International Journal of Scientific Reports
Teja KSR et al. Int J Sci Rep. 2023 Nov;9(11):376-381
http://www.sci-rep.com
pISSN 2454-2156 | eISSN 2454-2164
DOI: https://dx.doi.org/10.18203/issn.2454-2156.IntJSciRep20233167

Review Article

Leveraging electronic health records and stem cell transplants: a review

K. S. Ravi Teja[1], Sai Lakshmi Gundimeda[2], Amulya Kolipakula[3], Anushree Ramprasad[4], Sandhya Kanti Nuzella[4], A. Ranganadha Reddy[5]*

[1]Clario, Bengaluru, Karnataka, India
[2]CSIR-CCMB Whole Genome Sequencing Lab, Siddhartha Medical College, Vijayawada, Andhra Pradesh, India
[3]Siddhartha Medical College, Vijayawada, Andhra Pradesh, India
[4]Department of Biochemistry, Maharani Lakshmi Ammanni College for Women, Bengaluru, Karnataka, India
[5]Department of Biotechnology, VFSTR, Guntur, Andhra Pradesh, India

Received: 18 September 2023
Revised: 12 October 2023
Accepted: 13 October 2023

***Correspondence:**
A. Ranganadha Reddy,
E-mail: rangaaluri@gmail.com

ABSTRACT

Biomedical informatics is a burgeoning multidisciplinary field that seeks to optimize the utilization of biomedical data, information, and knowledge for the purposes of scientific research, inquiry, problem-solving, and decision-making, all with the overarching objective of enhancing human health and well-being. Information, informatics, and its applications are used in organ transplantations, such as stem cell transplantation programs, and in programs that directly change disorders. So, many hospitals can maintain EMRs (Electronic medical records), but few are supporting C programs. So, using informatics, we introduced software and programs to run these SCT applications in a very short period of time without any effect.

Keywords: Biomedical informatics, Stem cell transplantation, EMRs, Software

INTRODUCTION

In the context of stem cell transplantation, patients undergo a procedure involving the administration of high-dose chemotherapy with the purpose of eradicating the cells present in the bone marrow.[1] The subsequent step in the treatment process involves the administration of fresh, robust hematopoietic stem cells to the patient.[2] The advent of stem cell transplants marked a significant milestone in the field of medical research.[3]

The process of obtaining new stem cells from bone marrow, commonly referred to as bone marrow transplantation, has been extensively studied and documented in the scientific literature.[4] Stem cell transplantation is a widely employed therapeutic modality primarily used in the management of multiple myeloma.[5] The administration of drug treatment or drug doses prior to transplantation has been shown to be beneficial in reducing the quantity of myeloma cells within the patient's body.[6] The transplantation of stem cells can be categorised into two main types: autologous and allogenic.

AUTOLOGOUS TRANSPLANTATION

Regenerative medicine uses autologous transplantation to obtain stem cells from the patient. This method avoids immunological rejection and graft-versus-host disease, making it promising for many medical problems.[7] Autologous stem cell therapy uses patient stem cells to regenerate.

In transplantation, patient-derived stem cells are popular. Patients' bone marrow or peripheral blood supply these stem cells Pre-transplantation cell extraction is required.[8] This study examines cell preservation and return. The results show that cells may be stored and repositioned. This discovery affects cell-based therapeutics and tissue

engineering.[9] Explore the mechanics and enhance cell storage and retrieval. Oncologists treat myeloma with high-dose chemotherapy or radiation. These treatments target cancer cells and stop disease progression.[10,11] After the requisite procedures, stem cells are reintroduced into the patient's bloodstream via the venous route.[12] Multiple myeloma patients frequently undergo allogeneic stem cell transplantation.[13]

This technique extends remission periods for years but does not cure the condition. After transplantation, myeloma often relapses, requiring further treatment. Medical professionals usually recommend that myeloma patients get two autologous donations about 6 to 12 months apart as a treatment plan. The treatment that is being thought about in this case is called "tandem transplantation.[14]

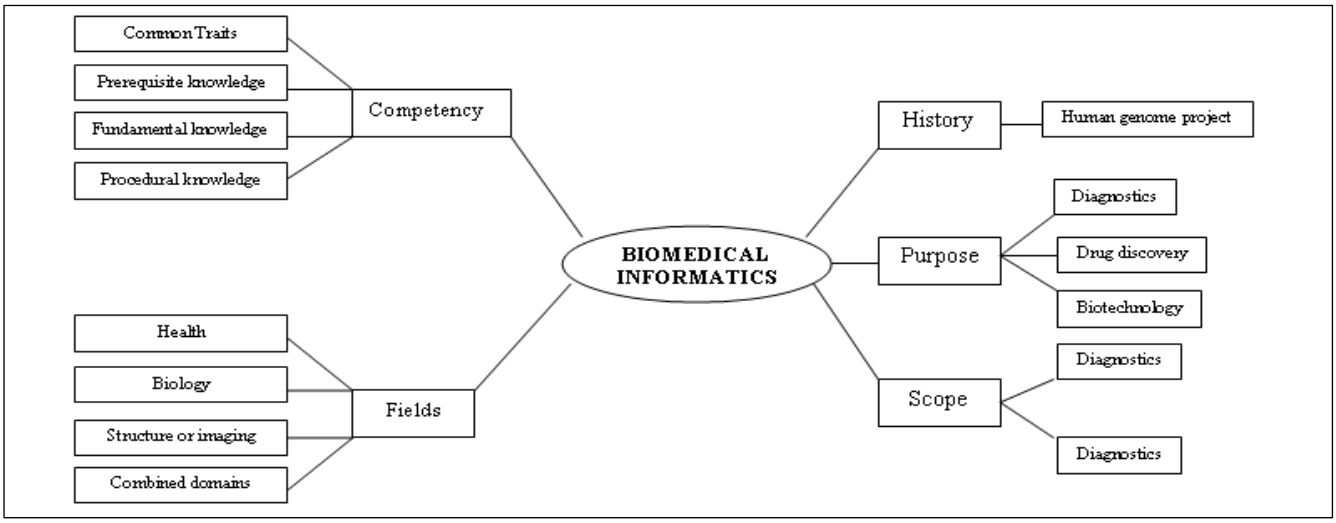

Figure 1: Core competencies of biomedical informatics.[15]

ALLOGENIC TRANSPLANTATION

Allogeneic transplantation, a widely employed therapeutic approach in the field of hematopoietic stem cell transplantation (HSCT), involves the infusion of stem cells obtained from a genetically distinct individual, commonly referred to as the donor, into the recipient.[16]

This procedure aims to replenish the recipient's hematopoietic system by facilitating the engraftment and subsequent differentiation of the transplanted stem cells into functional blood cells.[17,18] The utilisation of allogeneic stem cells in order to achieve optimal treatment outcomes, it is imperative that the donor cells exhibit a high degree of similarity to the specific type of stem cells present in the recipient patient.[19]

In this context, it is worth noting that the giver and the patient share a familial relationship, specifically as siblings or cousins stemming from a common sister or brother. The risk associated with allogenic transplantation is significantly higher when compared to autologous transplantation.

Allogeneic transplantation has demonstrated superior efficacy in combating multiple myeloma compared to autologous transplantation.[20] These donor cells help kill multiple myeloma cells in patients.[21] This is called the graft or tumour effect. So, when allogenic transplantations are done, there are often drawbacks or some critical problems that the patients will face in a very short period of time.

So autologous transplantation is better than allogenic transplantation.[22]

Allogenic transplantation is not a standard treatment for myeloma (cancer). It may be done as part of clinical trials.[23] IT tools are used to support medical practise research, clinical processes, and outcomes this is the essential component of the medicine.[24] In every general and specialised hospital, they usually use EMRs because, in the majority of cases, they are connected with practical issues. EMRs have the capability to care for a single patient at a time. So EMRs have an emphasis on justifying the medical records and billing details of the patients.[25] So, using the SCT process, we can treat multiple patients at a time SCT is a research-based method. The SCT process can be done either with a research based direct method for evaluation treatment or standard of care treatment.[26]

TOOLS AND SOFTWARE

Derived of knowledge from the various fields namely: computer science, clinical science, basic biomedical science, cognitive science, management science, epidemiology and statistics

TOOLS REQUIRED FOR INFORMATICS

Clinical protocols

Tools used to standardize and automate care in a common clinical scenario.

Clinical Documentation (includes notes, forms, and flowsheets)

A patient's history, condition, responses, therapies, activities, and/or plans are recorded and transmitted in documents.

Clinical user profiles

Personalization and/or data collection tools for clinical users.

Clinical patient education modules

A patient's education on a frequent healthcare topic using written materials.

Clinical pathways

Order set groupings that are used to standardize the rounding procedure for a typical clinical diagnostic.

Telephone number lists

Documents used to help contact a clinical staff member.

I2b2 platform

I2b2 is a translational research tool that is part of the tranSMART Foundation. The TranSMART Foundation is a non-profit organization that is run by its members.

SOFTWARE USED IN INFORMATICS

Clear health

It is a practise management (PM) and electronic health records (EHRs) solution that is free and available under the General Public Licence. These programmes are running in the background on PHP, Windows, Linux, Apache, and MySQL.

Cottage Med is an open-source electronic medical record (EMR) software based on FileMaker. It was created by a caring community. Since 2003, it has developed 10,000 downloads, hundreds of installations, and updates to software.

Free MED is a direct descendant of AMOS. Free MED is mainly written in PHP and makes heavy use of SQL; it also uses Bash, Perl, and other programming languages. Free MED stores and represents medical data in a group of 'Modules'.

Gaia EHR is medical practise management software that supports EMRS. It has various open-source technologies. This software can be written as a web application, including both server and client, in the PHP programming language. Hospital OS is a study and development project for software that will help small hospitals manage their health care. This software is a free, open-source programme that can help with hospital management and medical services. Hospital OS is used in 95 small rural hospitals and 402 health care centres that care for and treat more than 5 million people.

Pop Health is an open-source implementation software that automates population health reporting. Pop Health integrates with healthcare providers electronic health record (EHR) systems to provide clinical quality measures (CQM) and patient information. This project is initially funded by the Office of the National Coordinator (ONC). It uses ruby on rails and web 2.0 JavaScript libraries.

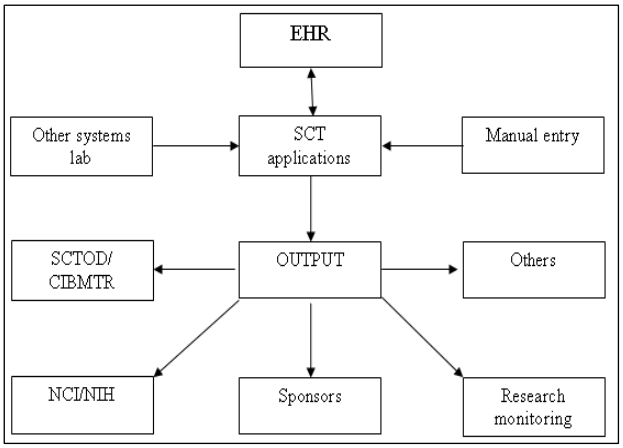

Figure 2: Schematic flow chart of electronic health record.[27]

The term 'telehealth services' refers to the use of electronic information and communication tools to help and promote clinical health care over long distances. So, telehealth care, which can help the patient's problem through the visualisation of a doctor.

The term 'telehealth services' refers to the use of electronic information and communication tools to help and promote clinical health care over long distances. So, telehealth care, which can help the patient's problem through the visualisation of a doctor.

NATURAL LANGUAGE PROCESSING

Natural language processing (NLP) is any system that manipulates text or speech. It could involve various degrees of linguistic knowledge. There are different types of NLP systems.

NLP technologies are a branch of computer science and artificial intelligence (AI). NLP helps us understand human language. Which make use of unstructured and structured data from patient datasets.[29] NLP, which understands the patient data. Once the information is uploaded to the database, it is automatically extracted from the database according to the requirements.[30] NLP helps to understand the patient trials and the efficacy and safety of

the study drug. When the radiologist will see the report and read the findings in the report. NLP automatically converts the document into text.[31] So, when the doctor reads the report, it's automatically transcribed into a text document. NLP plays a crucial role in clinical trials by choosing eligibility criteria and the randomization process for which subjects are to be included in and excluded from the study.[32] Randomization helps in clinical trials to remove or avoid the bias of study drugs, placebos, and standard drugs.[33]

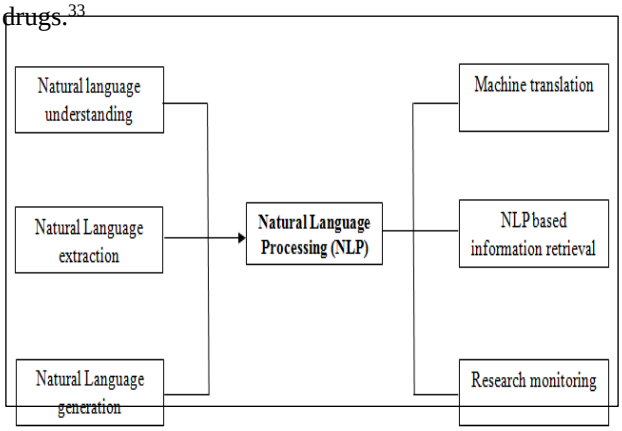

Figure 3: Schematic flow of NLP.[28]

FACILITATE CANCER RESEARCH

To assess the disparities and risks of developing breast cancer for minority women. Retrieve 12 types of findings from pathology reports: DNA INDEX, G2-M, quantitative S-phase, proliferation, oestrogen receptors, progesterone receptor, procedure, nuclear grade, positive Lymph nodes, Her-2/aneuploidy, and qualitative S-phase.[34]

DATA SHARING

Data sharing is nothing but the sharing of patient data from one place to another, i. e.; from one hospital to another hospital.[35] So, all patient data was stored in a specific database or website that could be accessed from a central server maintained by all hospital groups or the government.[36] So, if the patient has a regular check-up at a particular hospital e. g., if a person has regular check-ups in an American hospital. So, if the person is in another place, such as Russia or another place that is far from their hospital, and if the patient has any problems, then this data sharing is very useful to that person. So, the patient will go to a nearby hospital, and patient data on a website is very useful to understand his problem or disease.[37] Then, it will be easy to prescribe the medicine or diagnose the problem easily and immediately.[38,39]

RESULTS

According to these available studies, there is no existing single system that is easily designed to support both identical SCT and EMR functions. There are many IT tools used for SCT, but EMR, with the help of EMR, has some issues. So, IT tools are very useful for SCT. So, we can get results very quickly and easily, and based on programming or IT tools, the work is easy. Because of IT data or programming, write the code and make a tool or database. Then it will check for a trail run; if it is successful, then it's fine; if not, they will go identify the problems and rectify them. If SCT is a machine, then it has some problems because machines show some issues or problems, but IT tools are not like that. If we write once, we can run anywhere and anytime, including most of the day. It will not erase the data. And also, data is constant.

Compared to machines, IT tools have many advantages. And new technology like artificial intelligence and machine learning will make the process or procedure easier to perform research in EMR and SCT technology. These advancements in technology have the potential to revolutionize the field of healthcare by improving the accuracy and efficiency of medical diagnoses and treatments.

With artificial intelligence and machine learning, healthcare professionals can analyse vast amounts of patient data to identify patterns and trends that may have previously gone unnoticed. This can lead to more personalized and effective treatment plans, ultimately improving patient outcomes. Additionally, these technologies can automate routine tasks, freeing up healthcare professionals to focus on more complex and critical aspects of patient care. Overall, the integration of artificial intelligence and machine learning in EMR and SCT technology holds great promise for the future of healthcare.

DISCUSSION

This concept uses standard data standards for any data plan. So based on the use of these EMRs and SCT in IT tools, they can be very helpful for both patients and doctors. To make the data easily and quickly visualised. Compare to previous days. These types of tools and data from EMRs are very useful to improve the technology. Today's treatment is based on the technology of different equipment and computers and uses different types of software to get results or data quickly or easily.

CONCLUSION

These are studies that show the analytical features for both EMR and SCT applications. If not, most SCT applications or SCT centres will require the feature. The complexity required of these products and rapid development in medicine and science used in research and development it is important that an IT array be designed to improve the workflow of research and its productivity. And also, these EMR applications can save the patient's life because each and every patient has a unique ID, so based on that, if a person gets injured or has a health issue, then the patient will go to another country or state. So based on their unique ID, we can finalise their medical history and profile. And also, SCT plays a key role as a repair

mechanism for the disease. Among all these technologies that will play a key role in future research activities.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Ar MC, El Fakih R, Gabbassova S, Alhuraiji A, Nasr F, Alsaeed A, et al. Management of humoral secondary immunodeficiency in hematological malignancies and following hematopoietic stem cell transplantation: Regional perspectives. Leuk Res. 2023;133:107365.
2. Ashman J, Mutsonziwa N, Romano M, Kordasti S, Lombardi G, Shangaris P. Regulatory T cell niche in the bone marrow, a new player in Haematopoietic stem cell transplantation. Blood Rev. 2023;59:101030.
3. Atlam HF, Wills GB. Intersections between IoT and distributed ledger. Kim S, Deka GC, Zhang P, Advances in Computers. New York, NY: Elsevier; 2019: 73-113.
4. Li W, Liang H, Ao Y, Tang B, Li J, Li N, et al. Biophysical cues of bone marrow-inspired scaffolds regulate hematopoiesis of hematopoietic stem and progenitor cells. Biomaterials. 2023;298:122111.
5. Reddy AR, Venkateswarulu TC, Babu DJ, Indira M. Homology modeling studies of human genome receptor using Modeller, Swiss model server and Esypred 3D tools. Int J Pharm Sci Rev Res. 2015;30(1):1-6.
6. Guo S, Wang L, Xie Y, Luo X, Zhang S, Xiong L, et al. Bibliometric and Visualized Analysis of Stem Cells Therapy for Spinal Cord Injury Based on Web of Science and CiteSpace in the Last 20 Years. World Neurosurg. 2019;132:e246-58.
7. Wang G, Heimendinger P, Ramelmeier RA, Wang W. Pluripotent stem cell-based cell therapies: Current applications and future prospects. Curr Opin Biomed Eng. 2022;22:100390.
8. Jovanovich N, Habib A, Kodavali C, Edwards L, Amankulor N, Zinn PO. The Evolving Role of Induced Pluripotent Stem Cells and Cerebral Organoids in Treating and Modeling Neurosurgical Diseases. World Neurosurg. 2021;155:171-9.
9. Philips C, Terrie L, Thorrez L. Decellularized skeletal muscle: A versatile biomaterial in tissue engineering and regenerative medicine. Biomaterials. 2022;283:121436.
10. Kuznetsov M, Clairambault J, Volpert V. Improving cancer treatments via dynamical biophysical models. Phys Life Rev. 2021;39:1-48.
11. Ranganadhareddy A. A Review on Production of Polyhydroxyalkanoates in Microorganisms. J Biochem Techn. 2022;13(1):1-6.
12. Yang L, Yang Y, Chen Y, Xu Y, Peng J. Cell-based drug delivery systems and their in vivo fate. Adv Drug Deliv Rev. 2022;187:114394.
13. Ar MC, El Fakih R, Gabbassova S, Alhuraiji A, Nasr F, Alsaeed A, et al. Management of humoral secondary immunodeficiency in hematological malignancies and following hematopoietic stem cell transplantation: Regional perspectives. Leuk Res. 2023;133:107365.
14. Isser A, Livingston NK, Schneck JP. Biomaterials to enhance antigen-specific T cell expansion for cancer immunotherapy. Biomaterials. 2021;268:120584.
15. Davies A, Mueller J, Moulton G. Core competencies for clinical informaticians: A systematic review. Int J Med Inform. 2020;141:104237.
16. Davies A, Mueller J, Moulton G. Core competencies for clinical informaticians: A systematic review. Int J Med Inform. 2020;141:104237.
17. Fang J, Li JJ, Zhong X, Zhou Y, Lee RJ, Cheng K, et al. Engineering stem cell therapeutics for cardiac repair. J Mol Cell Cardiol. 2022;171:56-68.
18. Ranganadha RA, Vidyaprabhakar K, Venkateswarulu TC, Krupanidhi S, Bobby N, Abraham PK, et al. Statistical optimization of Polyhydroxtbutyratye (PHB) production by novel Acinetobacter nosocomialis RR20 strain Using Response Surface Methodology. Current Trend Biotech Pharm. 2020;14(1):62-9.
19. Timofeeva OA, Philogene MC, Zhang QJ. Current donor selection strategies for allogeneic hematopoietic cell transplantation. Hum Immunol. 2022;83(10):674-6.
20. Mishkin AD, Shapiro PA, Reshef R, Lopez-Pintado S, Mapara MY. Standardized Semi-structured Psychosocial Evaluation before Hematopoietic Stem Cell Transplantation Predicts Patient Adherence to Post-Transplant Regimen. Biol Blood Marrow Transplant. 2019;25(11):2222-7.
21. Ranganadhareddy A. A Review on Biotechnological Approaches for the Production of Polyhydroxyalkanoates. J Biochem Techn. 2023;14(2):12-7.
22. Kiefer T, Lüders C, Völler H, Daeschlein G. Update on the risk assessment of a rehabilitation stay for patients after allogeneic stem cell transplantation. Transpl Immunol. 2023;79:101865.
23. John L, Sauer S, Hegenbart U, Dreger P, Hundemer M, Müller-Tidow C, et al. Idecabtagene Vicleucel Is Well Tolerated and Effective in Relapsed/Refractory Myeloma Patients with Prior Allogeneic Stem Cell Transplantation. Transplant Cell Ther. 2023;29(10):601-9.
24. Lalmuanawma S, Hussain J, Chhakchhuak L. Applications of machine learning and artificial intelligence for Covid-19 (SARS-CoV-2) pandemic: A review. Chaos Solitons Fractals. 2020;139:110059.
25. Hoang KH, Ho TB. Learning and recommending treatments using electronic medical records. Knowl Bas Sys. 2019;181:104788.
26. Jacobs M, Kerkmeijer L, de Ruysscher D, Brunenberg E, Boersma L, Verheij M. Implementation of MR-linac and proton therapy in

two radiotherapy departments in The Netherlands: Recommendations based on lessons learned. Radiother Oncol. 2022;167:14-24.
27. Qu Z, Zhang Z, Zheng M. A quantum blockchain-enabled framework for secure private electronic medical records in Internet of Medical Things. Informat Sci. 2022;612:942-58.
28. Cheema SM, Tariq S, Pires IM. A natural language interface for automatic generation of data flow diagram using web extraction techniques. J King Saud Univ Comp Inf Sci. 2023;35(2):626-40.
29. Locke S, Bashall A, Al-Adely S, Moore J, Wilson A. Kitchen GB. Natural language processing in medicine: A review. Tre Anaes Critical Care. 2021;38:4-9.
30. Han S, Zhang RF, Shi L, Richie R, Liu H, Tseng A, et al. Classifying social determinants of health from unstructured electronic health records using deep learning-based natural language processing. J Biomed Inform. 2022;127:103984.
31. Bitterman DS, Miller TA, Mak RH, Savova GK. Clinical Natural Language Processing for Radiation Oncology: A Review and Practical Primer. Int J Radiat Oncol Biol Phys. 2021;110(3):641-55.
32. Shi S, Largent EA, McCreedy E, Mitchell SL. Design Considerations for Embedded Pragmatic Clinical Trials of Advance Care Planning Interventions for Persons Living With Dementia. J Pain Symptom Manage. 2023;65(2):155-63.
33. Stengel D, Augat P, Giannoudis PV. Large-scale, pragmatic randomized trials in the era of big data, precision medicine and machine learning. Valid and necessary, or outdated and a waste of resources? Injury. 2023;54(3):2-9.
34. Koçak A, Heselmeyer-Haddad K, Lischka A, Hirsch D, Fiedler D, Hu Y, Doberstein N, et al. High Levels of Chromosomal Copy Number Alterations and TP53 Mutations Correlate with Poor Outcome in Younger Breast Cancer Patients. Am J Pathol. 2020;190(8):1643-56.
35. Kumar R, Wang W, Kumar J, Yang T, Khan A, Ali W, et al An Integration of blockchain and AI for secure data sharing and detection of CT images for the hospitals. Comput Med Imaging Graph. 2021;87:101812.
36. Ranganadha, A. R., Chandrasekhar. Production of Polyhydroxtbutyratye from marine source-A Review. Indian J Ecol. 2021;48(6):1829-36.
37. Ranganadha AR, Sravani K, Sanjana N, Chandrasekhar C. Production of biopolymer from bacteria – A Review. Environment Earth Sci Res J. 2021;8(2):91-6.
38. Atlam HF, Wills GB. Chapter Three - Intersections between IoT and distributed ledger, Editor (s): Shiho Kim, Ganesh Chandra Deka, Peng Zhang, Advances in Computers. Elsevier. 2019;115:73-113.
39. Ranganadha AR, Venkateswarulu TC, Indira M, Narayana AV, Lohita TN, Sriharsha M. Identification of Membrane Drug Targets by Subtractive Genomic Approach in Mycoplasma Pneumonia. Res J Pharm Tech. 2015;8(9):1209-16.

Cite this article as: Teja KSR, Gundimeda SL, Kolipakula A, Ramprasad A, Nuzella SK, Reddy AR. Leveraging electronic health records and stem cell transplants: a review. Int J Sci Rep 2023;9(11):376-81.