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| Stem cElls DATABASE MANAGEMENT SYSTEM |  |

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**INTRODUCTION**

Stem cells serve as the repair system of the body with special capabilities that are especially important in early and later stages of life. These cells have the potential to develop into many different types of cells in the body. Stem cells originate from two main sources, adult body tissues and embryos. Stem cells provide new cells for the body to grow and replace specialized cells that are damaged or lost. Adult stem cells exist throughout the body from the time an embryo develops. Most blood cells are specialized to perform functions, such as red blood cells that carry oxygen around the blood, but they do not multiply. Stem cells provide new cells for the body as it multiplies and replace damaged or lost or diseased cells. In the past few years, stem cell therapy has been benefited many diseases. A stem cell donation bank will be established in a single location or in any of the hospitals. This stem cell data consists of availability of stem cell, donors, recipients, and price of different type of cells. Database consists of past and present data available like the donors and recipient’s information, list of type of cells, and their availability. User manual consists of how the database can be accessed by a doctor and the analyst. Step by Step procedure will be explained with proper screen shots.

**BUSINESS SCOPE**

The previous years has seen an incredibly quick expansion in the quantity of recently settled stem cell data. The rapid growth of stem cell companies is being driven by accelerated funding for stem cell therapies, Increased interest among pharmaceutical companies in stem cell partnerships, Use of cell therapies in the treatment of Covid-19 complications, such as immune and respiratory complications, rising number of stem cell therapy trails underway worldwide. Further market growth is expected to come from government funding for the development of cellular therapies for cancer. Research and Markets is even more bullish, estimating that the global stem cell therapy market will grow at a compound annual growth rate of 28 percent from 2020 to 2025, reaching US$20.87 billion. The report’s authors attribute this growth to the rising prevalence of chronic diseases. Some of top companies who are working widely on stem cells are Moderna, BioNTech, Prothena, Brainstorm Cell Therapeutics etc.,

**BUSINESS PROBLEM**

Some potential companies like Moderna, BioNTech who are extensively are using stem cells in their research domain. Since stem cells are now being widely used in medical field, a lot of research is being done on them. Many stem cell products such as Pluripotent stem cells, Neural stem cells, Cancer stem cells, Hematopoietic stem cells are being used for treatment of patients suffering from diseases such as type 1 diabetes, Parkinson's disease, Spinal cord injury, Alzheimer's disease, cancer etc. For these type of research purposes, data should be integrated as part of an effective data management system like ours. Since the first release of human induced pluripotent stem cells (iPSCs), there has been an expedition in the number of iPSC lines and availability of related information worldwide. This notable advancement in the healthcare industry has not only rapid studies of regenerative medicine but also provided ample opportunities to understand such practical problems as the quality of pluripotent stem cells and the disorder mechanisms. Stem cell banks and databases are expected to provide crucial information on individual stem cell lines. The exchange of data among the globally distributed stem cell banks is minimal, however, based on the available information, the scientific reproducibility of the stem cells has been proved to be problematic for both basic research and clinical applications due to lack of a standardized format. Additionally, as the categorization of cell lines is expected to advance in the future, the addition of new quality standards has complicated and diversified data formats among stem cell banks and registries, which has created issues for the research institutions select the stem cell lines for research purposes. With the expanding number of registered stem cell lines, the existing data deposition formats have made it tough for both data depositors and users to seek and obtain information regarding several cell lines collected under numerous different projects. In our project, we are going to collect and merge the information regarding globally distributed stem cell banks, cell lines and store the information in the database in a standardized format which could be effortlessly accessed by the researchers and users.

**HIGHLIGHTS OF OUR DATABASE MANAGEMENT SYSTEM**

* Integrated stem cell database management system so that it covers majority of stem cell resources.
* Minimum but efficient access to information on stem cell lines based on certain guidelines.
* Removing the cell line redundancy which is present in major stem cell database management systems.
* Including cell lines from countries which are identified as top countries working on stem cell research around the globe.
* Diverse human cell information to support a wide range of research.
* Extracted data from the largest stem cell line data in the world which is the collaboration of ICSCB(Integrated Collection of Stem Cell Bank Data) and SHOGoiN(Human Omics database for the Generation of iPS and Normal Cells.
* Addresses the problem of standardized data format which is usually lacking in several search websites of stem cells.

**DESCRIPTION OF TABLE AND FIELDS**

**Donor** table: This table contains information of the stem cell donors.

|  |  |  |  |
| --- | --- | --- | --- |
| **Field Name** | **Data Type** | **Constraint** | **Description** |
| DonorID | INTEGER(20) | PRIMARY KEY, UNIQUE,  NOT NULL, AUTO\_INCREMENT | Uniquely identifies each donor with a number |
| DonorFirstName | VARCHAR(200) | NOT NULL | First name of the donor |
| DonorLastName | VARCHAR(200) | NOT NULL | Last name of the donor |
| DonorGender | VARCHAR(10) | NOT NULL | Gender of the donor |
| DonorRace | VARCHAR(30) | NOT NULL | Race of the donor |
| DonorBloodGroup | VARCHAR(10) | NOT NULL | Blood group of the donor |
| DonorDOB | DATETIME | NOT NULL | Date of Birth of the donor |
| Married | VARCHAR(10) |  | Marital status of the donor |
| Illness | VARCHAR(200) |  | Any illness of the donor |
| Medication | VARCHAR(200) |  | Any medication of the donor |
| DonorAddress | VARCHAR(200) | NOT NULL | Address of the donor |
| DonorPhoneNum | VARCHAR(200) | NOT NULL | Phone Number of the donor |
| Insurance | VARCHAR(20) |  | Health Insurance information of the donor |

**StemCell** table: This table contains information of the stem cells stored and donated by the donors.

|  |  |  |  |
| --- | --- | --- | --- |
| **Field Name** | **Data Type** | **Constraint** | **Description** |
| CellID | INTEGER(20) | PRIMARY KEY, UNIQUE,  NOT NULL, AUTO\_INCREMENT | Unique cell identification number of the stem cell donated by the donor |
| CellType | VARCHAR(200) | NOT NULL | Type of the stem cell |
| CellOrigin | VARCHAR(200) | NOT NULL | Origin of the cell |
| CellPrice | INTEGER(20) | NOT NULL | Price of the cell in USD |
| DonorID | INTEGER(20) | FOREIGN KEY, NOT NULL | ID of the respective donor |
| LabID | INTEGER(20) | FOREIGN KEY, NOT NULL | ID of the lab where it is stored |

**Appointment** table: This table contains information of the appointment details of the donors done with the doctors.

|  |  |  |  |
| --- | --- | --- | --- |
| **Field Name** | **Data Type** | **Constraint** | **Description** |
| ApmntID | INTEGER(20) | PRIMARY KEY, UNIQUE,  NOT NULL, AUTO\_INCREMENT | Uniquely identifies the date of any appointment made by the donor |
| ApmntDate | DATETIME | NOT NULL | Date of the appointment |
| DonorID | INTEGER(20) | FOREIGN KEY, NOT NULL | ID of the respective donor |

**Invoice** table: This table contains information of invoices generated for the donors.

|  |  |  |  |
| --- | --- | --- | --- |
| **Field Name** | **Data Type** | **Constraint** | **Description** |
| InvoiceID | INTEGER(20) | PRIMARY KEY, UNIQUE,  NOT NULL, AUTO\_INCREMENT | Uniquely identifies any invoice generated for a donor |
| InvoiceDate | DATETIME | NOT NULL | Date of the invoice generation |
| DonorID | INTEGER(20) | FOREIGN KEY, NOT NULL | ID of the respective donor |
| InvoiceAmt | INTEGER(20) | NOT NULL | Amount mentioned in the invoice |

**Laboratory** table: This table contains information of the laboratories where the stem cells of the donors are stored for treatment and research purposes.

|  |  |  |  |
| --- | --- | --- | --- |
| **Field Name** | **Data Type** | **Constraint** | **Description** |
| LabID | INTEGER(20) | PRIMARY KEY, UNIQUE,  NOT NULL, AUTO\_INCREMENT | Unique identification number of the laboratory where the stem cell donated by a donor is stored |
| LabName | VARCHAR(200) | NOT NULL | Name of the laboratory |
| LabRoomNum | VARCHAR(20) | NOT NULL | Room number of the laboratory where the stem cell is stored |
| InchargeID | INTEGER(20) | FOREIGN KEY, NOT NULL | ID of the laboratory supervisor/officer |
| LabAddress | VARCHAR(200) | NOT NULL | Address of the laboratory |

**LabIncharge** table: This table contains information of the laboratories in charge where the stem cells of the donors are stored for treatment and research purposes.

|  |  |  |  |
| --- | --- | --- | --- |
| **Field Name** | **Data Type** | **Constraint** | **Description** |
| InchargeID | INTEGER(20) | PRIMARY KEY, UNIQUE,  NOT NULL, AUTO\_INCREMENT | Uniquely identifies each laboratory supervisor with a number |
| InchFstName | VARCHAR(200) | NOT NULL | First name of the lab supervisor |
| InchLstName | VARCHAR(200) | NOT NULL | Last name of the lab supervisor |
| InchAddress | VARCHAR(200) | NOT NULL | Address of the lab supervisor |
| InchPhNum | VARCHAR(200) | NOT NULL | Phone Number of the lab supervisor |
| InchGender | VARCHAR(10) | NOT NULL | Gender of the lab supervisor |

**ENTITY RELATIONSHIP DIAGRAM**

This Entity-Relationship diagram is created by loading the database tables in the MySQL workbench. The relationships between the database tables are explained below:

1. Donor and StemCell - One to Many Relationship: One donor may have multiple stem cells donated or stored in the bank and one stem cell can have only one donor.
2. Donor and Appointment - One to Many Relationship: One donor may book multiple appointments with the laboratories or doctors and one appointment can have only one donor associated with it.
3. Donor and Invoice - One to Many Relationship: One donor may have multiple invoices generated with each appointments or visits to the laboratories or doctors and one invoice can have only one donor associated with it.
4. Laboratory and StemCell - One to Many Relationship: One laboratory can store many stem cells and one stem cell can be stored only at one laboratory.
5. LabIncharge and Laboratory - One to Many Relationship: One lab in-charge or supervisor can be assigned for multiple laboratories and one laboratory can have only one supervisor.

Diagram

Description automatically generated

**DIVERSITY OF THE DATABASE**

From our database, we could visualize the distribution of donors based on their race, gender, marital status, blood group and chronic illness and distribution of stem cells based on their origin and type.

* In the pie chart distribution by race, majority of the people are white followed by Black, Native Hawaiian, American Indian and unclassified.
* As per the chart, majority of the donors are Male.
* A+ Blood group is dominating among all the other groups followed by O+, B+, O- and B-, AB+ and AB- and lastly A-.
* The persons affecting by the chronic illness are comparatively low as majority of the persons do not have illness.
* Most of the stem cells are originated from Early Embryonic Tissue followed by Muscle, Cerebral Cortex and Brain, Blood, Pancreas, and unclassified components.
* Neuron has the highest stem cells by type followed by Myoblast\_T24 and Leucocyte, Embryonic Stem Cell, Adipose derived Stem Cell, Primordial Germ Cell, TE and one variant of Embryonic Stem Cell.
* MedLife Health is the most preferred laboratory followed by equal share of Atlanta Medical Center, City Health Center, Denver Medical Center, Harvard Medical School, and Princeton Medical Center.

Chart, pie chart

Description automatically generated

**REPORTS**

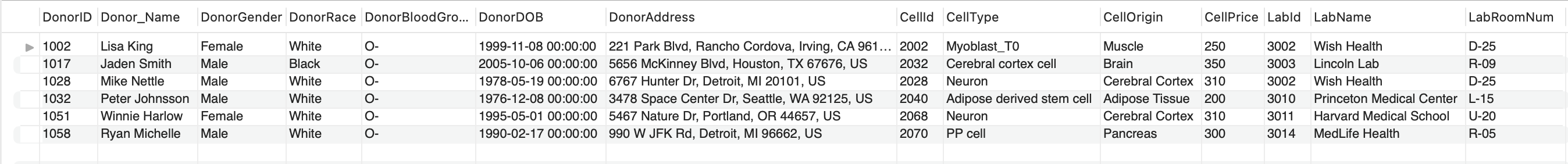
We have created a few sample reports from our database to show its functionalities.

1. List of the details of all the Male Donors

**Table

Description automatically generated**

1. Provide the details of ‘O Negative’ Blood group stem cell Donors along with the laboratory details where the cells are stored.

****

1. What is the available number of different types of stem cells?

Table

Description automatically generated

1. Provide the list of stem cell laboratories along with their in-charge contact details.

Table

Description automatically generated

1. List of all the cell types and price of the stem cells along with the donor details whose price is more than or equal to $350.

Text

Description automatically generated with medium confidence

1. Provide the number of stem cells collected by each laboratory along with the laboratory name.

Table

Description automatically generated

1. Generate a list of different types of stem cells with their origin.

Table

Description automatically generated

1. Generate a report that would show the number of invoices generated and total invoice amount in each year.

**Table

Description automatically generated**

**FUTURE SCOPE OF THE PROJECT**

* Our project can be further strengthened by designing a web interface to help researchers searching for cell lines to conduct various studies.
* The resources present in the database can be made as diversified as possible for different disease analysis.
* Suitable UI elements like text boxes for searching, filters for getting desired information can be used in the web interface so that it eases the process of research.
* We also aim at improving the quality and increasing the scale of our database.
* We wish and hope that our project further evolves through global collaboration thereby providing users better accessibility to relevant stem cell lines.

**CONCLUSION**

Our integrated stem cell database management system covers majority of stem cell resources. It has removed the cell line redundancy which is present in major stem cell database management systems that has made our database more efficient. Stem cell storage has been proved to be an inexpensive investment on personal health care. Therefore, citizens must be encouraged to donate their stem cells for storage to treat any chronic illness such as cancer and Parkinson’s disease, if any, in future.

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