OSSIUM HEALTH

Deceased Donor Bone Marrow for Advanced Cellular Therapies and Emergency Medicine

HRSA | Advisory Council on Blood Stem Cell Transplantation
27 April 2020

OSSIUM HEALTH

Ossium Delegation

Kevin Caldwell, Esq.
Co-founder, President & CEO

- Sr. Investment Associate, Bridgewater Associates
- Engagement Manager, McKinsey & Co.
- Research Associate, NERA Economic Consulting
- Alumnus of MIT and Harvard Law School

Dr. Erik Woods
Co-founder & Chief Science Officer

- Former Lead Scientist and SVP of Cook Regentec
- Co-founded General BioTech, Genesis Cord Blood Bank
- Former President, Society for Cryobiology

Dr. Brian Johnstone
VP of Research & Development

- Co-Founder NeuroFX (now Thermatome Bio), and Chemigen
- Director, Cardiovascular Ischemia and Vasculogenesis Core, Indiana Clinical and Translational Sciences Institute

Dr. Matthew Metz
Director, Strategic Partnerships

- Founder, Stratagem Insights
- USAID, CUBRC, BARDA, DuPont, Achaogen
- 17 years leading R&D partnerships in public and private sectors


Six decades of medical history...
bone marrow transplants
performed over 1,000,000 times around the world


125,000 patients per year could be treated by bone marrow transplant

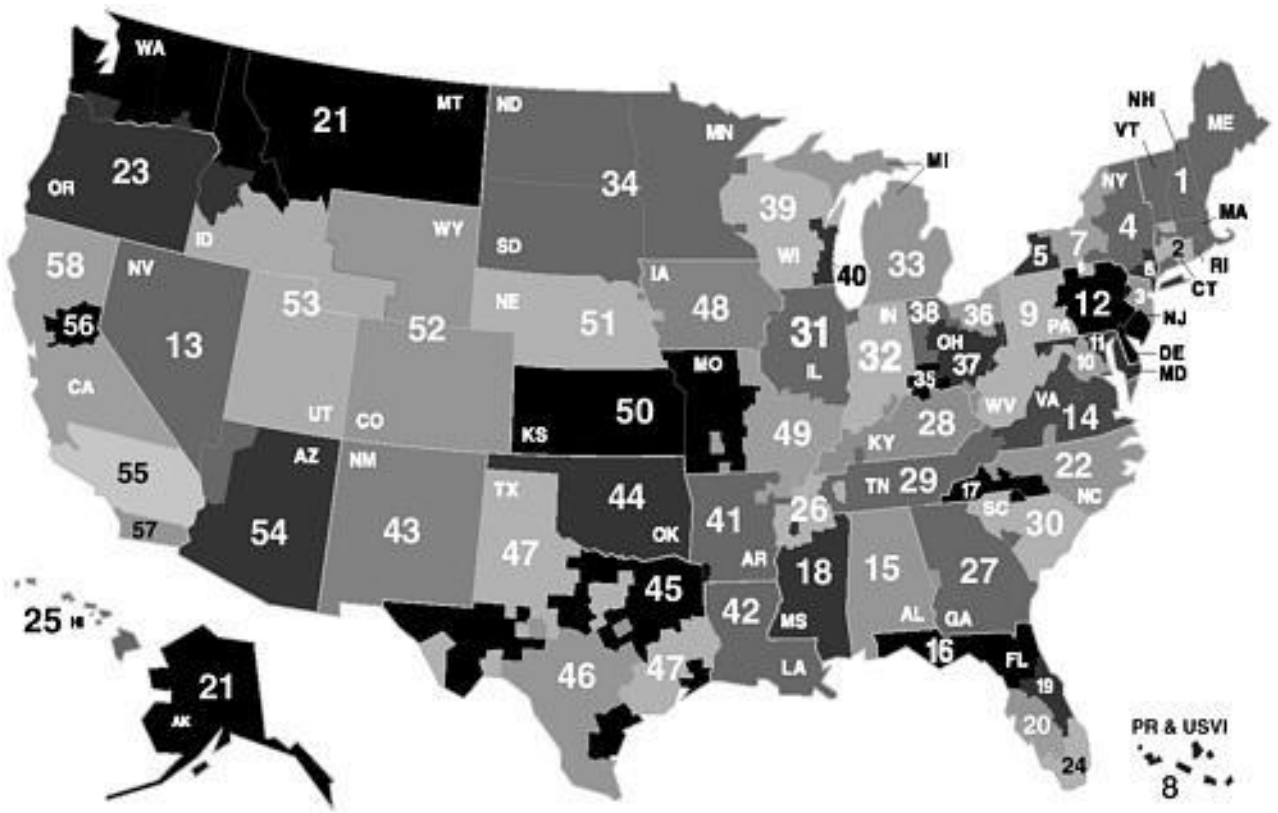

Fewer than 10,000 allogeneic bone marrow transplants are performed each year

OSSIUM BUSINESS MODEL

~40,000

deceased organ and tissue donors in the US each year

58 publicly-regulated, nonprofit Organ Procurement Organizations operate distinct US territories to manage donation



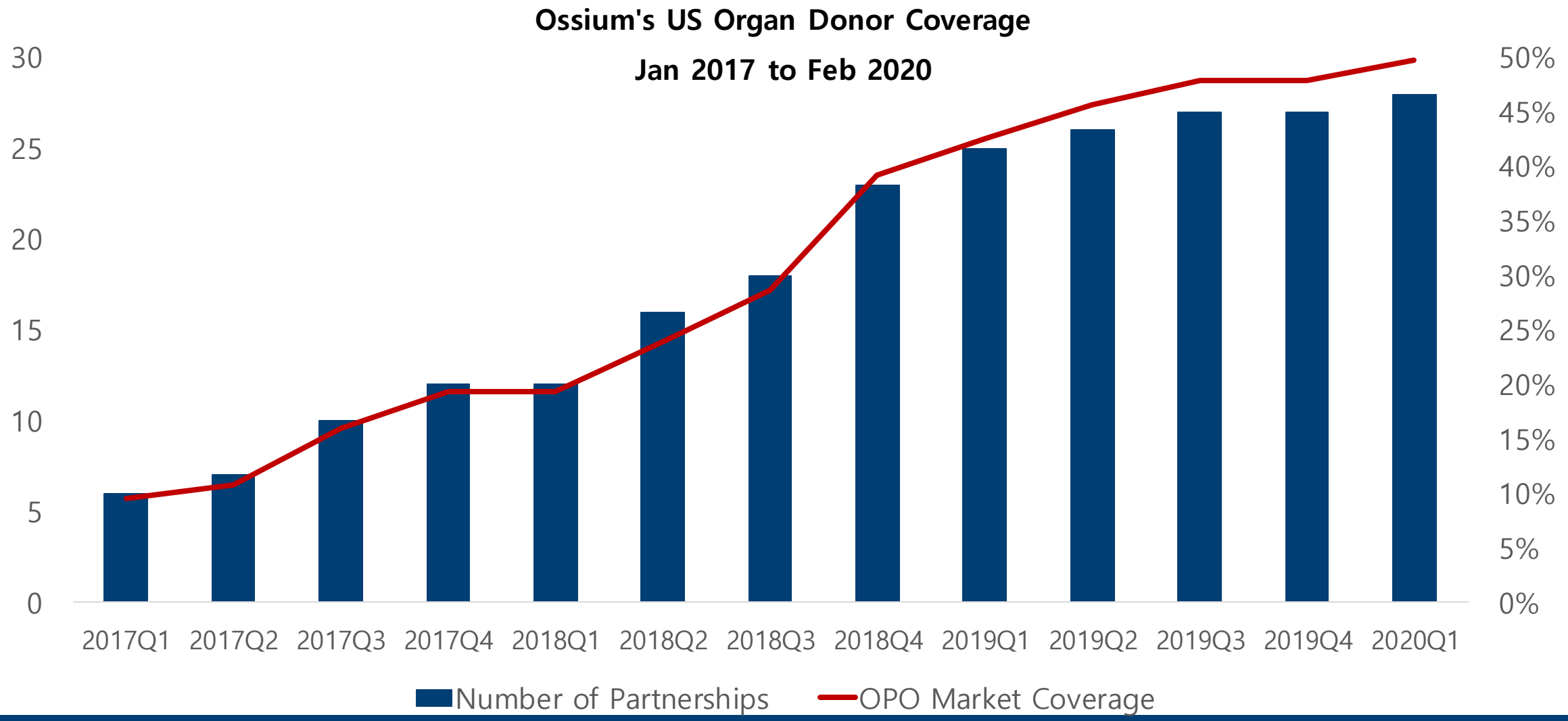
Each of the 58 Organ Procurement Organizations (OPOs) has a **sole accountability for donors in their region**

DONATE LIFE®

April is National Donate Life Month

- **OPOs are tasked with:**
  - Educating the public about donation
  - Obtaining consent from donor families
  - Managing recovery of donated organs and tissues

As of Q1 2020, Ossium has reached 50% coverage of US donors through 27 OPO partnerships and 1 recovery agency partnership




20,000 blood cancer patients per year search for a donor
OSSIUM HEALTH

No Conventional Match for 45%

5-year survival falls by 1% with every 3 days of wait


36,500 U.S. solid organ recipients per year

Immune Tolerance Induction: HSCT can save organ recipients from a life-long immuno-suppression

Need

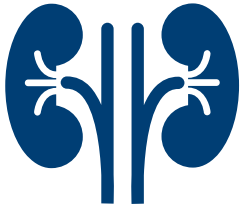
Life-threatening complications from compromised immunity

- ~35K patients receive organ transplants each year in the U.S.
- Each must take immunosuppressants for life

Solution

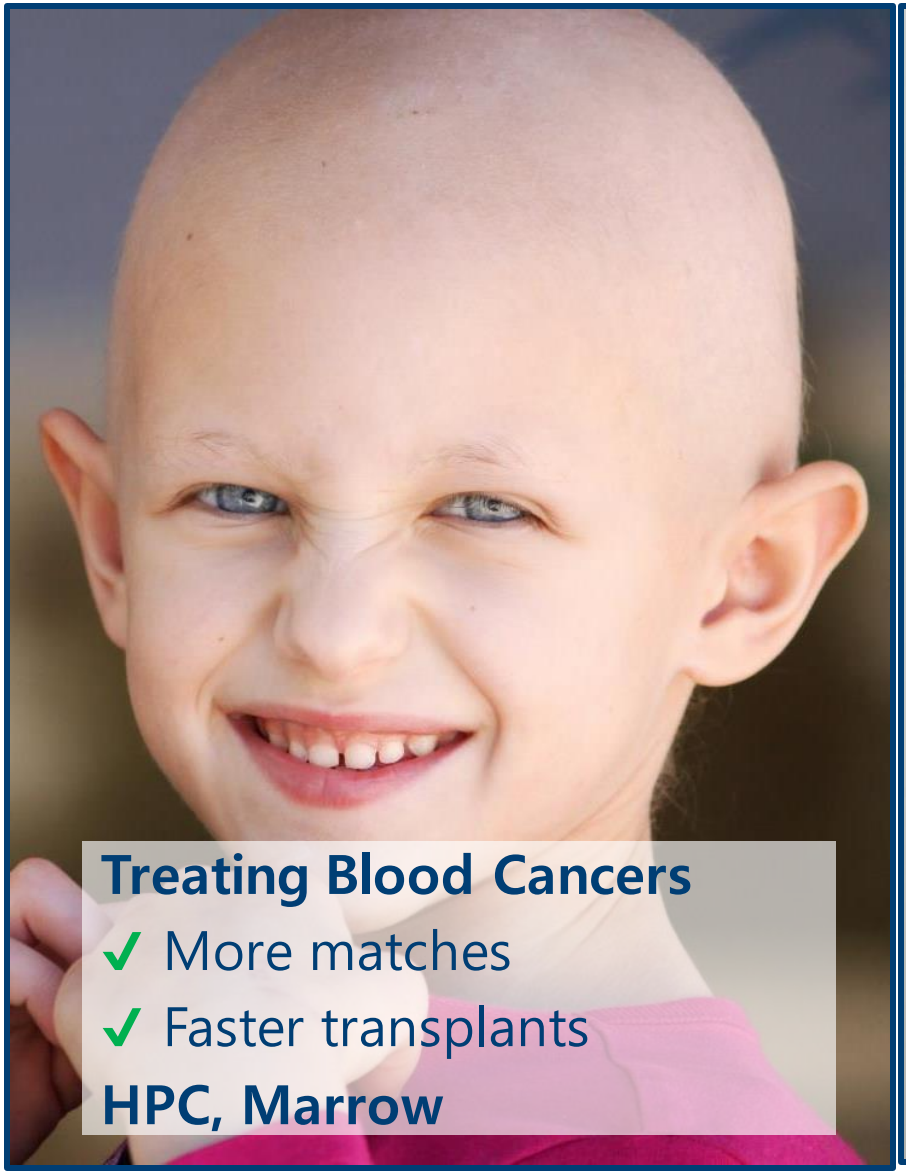
Immune tolerance induction

- HSCs from organ donor eliminates need for immunosuppressants
- Early results from advisors at Harvard and John's Hopkins



Radiological/Nuclear disaster scenarios call for HPC Marrow transplants

Bone & Marrow-derived cell therapies target many medical needs

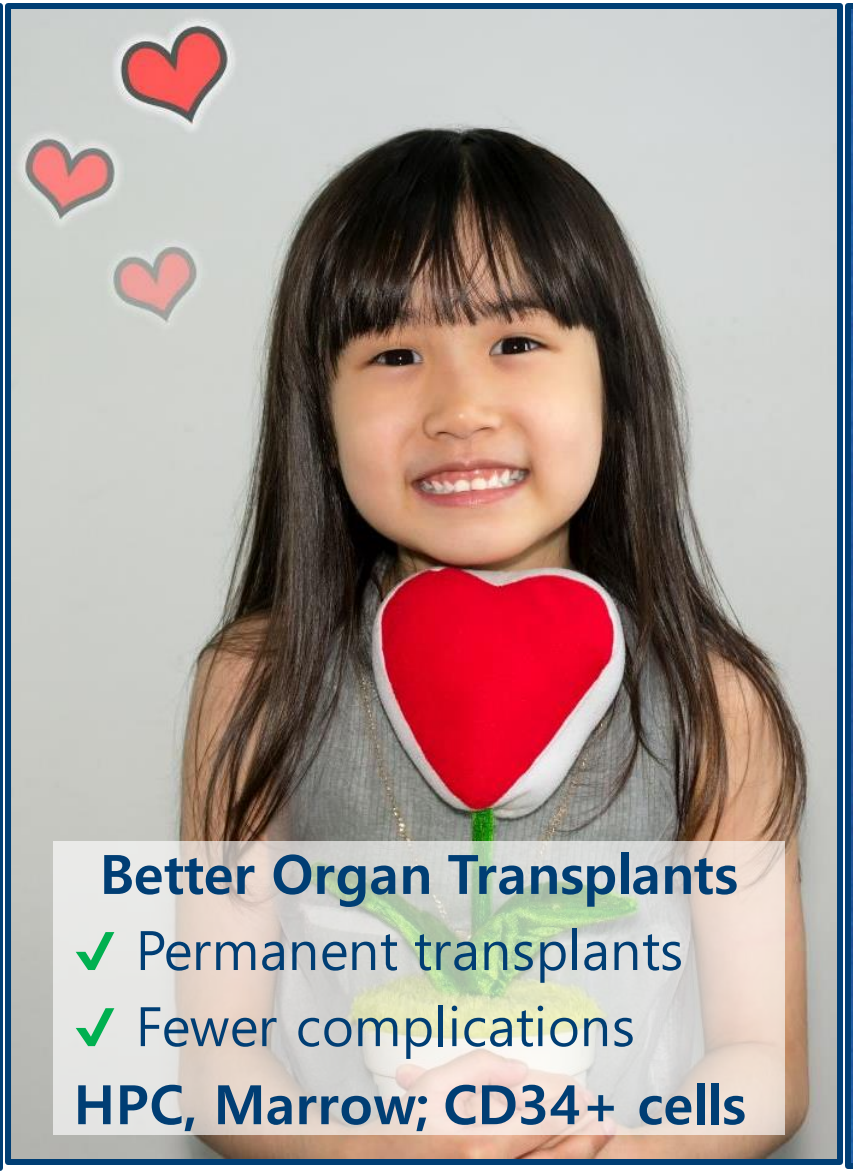


Treating Blood Cancers

✓ More matches

✓ Faster transplants

HPC, Marrow

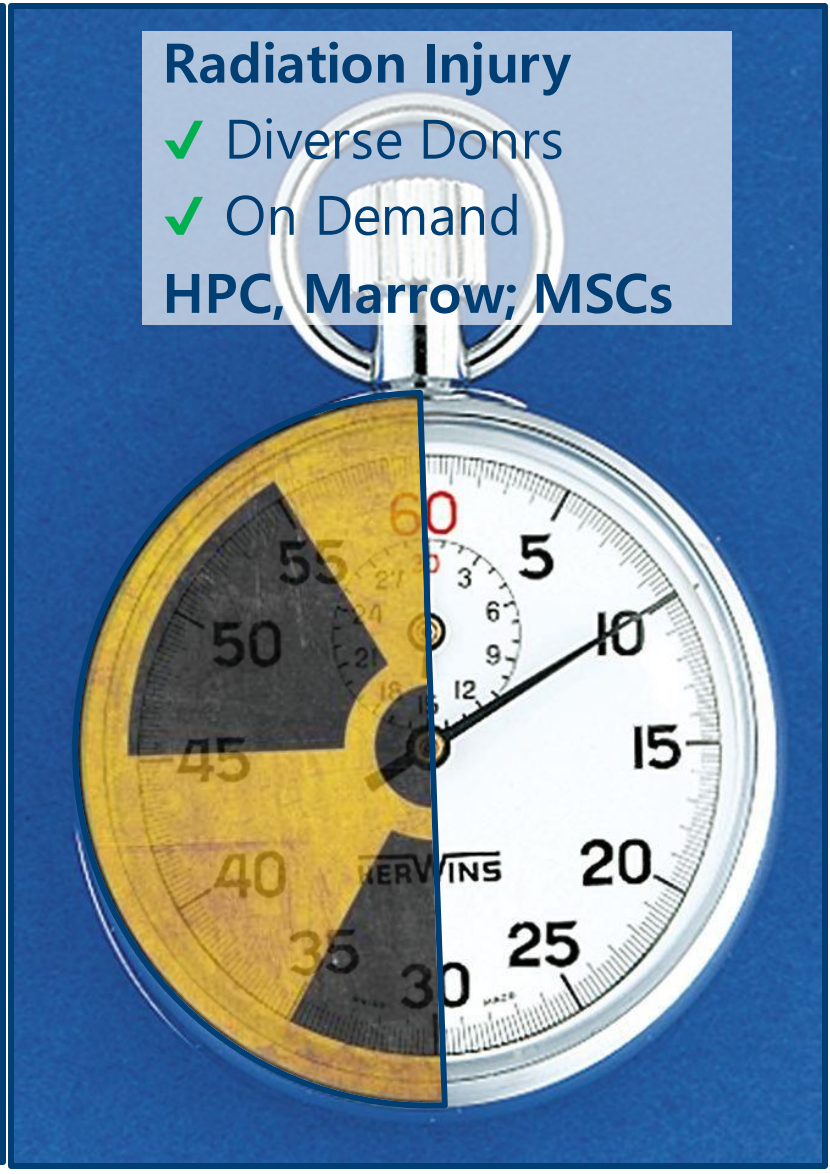


Better Organ Transplants

✓ Permanent transplants

✓ Fewer complications

HPC, Marrow; CD34+ cells



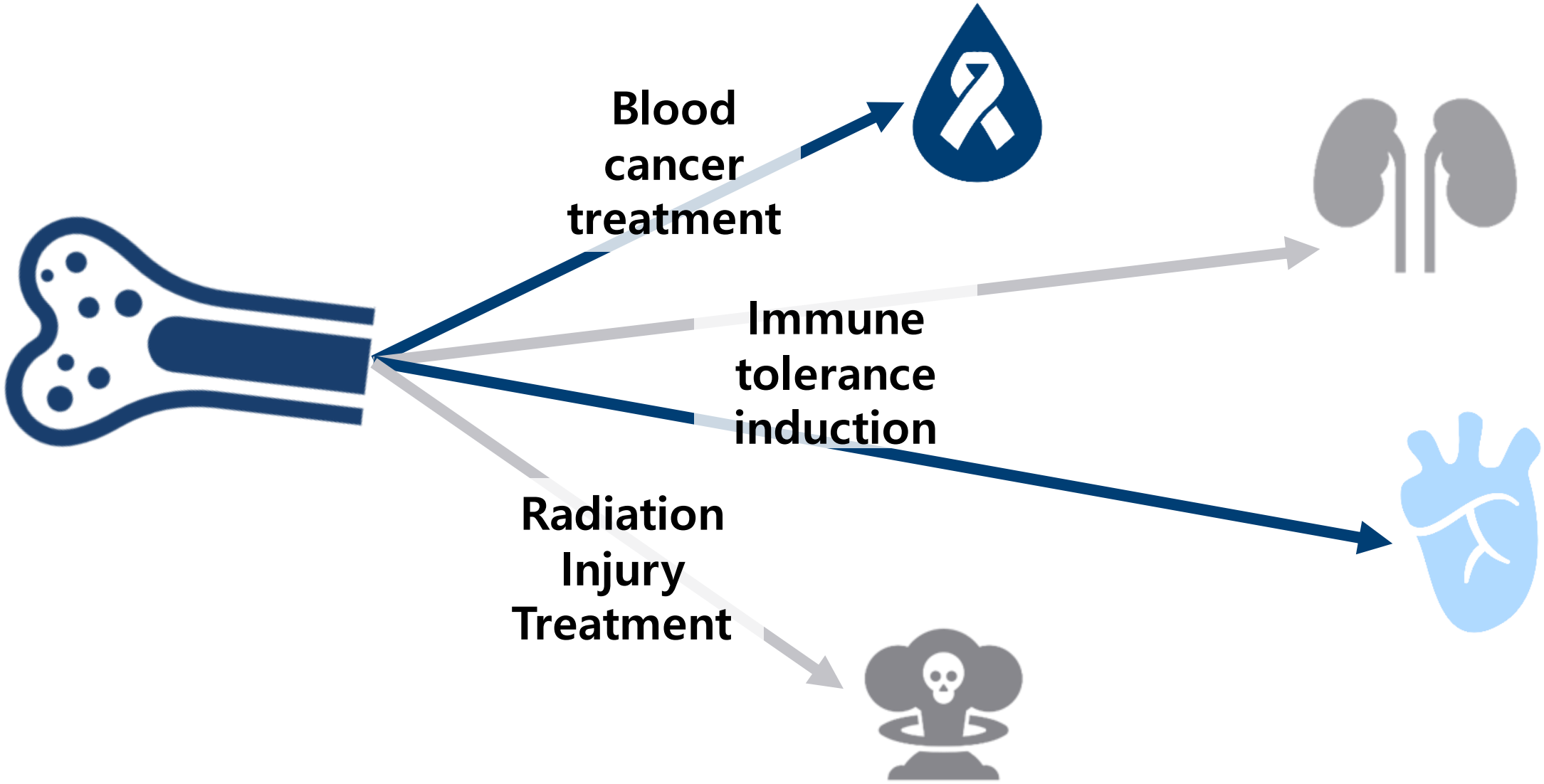
Radiation Injury

✓ Diverse Donrs

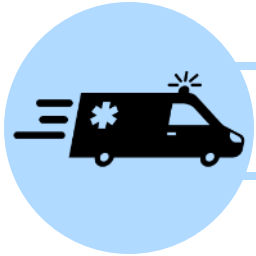
✓ On Demand

HPC, Marrow; MSCs

Ossium HPC-Marrow and selected cells provide for numerous transplants and therapeutic options per donor

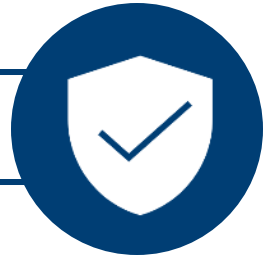


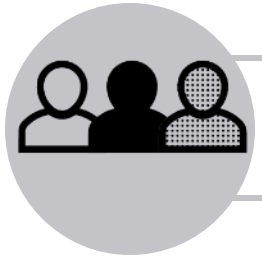
Ossium HPC Marrow bank complements registries



Banked HPC, Marrow can be provided on-demand

No risk to donors or donor attrition





Demographically diverse donor pool

Multiple treatment courses per donor

Cryopreserved cells retain high quality for decades

Scaling the next peak in bone & marrow-derived cell therapies to improve human health

PRODUCT CHARACTERIZATION

Ossium HPC Marrow changes the dynamics of stem cell therapy

Hematopoietic stem cells are hard to get

Very limited volumes

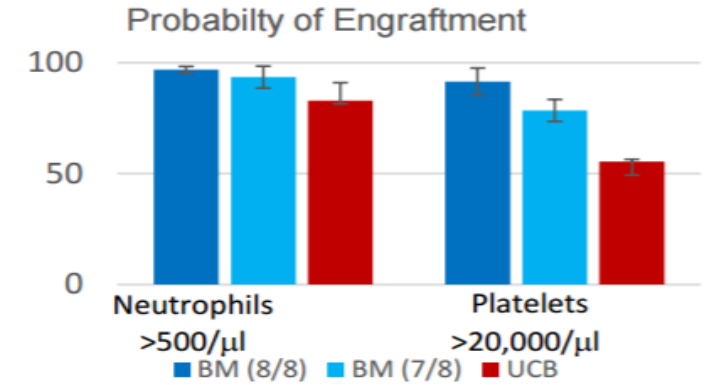
Risk to live donors

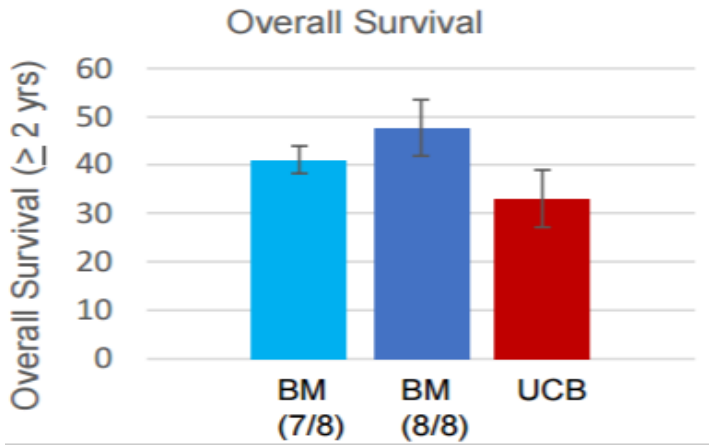
Single donation per procedure

Advance planning and preparation required

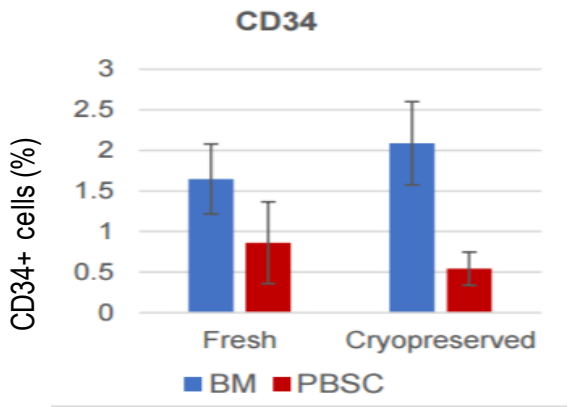
Donor BM is clinically superior to cord blood and peripheral blood stem cells

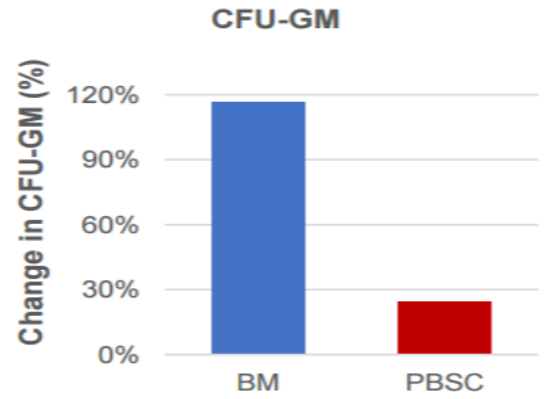
BM vs. cord blood





BM vs. peripheral blood stem cells

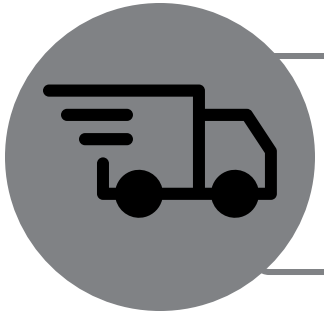




Weisdorf, D., et al., Acute radiation injury: contingency planning for triage, supportive care, and transplantation. Biol Blood Marrow Transplant, 2006. 12(6): 672-82.
Grewal, S.S., et al., Unrelated donor hematopoietic cell transplantation: marrow or umbilical cord blood? Blood, 2003. 101(11): 4233-44.
Kekre, N. and J.H. Antin, Cord blood versus haploidentical stem cell transplantation for hematological malignancies. Semin Hematol, 2016. 53(2): 98-102.

Deceased donor BM is equivalent to living donor BM and offers unique benefits

CD34+ High CD34+ cell yield and viability have repeatedly been obtained across a wide range of ischemia times



Allows for overnight delivery to transplant centers so patients can be treated faster leading to better outcomes and fewer stays

Larger volumes mean multiple doses can be banked for re-engraftment or use of rare units

Ballen KK, Gluckman E, Broxmeyer HE. Umbilical cord blood transplantation: the first 25 years and beyond. Blood. (2013) 122(4):491-8. doi: 10.1182/blood-2013-02-453175.
Fred Hutchison "History of Transplantation" https://www.fredhutch.org/en/treatment/long-term-follow-up/FAQs/transplantation.html
Körbling M, Freireich EJ. Twenty-five years of peripheral blood stem cell transplantation. Blood. (2011) 117(24):6411-6. doi: 10.1182/blood-2010-12-322214.

Ossium's deceased donor bone marrow is equivalent to living donor bone marrow across key quality metrics

	% of hematopoietic stem/progenitor cells	viability of hematopoietic stem/progenitor cells	Colony Forming Potentials
Deceased donor	1.2±0.3% CD34+	92±4% of CD34+ cells are viable	0.42±0.05% of TNC form CFU-GM
Living donor (aspirate)	0.9±0.2% CD34+	97±2% of CD34+ cells are viable	0.21±0.02% of TNC form CFU-GM

Average of n=3 (living) and n=3 (deceased)

PRODUCT

Remains **viable for decades** after cryopreservation

Acknowledgments

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Key NIH Points of Contact for Grants:

NIAID: Andrea Di Carlo-Cohen: cohena@niaid.nih.gov
Carmen Rios: carmen.rios@nih.gov
NHLBI: Margaret Ochocinska ochocinm@mail.nih.gov

BACKUP

OSSIUM HEALTH

Extensive literature proves the robustness, recovery feasibility, and successful use of deceased donor bone marrow

Deceased donor hematopoietic cells remain healthy and have been used successfully many times

1. Cadaveric bone marrow and spleen cells for transplantation. Soderahl G, et al. Bone Marrow Transplant. 1998 Jan; 21(1):79-84.
   - *Bone marrow recovered from 20 brain dead donors showed good functional characteristics and robustness in multiple storage conditions*

Recovery protocols for deceased donor bone marrow have been developed and validated

2. Clinical implementation of a procedure to prepare bone marrow cells from cadaveric vertebral bodies. Donnenberg AD, et al. Regen Med. 2011 Nov;6(6):701-6.
   - *Detailed procedure for successfully preparing bone marrow from deceased donor vertebral bodies - developed by our Founding Scientific Advisor*

The literature is full of examples of successful use of cryopreserved deceased donor bone marrow

3. Bone marrow transplantation from a cadaveric donor. Kapelushnik, et al. Bone Marrow Transplantation. 1998; 21(8):857-858
   - *Case study in which a pediatric patient with Gaucher's disease was successfully given cryopreserved sibling matched deceased donor bone marrow*
4. A clinical trial combining donor bone marrow infusion and heart transplantation: intermediate-term results. Pham SM, et al. J Thorac Cardiovasc Surg. 2000 Apr;119(4 Pt 1):673-81.
   - *Patients receiving cryopreserved deceased donor bone marrow in combination with a heart transplant experienced significantly less rejection that patients receiving only hearts*
5. Upper-extremity transplantation using a cell-based protocol to minimize immunosuppression. Schneeberger S,et al. Ann Surg. 2013 Feb;257(2):345-51.
   - *Patients receiving hand/arm transplants combined with deceased donor bone marrow tolerated reduced immunosuppression*

Ossium's HPC-Marrow leverages established science

1 Deceased donor BM is already used by top-tier universities

- University of Pittsburgh[1,2,3,4,5]
- Johns Hopkins[6] + several of above
- University of Miami[7,8,9,10]
- University of Michigan[11]
- Karolinska Institut, Sweden[12]

2 Bone Marrow outperforms cord blood

- More rapid engraftment
- Better survival outcomes
- Greater stem cell quantities

3 Deceased donor BM is equivalent to living donor BM

- Comparable flow cytometric cellular profiles and high viability
- Functional viability consistent per CFU assays

4 Scale-up and GMP coming online 2019

- Industrial scale tissue processing well established
- 4,000 sq ft facility upgrade to Indianapolis site

[1]Schneeberger et al. Ann Surg. (2013) 257(2):345-51. doi: 10.1097/SLA.0b013e31826d90bb. [2]Rao AS et al. The Annals of Thoracic Surgery. (1995) 60(4):1015–1020. [3]Rao AS et al. Transplant Proc. (1997) 29(1-2):1184-5. [4]Rao AS, Ann Thorac Surg. (2000) 69(2):345-50. [5]Rao AS et al. Transplant. Proc. (1995) 27:3387-3388. [6]Donnenberg AD et al. Regen Med. (2011) 6(6):701-6. doi: 10.2217/rme.11.89. [7]Fontes P et al. Lancet. (1994) 16;344(8916):151-5. [8]Burke GW et al. Transplant Proc. (1995) 27:3121-3122. [9]Burke GW et al. Transplant Proc (1997) 29:1207-1208. [10]Carroll PB et al. Transplant Proc. (1994) 26(6):3523-4. [11]Dafoe DC et al. Transplantation. (1985) 40:572-574.
[12]Ringdén O, et al. Transplantation. (2000) 27;69(10):2043-8.