 (USD) per unit. These commercial transactions of UCB are unregulated in the United States,⁹⁶ and the only circumstances in which such transactions can be proscribed occur when the post-sale use of the UCB is illegal.

For example, US research laws mandate that prior FDA approval is required for experiments on humans.⁹⁷ When Dr. Mitchell Ghen, an osteopath, began offering highly experimental and expensive stem cell transfusions to patients with Lou Gehrig's disease without having obtained the necessary approval, the FDA made Cryobanks International Inc., the private bank which was supplying the doctor with UCBSCs, stop shipment to him.⁹⁸ Interestingly, Cryobanks markets this as a "public bank."⁹⁹ Also noteworthy is a new State law in Illinois, which requires that pregnant women be asked if they would like to "donate" their child's UCB to a publicly accessible cord blood bank.¹⁰⁰ Most of the donations, however, go to Cryobank International's "public" bank.¹⁰¹

The Council of Europe's *Additional Protocol to the Convention on Human Rights and Biomedicine Concerning Transplantation of Organs and Tissues of Human Origin* explicitly forbids this type of private banking by stating that the human body and its parts, such as human umbilical cord blood, should not give rise

⁹⁶ K. Hundley, "Mining medical waste" *St. Petersburg Times* (12 May 2003), online: *St. Petersburg Times* <http://www.sptimes.com/2003/05/12/Business/Mining_medical_waste.shtml> (date accessed: October 27th, 2004).

⁹⁷ 45 C.F.R. § 46 (2001).

⁹⁸ *Supra* note 96.

⁹⁹ Cryobanks International, "Public Cord Blood Donation", online: <<http://www.cryo-intl.com/cordblooddonation.html>> (date accessed: October 27th, 2004).

¹⁰⁰ *An Act in relation to health*, Pub. L. No. 93-0566, (2004), online: <<http://www.ilga.gov/legislation/publicacts/93/093-0566.htm>> (date accessed: January 24, 2005).

¹⁰¹ A. Thon, "Illinois seeks donations of umbilical-cord blood" *The Dispatch* (10 October 2004), online: *The Dispatch* <<http://64.4.171.250/archives/qco/sections.cgi?prcss=display&id=214814>> (date accessed: October 27th, 2004).

to financial gain. It also states that advertising the need or availability of organs or tissues (including UCBSC units), with a view of offering or seeking financial gain or comparable advantage, should be prohibited.¹⁰²

Another blurring of the traditional public/private boundary is occurring with the possibility of designated donations for family members in need of a stem cell transplant. The practice is approved by many organisations and professional associations, including many who do not support private banking.¹⁰³ In fact, this option is available in public cord blood banks in Australia,¹⁰⁴ France,¹⁰⁵ and Canada,¹⁰⁶ among others. As the need for stem cells has already materialized, there is no trade-off to society by allowing the directed donation. The UCB unit will not be stored for the exclusive use of someone who will likely never need it, thereby depriving someone else of its use.

Nevertheless, the possibility of allowing directed donations in the context of a public bank raises the issue of exactly how far to go in terms of directed storage. An interesting case arose in Italy, where a couple, both heterozygous for the thalassaemia gene, stored the cord blood of their first child (who was not homozygous for thalassaemia) in a public cord bank; this was done in case they later gave birth to a child who was homozygous for the disease.¹⁰⁷ Given that any future child would have a 25% chance of being homozygous for thalassaemia and a 25% chance of being a tissue match with their older sibling, there is a 6.25% chance for any future child of this couple needing the stored umbilical cord blood.¹⁰⁸ Of course, it must be recalled that private storage is forbidden by law in Italy; these parents did not have the option of storing the UCB at their own expense.

Conclusion

We have attempted to establish throughout this essay that the collection and banking of UCB, whether in private or public facilities, raises a number of legal dilemmas. The ownership of the umbilical cord blood is undoubtedly the single

¹⁰² Council of Europe, *supra* note 63 at 2.2.

¹⁰³ RCOG, *supra* note 58; Leukemia Research Fund, *supra* note 58; Académie Nationale de Médecine, *supra* note 59; *Supra* note 60; See also EGE, *supra* note 49 and France, *supra* note 48.

¹⁰⁴ Australian Cord Blood Bank, "Sydney Cord Blood Bank", online: <<http://www.sch.edu.au/departments/acbb>> (date accessed: October 27th, 2004).

¹⁰⁵ France, *supra* note 48.

¹⁰⁶ The Alberta Cord Blood Bank offer family storage if a brother or sister of the donor has a disease potentially treatable by cord blood transplantation. Nevertheless, this provision applies only to siblings; it does not apply to parents or other family members. In addition, the request must be supported by documentation from a doctor specializing in blood diseases or cancer. Online: Alberta Cord Blood Bank <<http://www.acbb.ca/ACBBmain.htm>> (date accessed: October 27th, 2004).

¹⁰⁷ F. Locatelli & G. R. Burgio, "Ethics of placental blood collection and storage" (2002) 360 *The Lancet* 1335.

¹⁰⁸ *Ibid.*

most important legal question that needs to be addressed. Indeed, from the moment it is collected and stored to the time it is used for research or sold to third parties, determining who owns the cord blood will help us understand who holds valid title upon it, and accordingly is entitled to consent to its use.

The discovery of the therapeutic potentials of UCB has created an impetus to store UCB units, previously discarded as medical waste. Currently, over 70 000 cord blood units are available worldwide, and over 2000 patients, mostly children but also adults, have been treated with UCBSC transplants.¹⁰⁹ While the current clinical uses of UCB are limited to blood-related disorders in the context of allogeneic transplants, and to non-genetic blood disorders in the context of autologous transplants, it is impossible to know what the therapeutic uses of UCB will be ten years from now. Whether an increased number of uses from UCB units legitimizes private banks depends on whether the initial criticism of them is based on their current limited scientific use in the autologous context, or on concerns for equity and equality. These latter concerns also significantly impact how one envisages the role of public banks.

Public banks, by their very nature, aim to serve society as a whole above any particular individual in it. This is evidenced by the policy of many public banks to collect umbilical cord blood only at a select and “representative” sampling of hospitals. For example, the newly created Quebec public cord blood bank collects only from CHU Mère-enfant, Sainte-Justine and St. Mary’s hospitals — a small fraction of the Quebec hospitals in which babies are born.¹¹⁰ Accordingly, it cannot be guaranteed that if an individual donates a cord blood sample to a public bank that the sample will be available to that individual, related child or other blood relative if needed. In addition, there may be no public bank that is readily accessible to receive such a donation.

The only exception is, of course, if you qualify for a “directed donation”, as discussed earlier. Some may consider this reason enough to legitimate the existence of private banks: they prevent valuable UCB units from being thrown away. However, from a societal perspective, storage for the exclusive benefit of an individual who will probably never need that sample is hardly putting the UCB to its best use.

Ultimately, it is important that the public be kept informed about the merits and the shortcomings of public and private banking and not be subject to unethical recruitment procedures. Scientific advances in the medical sciences are meant to improve the health of humankind. As with all medical treatments, there are tradeoffs

¹⁰⁹ *Supra* note 2.

¹¹⁰ Héma-Québec, “Héma-Québec annonce le lancement officiel de la Banque publique de sang de cordon pour le Québec”, online: <http://www.hema-quebec.qc.ca/F/presse/com170604_01.htm> (date accessed: October 27th, 2004).

involved in the choice of how to structure a system of UCB banking. The positions of individuals and groups may vary as to how a balance should be struck, but one thing is clear: it is not in the interest of anyone for regulatory shortcomings to hamper potential benefits of medical progress.