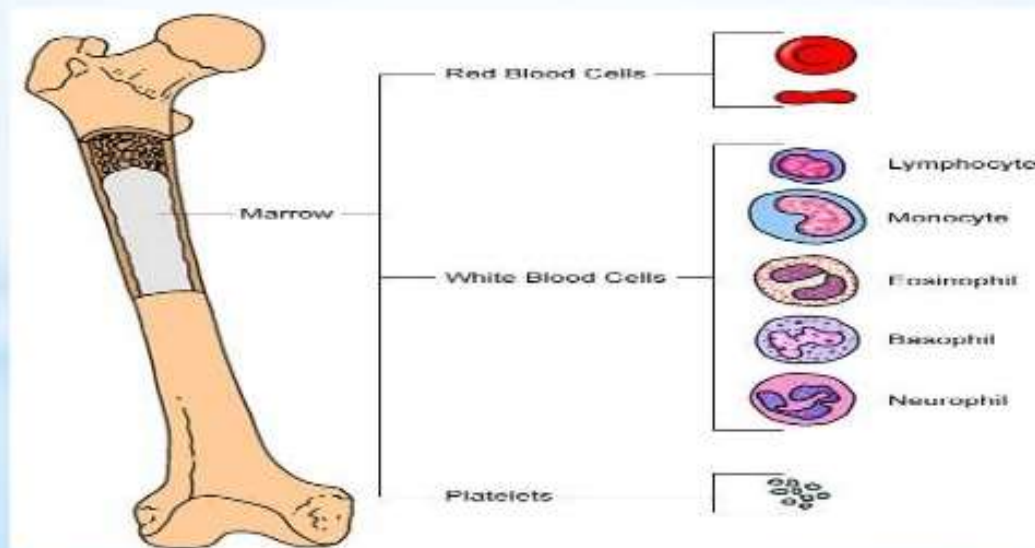


Patient Flow Predictive Model

WHAT IS THE BONE MARROW ?!

Bone Marrow is the soft spongy tissue that fills the cores of larger bones.

It serves an active function in the body by producing all three types of blood cells, as well as lymphocytes, which support the immune system.





Types of Bone Marrow Transplant

Autologous Transplants

Here stem cells are removed from the patient before high-dose chemotherapy or radiation treatment. After chemotherapy your stem cells are put back in your body to make (regenerate) normal blood cells

Allogeneic Transplants

Stem cells are removed from another person, called a donor. Donor's genes must at least partly match your genes, which are decided through special blood tests. Brother, sister, parents, children are most likely to be a good match.

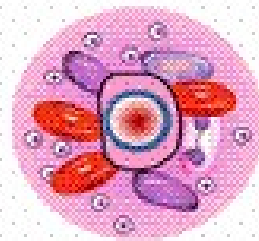
Umbilical cord blood transplant

Stem cells are removed from a newborn baby's umbilical cord right after birth. The stem cells are frozen and stored until they are needed for a transplant. These cells are very immature so there is less of a need for matching.

The Autologous Transplant Process

1. Collection

Stem cells are collected from the patient's bone marrow or blood.



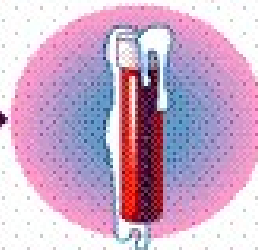
2. Processing

Blood or bone marrow is processed in the laboratory to purify and concentrate the stem cells.



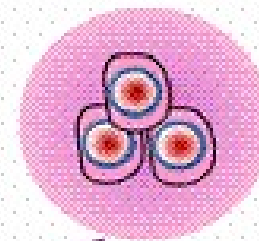
3. Cryopreservation

Blood or bone marrow is frozen to preserve it.



5. Reinfusion

Thawed stem cells are reinfused into the patient.

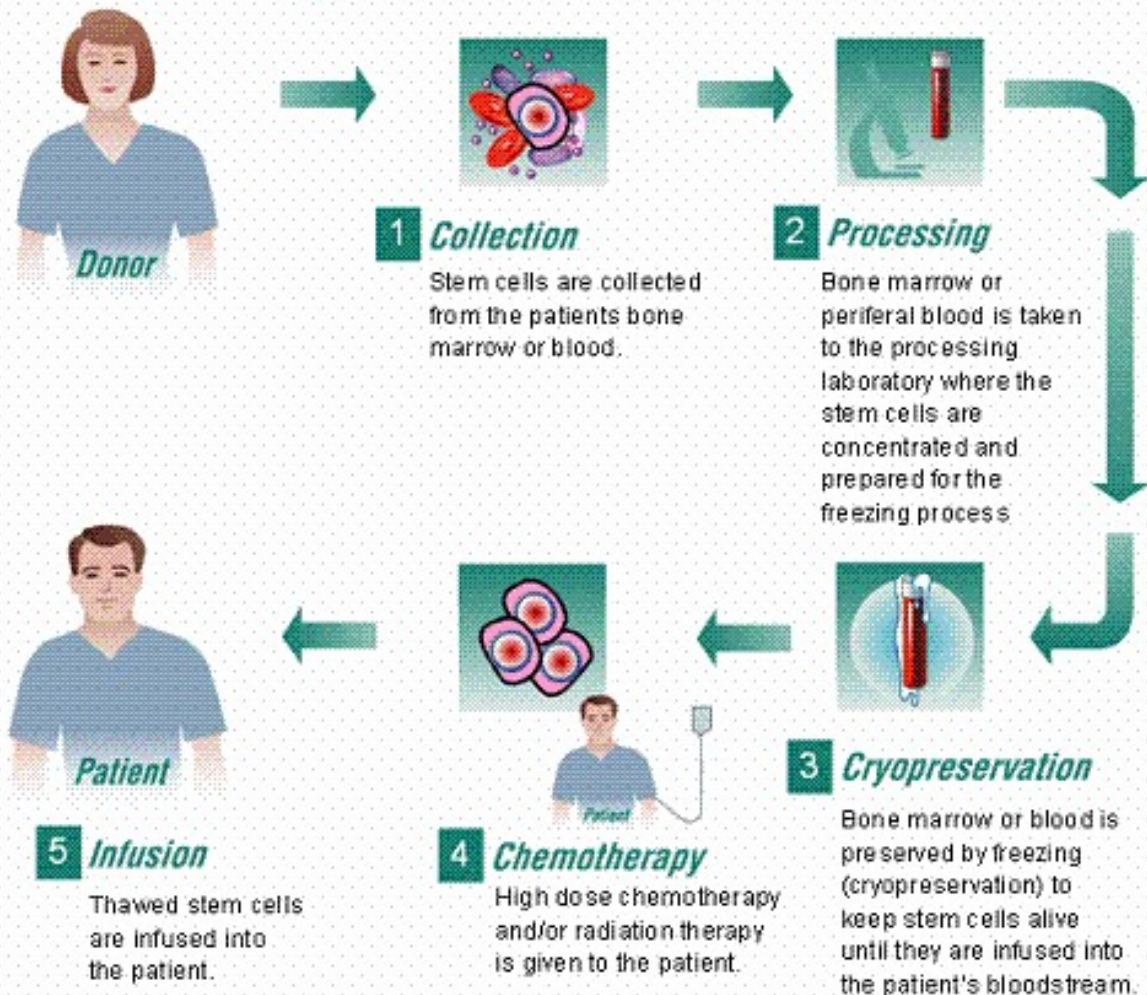


4. Chemotherapy

High dose chemotherapy and/or radiation therapy is given to the patient.

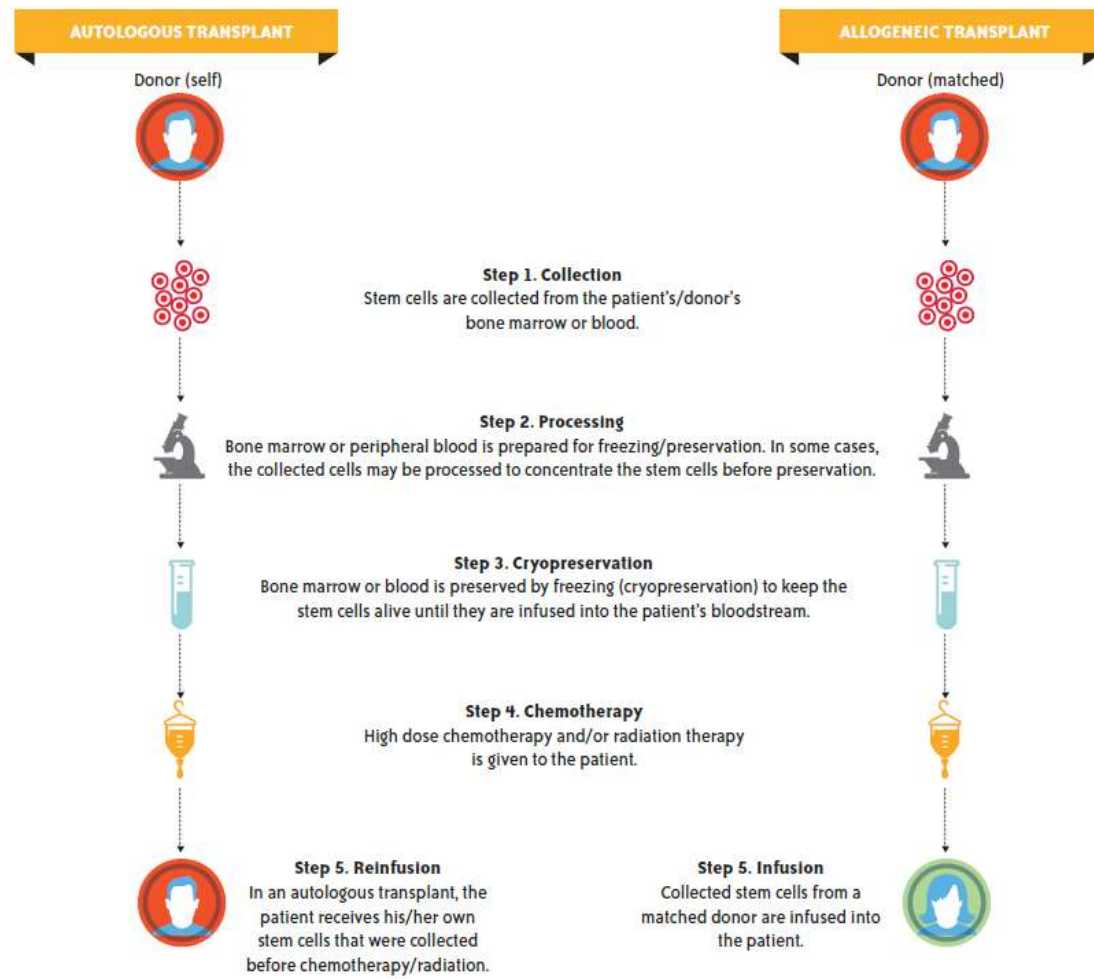


The Allogeneic Transplant Process



STEM CELL TRANSPLANT

How does it work?



| Donor Search | | Conditioning (Chemo and/or radiation) | Cell Infusion “Day 0” | In-Patient Recovery | Out-Patient Recovery | At Home Recovery | The “New Normal” |
|---|-------------------------------------|---|--------------------------|------------------------|-------------------------|---------------------|---------------------|
| Adult donor: About 2 months or longer | Cord blood: About 2 weeks | Standard (Myeloablative) transplant | | | | | |
| | | 6–12 days | “Day 0” | 30–100 days | 100 days or more | 100 days or more | 1 year or more |
| | | Reduced Intensity (Non-Myeloablative) transplant | | | | | |
| | | Varies | “Day 0” | Varies | Varies | Varies | 1 year or more |

Project Goal:

Create a predictive model from historical data that will estimate patient volume through the various clinical phases of the Bone Marrow Transplant (BMT) process.

Data from 2010-2015 will be used to train the model.

Data from 2016-2017 will be used to test and validate model accuracy.

Project Outputs:

Dashboard that shows red, yellow or green representation of patient volume through each phase of the process

Estimate of quarterly and annual transplant volumes

Model Building

Neural Net

Model Selection

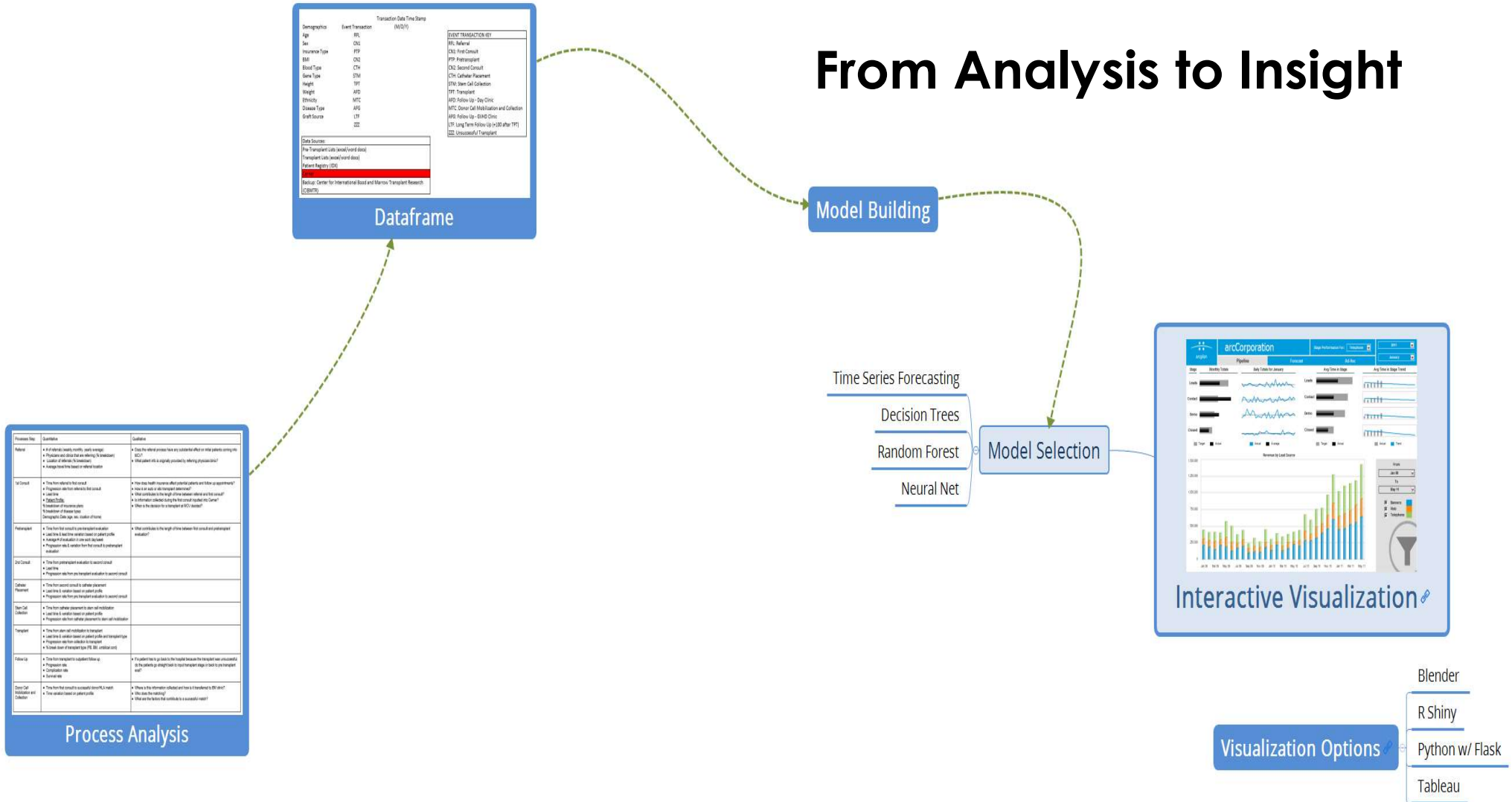


Tableau

Visualization Options

Dataframe

Process Analysis



The Process

| Processes Step: | Quantitative | Qualitative |
|--|---|--|
| Referral | <ul style="list-style-type: none"> # of referrals (weekly, monthly, yearly average) Physicians and clinics that are referring (% breakdown) Location of referrals (% breakdown) Average travel time based on referral location | <ul style="list-style-type: none"> Does the referral process have any substantial effect on initial patients coming into MCV? What patient info is originally provided by referring physician/clinic? |
| 1st Consult | <ul style="list-style-type: none"> Time from referral to first consult Progression rate from referral to first consult Lead time <u>Patient Profile:</u> % breakdown of insurance plans % breakdown of disease types Demographic Data (age, sex, location of home) | <ul style="list-style-type: none"> How does health insurance affect potential patients and follow up appointments? How is an auto or allo transplant determined? What contributes to the length of time between referral and first consult? Is information collected during the first consult inputted into Cerner? When is the decision for a transplant at MCV decided? |
| Pretransplant | <ul style="list-style-type: none"> Time from first consult to pre-transplant evaluation Lead time & lead time variation based on patient profile Average # of evaluation in one work day/week Progression rate & variation from first consult to pretransplant evaluation | <ul style="list-style-type: none"> What contributes to the length of time between first consult and pretransplant evaluation? |
| 2nd Consult | <ul style="list-style-type: none"> Time from pretransplant evaluation to second consult Lead time Progression rate from pre transplant evaluation to second consult | |
| Catheter Placement | <ul style="list-style-type: none"> Time from second consult to catheter placement Lead time & variation based on patient profile Progression rate from pre transplant evaluation to second consult | |
| Stem Cell Collection | <ul style="list-style-type: none"> Time from catheter placement to stem cell mobilization Lead time & variation based on patient profile Progression rate from catheter placement to stem cell mobilization | |
| Transplant | <ul style="list-style-type: none"> Time from stem cell mobilization to transplant Lead time & variation based on patient profile and transplant type Progression rate from collection to transplant % break down of transplant type (PB, BM, umbilical cord) | |
| Follow Up | <ul style="list-style-type: none"> Time from transplant to outpatient follow up Progression rate Complication rate Survival rate | <ul style="list-style-type: none"> If a patient has to go back to the hospital because the transplant was unsuccessful, do the patients go straight back to input transplant stage or back to pre transplant eval? |
| Donor Cell Mobilization and Collection | <ul style="list-style-type: none"> Time from first consult to successful donor/HLA match Time variation based on patient profile | <ul style="list-style-type: none"> Where is this information collected and how is it transferred to BM clinic? Who does the matching? What are the factors that contribute to a successful match? |

Transaction Date Time Stamp
(M/D/Y)

| Demographics | Event Transaction |
|----------------|-------------------|
| Age | RFL |
| Sex | CN1 |
| Insurance Type | PTP |
| BMI | CN2 |
| Blood Type | CTH |
| Gene Type | STM |
| Height | TPT |
| Weight | AFD |
| Ethnicity | MTC |
| Disease Type | AFG |
| Graft Source | LTF |
| | ZZZ |

The Data

EVENT TRANSACTION KEY

RFL: Referral
CN1: First Consult
PTP: Pretransplant
CN2: Second Consult
CTH: Catheter Placement
STM: Stem Cell Collection
TPT: Transplant
AFD: Follow Up - Day Clinic
MTC: Donor Cell Mobilization and Collection
AFG: Follow Up - GVHD Clinic
LTF: Long Term Follow Up (+100 after TPT)
ZZZ: Unsuccessful Transplant

Data Sources:

Pre-Transplant Lists (excel/word docs)
Transplant Lists (excel/word docs)
Patient Registry (IDX)

Cerner

Backup: Center for International Blood and Marrow Transplant Research
(CIBMTR)

Next Steps:

- 1) Develop business rules for transactions and date of transaction by data source with retrieval method
- 2) Capture demographic data for each patient
- 3) Capture transaction data for each process
- 4) Join patient and process data via column vector
- 5) Perform analysis and choose best model

Questions/Comments