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EDITOR’S MESSAGE

With great pride, and enthusiasm, as an Editor-in-Chief, that I invite you to read this special issue of the Life Science Edge. Life Science Edge is a unique journal with the purpose to enhance our natural and scientific knowledge dissemination in the world under the free publishing principle. An enormous amount of work has gone into the development of this issue and I believe you will see that effort reflected in this edition and in the impact it will have on the field.

The papers in the present issues mainly focus on the current aspects of life sciences. With rapid advances in Science and Technology (S&T), the societal expectations from S&T are increasing. These expectations impose upon the scientific community, the responsibly of fulfilling diverse societal needs: providing the basic infrastructure, efficient transportation, IT connectivity and e-governance, safety and security of citizens as well as finding solutions for alleviating malnutrition, offering adequate health care. To cope up with the increasing population in India, the only option left with us is to tap every channel of recent advances of technology for the security of life and sustainable development.

This issue will be very useful for students, researchers, scientists and all entrepreneurs.

I acknowledge my deep thankfulness to Chancellor, Vice-Chancellor, Pro-Chancellor, Registrar, Director – Strategy and Planning, Dean and Principal of the Garden City University for their endless support throughout the creation of this edition.

Editor-in-Charge
Life Science Edge
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BRIDING THE GAP BETWEEN UNIVERSITY AND INDUSTRY

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Abstract

The role of the university has become very dynamic and entrepreneurial at this time. There are models and indicators available to judge entrepreneurial orientation of the university. University and industry (UI) are joining hands to explore the new horizons of opportunities through research and development. This mutual relationship benefits both the organizations and strengthens the country’s economy by industrializing the researched products. For a long time collaboration between Universities and industry has been existed, but the rapid increase of global knowledge has strengthened the demand for strategic relationships that go beyond the conventional funding of research projects. The role of the university research should be developed in the coming centuries to play an important role in industrial and in turn economic growth. To make the chemistry work, both sides should overcome the communications and the cultural divide that tends to impair university – industry relationships of all categories and undercut their potential. A number of efforts have been made to collaborate with these industries by mutual reciprocal visits of university and industry personnel as well as student internships. It is aimed to solve short term and long term technological issues at the industrial units. This will not help the local knowledge base and skills to improve but bring confidence and trust between two partners that make the university - industry relationship as a win-win situation. Hence, academic entrepreneurship is not only responsible for creating knowledge but they go one step further and take various initiatives to facilitate the conversion of this knowledge through technology transfer processes into market environments by making suitable prototypes, Patents and Publications.

Keywords: University-industry relationship, knowledge base, Research University, Prototype, and Patents & Publications

INTRODUCTION

With growing economy, India is also witnessing the growth of education sector. However, Indian industry is not so convinced about the job-readiness of the graduates. There is an urgent need that Indian Industries and Academia come together and address some of the underlying challenges.

Academia and Industry are two different worlds which operate on different pedestals. Both have different purposes and different ideologies. However, the rapid pace of change in the outside environment is compelling these two different worlds to come together to address and solve some of the real-world challenges.
As per the recent statistics, the education sector in India is poised to witness major growth in the years to come as India will have world’s largest tertiary-age population and second largest graduate talent pipeline globally by the end of 2020. India’s economy is also expected to grow at a fast pace; rapid industrialization would require a gross incremental workforce of ~250 million by 2030; India could potentially emerge as a global supplier of skilled manpower. However, despite these encouraging statistics, a major segment of graduates remain unemployable - according to ‘National Employability Report’ 2016, which is based on a study of more than 1,50,000 engineering students who graduated in 2015 from over 650 colleges, 80% of them were unemployable and only 3% had suitable skills to be employed in software or product market.

Such large segment of the population not getting jobs is indeed a grave problem as it has direct repercussions on the Indian economy and on social conditions. Though educational institutions are training millions of youngsters yet corporate are often complaining that they are not getting the necessary skill and talent required for a job. Not only have they lowered their hiring standards in order to be fully staffed, they are also conducting training programs to make their hires productive and up to speed. But this arrangement can’t last for long as it hampers organization’s productivity.

So where we going wrong and what can be done to tackle this challenge? One of the approaches to tackle the problem of lacking skill and job readiness is partnerships between the industry and academia. While predicting the nature of jobs that would be available in the future is difficult, the efforts to prepare people for the jobs should continue. This paper focusses on the possible ways to collaborate the academia world and industrial sector to face the challenges together.
RESULTS AND DISCUSSION

The current academic system is mainly not able to cope with the requirements of the industry. Therefore, the different manufacturing industry sectors need to provide special training to the recruited freshers for a certain period, before they are ready to be fully employed in the industry. This process is both time consuming and expensive, as many decentralized practice-oriented educational infrastructures must be kept up-to-date and operated by the industry. This explains the importance of collaboration between the industry and the academic world to develop a complete professional before stepping out of the education world. This is where the concept of knowledge transfer comes to play.

- The Challenges

Statistics show that almost 60% of all graduates in almost every sector do not get jobs in industry right after their graduation. This can implicate skill gaps as the demand for professionals at present. This leads to the hypothesis that students are not readily employable for the industries, as they lack out-of-the-box thinking which is extremely essential to be a part of a well-established industry. Hence it is necessary to identify gaps in the competencies of young graduates in regard to future skills and mind-sets needed for emerging topics of the manufacturing industry, supporting strategically development goals. Based on the competence requirements from the industrial perspective, the as-is-situation of current teaching and learning systems from the academic perspective is reflected to reveal possible deficits. Opportunities and a new approach need to be designed for improving the skill-sets of future technical professionals in India.

- Industry analysis

Nearly all experts agree that theoretical knowledge is important and is seen as the foundation for being able to work and solve problems in an industry. The methodological competencies, which mainly refer to the transfer of theoretical knowledge into real application-based problems, are generally seen more important than the theoretical knowledge itself. Applied knowledge is often mentioned as the most important skill which lacks in the students of the current generation. Another often-mentioned methodological competency is problem solving. It is said that theoretical problem solving is not sufficient as it differs from real life problem solving. Today’s youth tends to get scared of problems rather than trying to solve them which is again unfit for being called a professional industrialist. Furthermore, planning skills, continuous improvement and project management skills are often expected which the academia world fails to provide. Social skills are often seen as very important skills for newly graduated freshers and dearth of such skills again become a major reason for their unemployment. Skills like teamwork, conflict management and interdisciplinary communication are necessary to be a part of the industry. Additionally, self-discipline and a positive work attitude mostly within the personal competencies are essential skills need to be incorporated within the students. Furthermore, presentation skills, the curiosity to learn new things and “world knowledge” are desired. The personal competency when compared to the methodological and social competency is regarded as less important but required. The most required skills, categorized by competencies, are summed up in Table 1.
Table 1. Qualitative analysis: Requirements and competency gap regarding freshly graduated production engineers from industry perspective

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<th>Competency category</th>
<th>Requirements</th>
<th>Gap</th>
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<tr>
<td>Professional</td>
<td>Production machines; latest industry standards</td>
<td>Mostly fulfilling demands</td>
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<tr>
<td>Methodological</td>
<td>Methodological Applied knowledge; problem solving; planning; continuous improvement; project management</td>
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<td>Self-discipline and positive work attitude are gapping</td>
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- **University analysis**
  
The study conducted with the industry experts reveals that graduates finish their academic education with insufficient methodological competencies. The selection of degree programs is partially biased by various factors like future job offers, profile of job, continued education possibilities, family, etc., resulting in a possible underperformance of the students. In the current curriculum of education, the project-based learning makes up 30% of the time and only 30% of the marks. However, the remaining 70% of the marks are still awarded by traditional written or oral examination methods. Against the background of the above-discussed factors affecting the competencies of the graduating freshers, students should be offered more practice-based learning and practical-based learning to try and train methodological competencies.

- **Approach to bridge the gap**
  
Different approaches can be chosen to address the outlined qualification gaps of graduates between academia and industry. The identified gap can be addressed by combining didactical approaches and existing concepts with emerging topics of the industry resulting in the concept of Learning Factories (LF). The identified challenges of current academic teaching/learning-systems for students lie mainly in the need to teach and train methodological and social competencies in extension to the very profound professional competencies. This means that the existing curriculum must be extended by didactic elements of problem-solving, applied knowledge and utilization of communication skills. A collection of different didactical approaches can be found in regarding the identified challenges and the status quo in the university analysis, activity-based methods like problem-based learning can be relevant approaches. In this process the teacher merely acts as a facilitator while new information is acquired by self-directed learning. The defined goals of problem-based learning include the
development of problem-solving skills, becoming an effective collaborator and increasing the intrinsic motivation to learn. Additional goals are the development of self-directed learning skills and the construction of an extensive as well as flexible knowledge base. Similar approaches fulfilling the needs partly or entirely are experience-based learning, game-based learning, project-based learning and research-based learning. These action-oriented, competency based didactical methods can be promoted by learning factors as a real world environment. Several learning factors have been established utilizing the mentioned methods. In this mode of education students are educated in an artificial, physical environment which represents a realistic situation as found in industrial application. Depending on the given requirements (curriculum, physical restrictions, financial budget and competence target-map), a suitable framework can be designed with the help of proposed frameworks. Sustainable production and advanced digital technologies will be important in the future for the manufacturing industry.

- **Collaborative research between universities and industries ; a key source of knowledge transfer**

Nowadays, universities are responsible for the key to the development of the regional economic and cluster formation because the economies of the industrial countries become more knowledge-based. The Organization for Economic Cooperation and Development (OECD) defines the knowledge-based economies as "one in which the production, use, and distribution of knowledge and information are critical to the process of economic growth". It is not surprising that the university's role is central to the emerging knowledge-based economies. Since the economies of the industrialized countries have become more knowledge-based, universities have become viewed as important players in regional economic development. A survey in the “Economist” suggested the concept of the knowledge-based economy serves to “portray the university not just as a creator of knowledge, a trainer of young minds, and a transmitter of culture, but also as a major agent of economic growth: the knowledge factory, as it were, at the centre of the knowledge economy”. When thinking about developing new technologies, universities bring valuable resources to the table. Among these are: research – basic and otherwise; access to funding; access to the latest, most up-to-date knowledge base; access to physical assets (i.e. technology, specialized equipment, etc.) and more. Universities that spin off research to companies to create viable products and services are a win-win situation. It sounds easy but can be difficult to achieve, which means the full potential of some technologies are never fully realized. Effective knowledge sharing between public science and industry is recognized as one of the pathways towards the knowledge based society and has been pointed out by the European Commission as one of the main features of the research area.
Fig 1: Knowledge transfer from industrialists to students can help bridge the gap

Relationships between universities and industry can take a number of different forms such as:
• Companies fund research projects at public research organizations; • Development of joint research projects with participants from the firm and the university; • Co-publications resulting from joint research projects; • Collaborative technology development resulting in inventing and/or assigning competent; • University scientists working at firms; • Firm's employees working within universities; • Companies license university patents; • University scientists undertaking short term consultancies; • Participation in formal and informal networks. Co-publishing between a university and industry must be understood on the background of the university publishing specialization and also the role the university plays in the national context. Top universities are important players in relation to university-industry co-publications. One of the problems with the use of the data on co-publications and patenting alone is the lack of detailed evidence on how good a proxy they are for measuring university-industry linkages. It is important for university professors and the students to carry out researches related to the industry and publish their results because the dissemination of knowledge is the essence of academic research. This is the main way for the professors’ peers to judge professors achievement, the advancement and tenure, and obtain future grants and recognition. For students, it is essential to publish their research results to obtain post-doctoral positions and jobs. Seminars, workshops and interactions between students and industrialists can be a great source of knowledge transfer. The industry university collaboration can be a perfect workout as it helps the transfer of knowledge to the students about every aspect; be it patenting or being industry ready; both from teachers as well as professional industrialists. Hence this collaborative education is the best way to bridge the gap between industry and university.
CONCLUSION

Collaboration between Universities and industries has existed since decades, but the rapid increase of global knowledge has strengthened the demand for strategic relationships that go beyond the conventional funding of research projects or a mere collaboration. Universities in India should swiftly adapt to new roles and get accustomed to the new demands and should design new approaches of transfer of knowledge from industry to their students. They should also promote young entrepreneurs, encourage new ideas and methodologies, support them financially and mentor them and cooperate with surrounding industries to develop knowledge into commercial products. Academic entrepreneurship is a main key to hit the target of economic prosperity. Indian industries should launch such programs for young entrepreneurs. It should work closely with universities to promote new ideas and provide necessary funding to university projects that impact the country’s economy. This will in turn benefit the industrialists to employ well prepared industry ready freshers.

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INFECTIOUS DISEASES AS AGENTS OF BIOTERRORISM

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ABSTRACT

Bioterrorism refers to the deliberate release of biological agents such as viruses, bacteria, or other germs to cause illness or death. Infectious diseases remain as a decisive factor in the health of all individuals worldwide. Acts of bioterrorism range from a single exposure directed at an individual by another individual or to government-sponsored biological warfare resulting in mass casualties. Attacks with biological agents are among the most insidious and create the greatest fear in society. Attacks could go undetected for a long time, potentially exposing a vast number of people, who are unaware of the threat. These germs are often found in nature. But they can sometimes be made more harmful by increasing their ability to cause disease, spread, or resist medical treatment. Biological agents spread through the air, water, or in food or through humans fomites. Scientists worry that anthrax, botulism, Ebola and other hemorrhagic fever viruses, plague, or smallpox could be used as biological agents. Biodefense uses medical measures to protect people against bioterrorism. This includes medicines and vaccinations. It also includes medical research and preparations to defend against bioterrorist attacks. An intervention by the government advocating accurate and substantial information to the public by credible public health and medical experts is critical in countering bioterrorism.

Keywords: Biological agents, biological weapons, bioterrorism

Infectious diseases remain as a decisive factor in the health of all individuals worldwide. In developed countries pneumonia, septicemia and influenza remain the as leading cause of death, in elderly people suffering from Acquired immunodeficiency diseases and those individuals undergoing immunosuppressive therapy. In under developed countries and developing countries the major burden of infectious diseases is among infants and children with death toll high as 10 million annually, due to malnutrition and unsanitary living condition leading to diarrheal and respiratory infections. Infectious agents can vary in size and belong to a wide range of classes.

Viruses: Viruses account for a large number of human infections. Many viruses results in transient illness such as cold and influenza. Viruses are intracellular microorganism which depends on host metabolic machinery for their replication. Many viruses persist within the body of the host for years and continue multiplying stemming into chronic infections. Hepatitis B viruses, herpes zoster virus, HIV are few of them. Viruses can also bring about host cell transformation leading to benign and malignant tumors.
Bacteria: Bacteria are prokaryotic organism lacking membrane bound nuclei and membrane enclosed organelles. Normal healthy people can be colonized by about $10^{12}$ bacteria on the skin, $10^{10}$ in the mouth and $10^{14}$ in the gastrointestinal tract. Bacteria infesting the skin include Staphylococcus epidermidis and Propionibacterium acne that causes acne. Streptococcus mutans in the mouth contribute to dental plaque, a major cause of tooth decay. There are about 395 species of normal intestinal flora in humans. Bacteria can be facultative intracellular or obligate intracellular bacteria. Obligate intracellular bacteria include Chlamydia and Rickettsia which replicate inside vacuoles in endothelial and epithelial cells. Chlamydia trachomatis is the most frequent infectious disease causing female sterility by infecting fallopian tubes and blindness by causing chronic inflammation of the conjunctiva. Rickettsiae injure the endothelial cells in the host resulting in hemorrhagic vasculitis; it can also affect central nervous system and cause death due to Rocky Mountain spotted fever and epidemic typhus.

Fungi: Fungi can be described as eukaryotic organism possessing thick chitin cell wall and ergosterol containing cell membranes. Pathogenic fungi exhibit thermal dimorphism. Fungi can result in superficial or deep infection. Deep fungal infections can spread systemically and invade tissues destroying vital organs. Candida, Aspergillus, Mucor, Cryptococcus are opportunistic organism that colonize individuals and give rise to life threatening infections characterized by necrosis, vascular occlusion and hemorrhage.

Protozoa: Single celled eukaryotes are major cause of mortality in developing countries. Protozoa replicate intracellularly like plasmodium in RBC cells or leishmania in macrophages. The common intestinal protozoans are Entamoeba histolytica and Giardia lamblia. Blood borne protozoans are transmitted by insect vectors, in which they replicate before being passed to humans. Intestinal protozoa are acquired by ingestion of cysts from contaminated food or water. Toxoplasma gondii is transmitted by contact.

Biological agents are organisms or toxins that can kill or incapacitate people, livestock and crops. Bioterrorism is the deliberate release of viruses, bacteria, toxins or other harmful agents to cause illness or death in people, animals, or plants. These agents are typically found in nature, but could be mutated or altered to increase their ability to cause disease, make them resistant to current medicines, or to increase their ability to be spread into the environment. Some bioterrorism agents can be spread from person to person and some cannot. The Centers for Disease Control and Prevention have evaluated the microorganisms that pose the greatest danger as weapons on the basis of the efficiency with which disease can be transmitted, how difficult the microorganisms are to produce and distribute, what can be done to defend against them, and the extent to which they are likely to alarm the public and produce widespread fear. These bioweapons are ranked into three categories A, B and C.

Category A: These are disease agents that pose a risk to national security because they can be transmitted from person to person and/or result in high mortality. Eg: The Anthrax (Bacillus Anthracis) attacks in the United States in 2001 had killed five
people and left 17 sickened. It had transformed the theoretical threat of bioterrorism into reality.

Category B: These are moderately easy to disseminate and result in low mortality.
Eg: Brucellosis (Brucella sp.), Epsilon toxin of Clostridium perfringens.

Category C: These include emerging disease agents that could be engineered for mass dissemination in the future. Eg: Nipah virus was first identified during an outbreak of disease in Malaysia in 1998. On this occasion, pigs were identified as the intermediate hosts. In Bangladesh in 2004, humans became infected with the virus as a result of consuming date palm sap that had been contaminated by infected fruit bats. Human-to-human transmission had also been documented.

Cases of outbreaks of Nipah virus in India had been reported earlier. But rapid urbanization and changing climate in recent years, has played a key role in triggering the re-emergence of Nipah Virus in India. An upsurge in the nipah virus epidemic had been reported in Kozhikode district of Kerala, India.

As till now there is no vaccine for prevention or cure and treatment is limited to supportive care. The Center for Infectious Disease Research and Policy (CIDRAP) at the University of Minnesota, with support from the Wellcome Trust and in collaboration with the WHO, has been tasked with facilitating the collaborative development of a draft “Nipah R&D Roadmap”.

Bioterrorism has become a real and increasing threat across the globe. The NIAID has prioritized towards genomics research, the expansion of research infrastructure, and the development of new diagnostics, therapies, and vaccines to protect civilians against potential agents of bioterrorism. Advanced biodefense research, has improved the methods of tackling these diseases to prevent the outburst of an epidemic.

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NANOMEDICINE AS A POTENTIAL THERAPEUTIC AGENT IN TREATMENT OF DIABETES

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ABSTRACT

Diabetes is a group of metabolic disorder characterized by a complete lack of insulin, a relative lack of insulin, or insulin resistance. The incidence of diabetes is increasing at an alarming rate and it has been speculated that the number of diabetic patients worldwide would increase to approximately 300 million by the year 2025. Consequently, the requirement for insulin will increase manifold and the productivity of current insulin expression system would not be sufficient to meet the future market demands. Insulin has been commercially produced since ages to treat diabetes using animal origin. However, ethical issues involved in extracting animal insulin has replaced conventional methods by utilizing microbes for commercial production of insulin. At present several researches have been focusing on alternative methods for managing diabetes. Among these options the use of nanomedicine is becoming an eye catching and most promising. To overcome the drawbacks of conventional injectable insulin, drugs have been modified through nanocarriers with targeting ligands for their selective and targeted delivery meant for oral and pulmonary delivery. Different nanoparticles developed to form stable and efficient insulin delivery system. In diabetic patients, oral administration of insulin can be beneficial not only to alleviate the pain and trauma caused by injections, but it can also mimic the physiological fate of insulin as well. It has been found that nanoparticles of chitosan, calcium pectinate zinc oxide, alginate, casein and different polymers have been used as a carrier for oral insulin delivery. Biodegradable Polymeric nanoparticles for parenteral insulin delivery have also been used, where the insulin matrix surrounded by the nanoporous membrane containing grafted glucose oxidase. A rise in blood glucose level triggers a change in the surrounding nanoporous membrane, resulting in biodegradation and subsequent insulin delivery. Inhalable, polymeric nano based drug delivery can be directed toward insulin delivery through inhalable nanoparticles The medical applications for nanotechnology are enormous and could give medicine, including the treatment of diabetes, an entirely new outlook.

Keywords: Insulin, Diabetes, Nanomedicine and Nanotechnology

INTRODUCTION

Diabetes mellitus, a metabolic disorder is caused either due to lower insulin secretion by the cells or due to lower binding efficiency of insulin on their cell surface receptors resulting in high blood glucose level. Diabetes has been categorized as Type 1 and Type 2. Type1 diabetes is a condition, characterized by deficiency of insulin due to destruction of insulin producing beta cells of Islets of Langerhans by autoimmune system in pancreas.
While, type 2 diabetes is distinguished as disorders of both insulin resistance and secretion due to defects in insulin receptor on cell membranes. Treatment of diabetes needs constant monitoring of blood glucose level, regulating it through modified dietary sugar intake, physical exercise and insulin therapy to attain normoglycemia (Garima et al, 2015). Current dosage of injectable insulin, required to maintain acceptable serum glucose level, comprise of up to four subcutaneous injections per day which can cause psychological stress leading to poor patient compliance (Stanley et al, 2012). Thus, focusing on the alternative route of administration (oral or pulmonary) or reducing the injection doses are beneficial to reduce the inconvenience and drawbacks associated with this conventional method. Orally delivered insulin reaches systemic circulation after passing through liver similar to physiological insulin secretion while injected insulin may result in peripheral hyperinsulinemia and associated complications (Carino et al, 2000). Insulin can get deteriorated by gastric pH and intestinal enzymes, and even intestinal epithelial cell membranes serve as absorption barrier for intact peptide structure resulting in less than 1 % bioavailability of total insulin taken orally (Lowman, 1999). Although, significant advancement has been made worldwide in attaining for a convenient and equally effective oral insulin delivery (Gilzhai,2003), still sufficient commercial development has not been achieved. As a solution to these challenges, nanocarriers have been considered as the best suited vehicle for oral delivery of insulin (Jin et al 2012). Various nanocarriers, like polymeric or micelles, have granted a promising advancement to acquire desirable biopharmaceutical and pharmacokinetic properties for insulin (Garima et al, 2015). Nanotechnology is a rapidly growing industry with great potential and applications in many areas, including nanomedicine. Nanomaterials have unique properties and applications when it comes to drug delivery and imaging, and they have the potential to improve diagnostics and therapy of many human disorders, including neurodegenerative disorders, by their ability to cross the Blood Brain Barrier. The nanosize and the large surface area of nanoparticles reflects increased reactivity, and even an inert bulk compound, such as gold, may elicit a response in humans when administered as a nanomaterials. The possibilities of nanomedicine include nanoformulations for efficient drug delivery, smart drugs which only activate when needed, engineered microbes which produce human hormones, and even "nanorobots", which would move autonomously around the body acting as a boost, or a replacement, for our immune system, red blood cells, or many other biological systems.

Applications of Nanotechnology for Diabetes Management

Oral Insulin
Insulin for Type 1 diabetes is currently delivered by injection, as orally administered insulin has limited effectiveness. It is denatured by the acidity of the stomach, and its large size means it is absorbed slowly, which means it can even be partially digested by enzymes in the intestine before it can be absorbed into the body. It has been found that nanoparticles of chitosan can be used as a carrier for oral insulin. It protects the insulin from digestive juices, and allows the insulin to be absorbed into the bloodstream much more effectively. Chitosan
nanoparticles are cheap and easy to produce, and completely biocompatible, so this technology should be realized on a fairly short timescale (Rahiman et al, 2012).

Monitoring Glucose Levels
Current methods of blood glucose monitoring are invasive and often painful. The finger-prick test has been associated with non-adherence to treatment regimes by diabetic patients because of this, but it also has very limited accuracy - it cannot be performed during other activities, such as driving, or sleeping, and its intermittent nature means that it can miss important and potentially dangerous spikes and fluctuations in blood glucose levels in between tests. Several improved methods for non-invasive, continuous monitoring of blood glucose have been proposed in the last few years. Many of these take advantage of the advances in medical technology made possible by nanotechnology.

Nanosensors
Nanosensors could use carbon nanotube electrodes to selectively measure glucose concentrations. Functionalization or the nanotubes would allow the presence of glucose to alter the current flowing down the conductive nanotubes. This data could then be fed to an embedded microchip, which could send the data wirelessly to a wearable computer. This would allow accurate, continuous monitoring of blood glucose levels. However, there may be issues with ensuring the biocompatibility of the sensors, as they would need to remain implanted in the body for a long period of time. One of the most promising near-term technologies is a "smart tattoo", which would contain polymer nanoparticles coated with molecules which fluoresce when glucose drops to dangerous levels, creating a visible glow in the skin. Whilst this is clearly not a complete monitoring solution, it would be helpful in identifying danger between tests.

Nanoporous Immunoisolation Devices
Pancreas transplants, which could potentially cure Type 1 diabetes, are extremely risky procedures. Even a partial transplant, targeting only the Islets of Langerhans cells which produce insulin, result in a massive immune response, rejecting the new organ. The amount of immunosuppressant drugs required to prevent rejection is unsafe, and may actually damage the islets of Langerhans cells themselves. One potential solution to this is to provide a "safe harbour", where transplanted pancreas cells are unaffected by the immune system whilst remaining productive. This could be achieved by using a porous container made of silica, or some other inert material. If the pore size of the material was around 20 nm, human or animal islets of Langerhans cells within would remain accessible to smaller molecules such as glucose and insulin, but white blood cells and other immune system components would be unable to access them, therefore preventing rejection.

Artificial Pancreas
The artificial pancreas is a machine which would monitor blood glucose levels using an array of sensors, and release insulin from a reservoir into the bloodstream, using an infusion pump, whenever it is required. The concept has been around for some time - the first proposal for an
artificial pancreas was made in 1974. With the technology at that time, and even the technology available currently, however, the size of such a device would make it impractical for permanent use. The advances made possible by nanotechnology could change this - simple nanomachines which respond directly to glucose concentration to release insulin as it is needed, without the need for a controlling computer unit, could potentially act as a one-time treatment which would remove all symptoms of diabetes permanently.

**Nanopumps**

The nanopump is a powerful device and has many possible applications in the medical field. The first application of the pump, introduced by Debiotech for insulin delivery. The pump injects insulin to the patient’s body in a constant rate, balancing the amount of sugars in his or her blood. The pump can also administer small drug doses over a long period of time.

**Conclusion**

Nanotechnology has proven beneficial in treating diabetes mellitus by not only improving the catalytic properties of electrodes but also by increasing the available surface area of the sensor-receptor complex. This can revolutionize insulin delivery through enhanced oral formulations and islet encapsulation. Polyethylene cyanoacrylate nanospheres have proven to be successful for insulin delivery in streptozotocin-induced (STZ) diabetic rat model. Hopefully, next generation nanoparticle mediated insulin will improve everyday lives of diabetic patients in the foreseeable future. Nanomedicine shows great potential for the diabetic management and at the moment the suggested benefits in diabetic health care outweigh the possible dangers of nanoparticles use in medicine. Use of nanomedicine in diabetic care is in initial stage, but progress is rapid. It is likely to be a key technology for solving many diabetic problems and will be a core technology in diabetic research. In the long run, nanotechnology will clearly open up many routes to treatments and cures for diabetes, as it will for many of the diseases and conditions that currently plague mankind. Whilst some of these technologies are quite far-fetched, there is evidence that we will see significant advances in the treatment and management of diabetes quite soon.

**REFERENCES**


Traditional knowledge in the improvement of breeds and their produces of livestock in Karnataka

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ABSTRACT

Animal farming has been practiced in India since the ancient time for their produces to use it as nutritional source. Area wise different species of livestock practicing by the farmers, ruminants and non-ruminants are maintained by maximum numbers in most of the family in required combinations. Traditional approaches and various methods were used for the improvement of the breeds of livestock in all the parts of the state. Karnataka is endowed with some recognized breeds of cattle (6), buffalo (1), sheep (4) and goat (2), pig (1), poultry (1) besides many non-descript domesticated animals. There are certain traditional background in the evolution and existence of these breeds. Genetic selection of animals and mating methods were evolved in earlier days itself. Further, efforts are being made by the farmers to change their sire in the herd / flock for improvement even without following the underlying modern principles. Traditional approaches are know-how to use it for the improvement of breeds of cattle, buffaloes, sheep, goats, pigs and poultry and their produces for healthy livelihood of farmers in Karnataka have been discussed.

Key words: Traditional knowledge, Breed improvement, Livestock, Animal farming, Animal produces

INTRODUCTION

Selection of livestock for higher productivity was a specialized subject even in the days of Mataya Purana, which gives instructions regarding the selection of a bull for mating. Several pastoral communities too keep livestock by tradition as a sole source of livelihood (Sastry, 1995). It is a historical perspective of humans and their association with livestock is the art of rearing under the different agro-ecological conditions of the country has not only led to the evolution of highly diverse animals genetic resources, but also many traditional technologies for the improvement of breeds (Karthickeyan and Gajendran, 2005).

Our country is bestowed with rich domestic animal biodiversity such as cattle, buffalo, goat, sheep, horse, camel, pig, donkey, yak, mithun, poultry etc. Vast range of agro-ecological zones of India has helped to develop large number of breeds of various species of livestock and poultry. This diversity of domesticated livestock and poultry breeds has emerged due to years of evolution within specific ecological niche. Several complex and interactive factors like human needs, adaptability of a species, agro-climatic conditions, selection and animal husbandry practices ultimately culminate in the emergence of a breed. Each breed/type/strain should be regarded as an aggregate of specific genes, to serve specific purpose(s) in particular agro-ecological zones (Joshi and Phillips, 1953).
India is the vast reservoir of animal genetic resources containing more than 41 recognized breeds of cattle, 13 buffaloes, 42 sheep, 28 goats and 18 poultry breeds. It is very relevant and accurate literature to mention the animal genetic resources available in Karnataka before discussing the current status of indigenous traditional breeding knowledge used for developing them.

**Traditional Technical Knowledge**

**Breed improvement and management**

Traditional technical knowledge used in breed development and also for improving the productivity of dairy cattle in the past were "selection of breed" and "mating management". By following the practice of mating deals with "best to best" or "like with like" rather naturally, which is now recognized as preferential mating, by which many useful breeds were evolved in all the parts of India. Similarly, continuous efforts have been made all along to improve them further for future (Balaine, 1980).

**Indigenous breed qualities**

Rearing of cattle’s has been a practice of traditional livelihood in India and is closely linked to agricultural economy. India, with its 199 million cattle heads, has 14.5 per cent of the world cattle population. Out of this, 83% (166 million) are indigenous. Most of the indigenous cattle (about 80%) are non-descript and only 20% belong to indigenous breeds recognised by National Bureau of Genetic Resources. Cattle genetic resource of India is represented by 41 recognised indigenous breeds and there are 13 recognised buffalo breeds. Indigenous cattle breeds, in India, are robust and resilient, and are particularly suited to the climate and environment of their respective breeding tracts. They are endowed with qualities of heat tolerance, resistance to diseases and the ability to thrive under extreme climatic stress and less than optimal nutrition.

**Cattle Breeds of Karnataka**

**Amritmahal**

Amritmahal literally means the department of milk. Originally the rulers of Mysore State had started an establishment of cattle collected from the prevalent types of cattle within the area for the supply of milk and milk products to the palace. At the same time, the bullocks were utilized for the movement of army equipage. The bullocks were regularly classified as gun bullocks, pack bullocks, plow bullocks, etc. They attracted great attention during the nineteenth century on account of their endurance and the speed with which they could move army equipment. It is claimed that they could maneuver a march of 100 miles in 2 1/2 days.

The cattle of Amritmahal establishment originally comprised three distinct varieties: Hallikar, Hagalvadi and Chitaldroog. Prior to 1860 it seems that these three varieties were maintained separate from each other. In 1860, the whole establishment was liquidated for reasons of economy. By the year 1866, it was realized that an establishment for the supply of cattle was necessity, and during the year a herd was again established. Thus, the foundation cattle from which the Amritmahal breed was developed were of the Hallikar and closely related types.

**Characteristics**
The coloring of Amritmahal cattle is usually some shade of gray varying from almost white to nearly black, and in some cases white-gray markings of a definite pattern are present on the face and dewlap. The muzzle, feet and tail switch are usually black, but in older animals the color looks lighter.

The most striking characteristic of these cattle is the formation of the head and horns. The head is well-shaped, long and tapering towards the muzzle. The forehead bulges out slightly and is narrow and furrowed in the middle. The horns emerge from the top of the poll, fairly close together in an upward and backward direction, and terminate in sharp points which are usually black. In old animals the long sharp points approximate each other and may even interlace to some extent. The eyes look bloodshot. The ears are small and taper to a point, being carried in a horizontal position. They are yellow inside.

The dewlap is thin and does not extend very far. The sheath and navel flap are very small and close to the body. The hump is well-developed and shapely in the bulls, rising to a height of about 8 inches. The body is compact and muscular with well-formed shoulders and hindquarters. The neck is strong and fairly long. The back is level, with broad loins and level rump. Legs are of medium length and well-proportioned. The fetlocks are short and the hooves are hard, close together and small. The skin is thin, mellow and jet black in color, with short glossy hair.

As the cattle are maintained in the pasture areas without any restrictions and handling, they show a very impatient, wild and unruly disposition. They are at time dangerous, particularly to strangers. They need patience and care in training; hard treatment makes them stubborn. Once they are trained they are extremely fine bullocks, particularly for quick transportation. They are observed to have great endurance. Cows are very poor milk yielders.

2. Hallikar

The Hallikar cattle are Bos indicus breed of cattle selected primarily for draft purposes. It is native to the state of Karnataka, India. It is considered one of the premier draft cattle breeds in India. The breed is often raised by the families who have specialized in production of Hallikar draft animals for hundreds of years. Currently the breed is more common in the traditional Hallikar belt of Mysore, Mandya, Hassan and Tumkur districts of South Karnataka.

The Hallikar cattle is one of the two breeds, along with Amrit Mahal which have received the royal patronage and care from the erstwhile sultans and princely state of Mysore through conservation and development. The breed is said to have originated from the Amrit Mahal cattle breed. The Department of Posts, Government of India has commemorated the Hallikar cattle breed by releasing a postage stamp in it’s name in the year 2000 A.D. Read more information about the breed below. This is one of the finest draft breeds originating from Karnataka State (Hassan and Tumukar regions). Colour is dark grey to black. Forehead is prominent and furrowed in the middle. The face is long tapering towards the muzzle. Horns emerge near each other from the top of the poll and curve backwards and slightly upwards ending in a sharp point. They possess sharp ears, medium hump, straight back and powerful quarters. This is well known draft breeds. Bullocks are strong, spirited, quick and steady workers. Cows are however, poor milk yielders.

Characteristics

Hallikar cattle are smaller sized animals with moderate to long height and medium size of the body. They are generally white to grey in color and occasionally black complexions. There are white markings or irregular patches around their eyes, cheeks, neck or in the shoulder region are also found. Both bulls and cows have horns. And their horns are long, vertical and backward bending. The bulls
have large humps, while the cows have relatively small humps than the bulls. Young breeding Hallikar bulls have dark shade on shoulder and hindquarters.

3. Deoni

Deoni cattle is a native breed of India. It is also known by some other names. Such as Deccani, Dongari, Dongarpati or Surti. Deoni cattle breed originated in the taluks of Basavakalyan, Bidar and Bhalki of Bidar district in Karnataka and adjoining Latur district of Maharashtra state. The name of this breed Deoni is derived from the Deoni Taluka of Latur district of Maharashtra. It is considered as an important dual purpose cattle breed in India. And they are known to be both draft animals and good milk yielders.

It is believed that ‘the Deoni cattle has been developed from a strain descended from a mixture of Dangi, Gir and local cattle’. The formation of the head and ears of Deoni cattle, and also of the horns to a certain extent is quite evident of a contribution from the Gir type cattle. Their general conformation and ruggedness are also similar to the Dangi cattle. Deoni cattle crosses with Holstein and Jersey are very good milk yielders. The cattle breed is now quite popular in the tracts of Telangana and adjoining districts of Maharashtra and Karnataka.

Characteristics

Deoni cattle is a medium sized animal. It resembles the Gir in physical structure to a large extent. Their body is moderately developed and symmetrical with distinct muscles. The Deoni cattle is found in three color variations. These variations are; white body with irregular black spots (Shevera), clear white with black color at the sides of the face (Wannera) and clear white with black spots on the lower side of the body (Balankya). Their skin is thick and loosely attached to the body. The head of Deoni cattle is masculine, alert, broad and slightly convex. Their head is completely white in the Balankya strain and black and white in Shevera and Wannera strain. Their horns are thick and medium in size. The chest is deep and wide. Their ears are long and drooping with slightly curved tips.

The forehead of Deoni cattle is prominent, broad, slightly bulged and white in color in all the three strains. Their eyes are prominent, bright and alert with black eyebrows. The tips of the horns are blunt. They have strong and well developed short neck. And the hump is small in cows and massive and well developed in bulls. Their dewlap is thick, pendulous (less pendulous in cows than the bulls) and muscular with folds. The udder of Deoni cow is well attached and medium sized with squarely placed black teats. The tail of this cattle is long, reaching below the hock with black and white switch. Their hooves are black in color and are well made and shapely. The Deoni bulls are easily characterized by blackish scrotums of good size. Average body weight of Deoni cattle ranges from 620-680 kg in bulls and from 432-485 kg in cows.

4. Khillari

The Khillari cattle are a draught breed of cattle native to Satara, Kolhapur and Sangli regions in Maharashtra and Bijapur, Dharwad and Belgaum districts of Karnataka in India. It is of Bos indicus sub-species and is well adapted to the tropical and drought prone conditions of these area. Most recently the breed is showing a steady decline in numbers mainly because of the low milk production which forms an alternate stream of income for the local farming community.
The Khillari cattle breed has many varieties. And the breed with its several varieties, possibly owes its origin to the Hillikar cattle breed from Mysore state or from the Maharashtra state. Name of the breed ‘Khillari’ came from ‘Khillar’ which means a herd of cattle. And meaning of the word ‘Khillari’ is the herdsman. Mostly these animals are basically from Satara district of south Maharashtra. And the animals are also found in the neighboring districts of Sangli, Kolhapur and Solapur of western Maharashtra.

**Characteristics**

Khillari cattle are small sized animals. They are usually compact and tight skinned with clean cut features and squarely developed hindquarters. Their overall appearance is compact with stout strong limbs. The pelvis of these animals is slightly higher than the shoulders.

Most varieties of the Khillari cattle have a long narrow head with long horns. Their horns are sweeping back and then upward in a distinctive bow, and tapering to a fine point. Their coat is fine, short and glossy and the ears are small and pale yellow colored inside. Legs of the animals are round and straight with black hooves. Muzzle of the Khillari cattle is frequently mottled in color. Both bulls and cows usually have hump. And the hump in the bulls is firm fleshed and of moderate size. Their shoulders are tightly muscled, well set in and merge smoothly with the cylindrical shape of the body. As a small sized animal, average body weight of the bulls is about 450 kg. And the cows on average weight about 360 kg.

5. Krishna Valley

The Krishna Valley cattle are a domestic breed of cattle native to the North Karnataka region in India. They are a draught breed and mainly used for agricultural works purposes. The cows are moderate milk producers and the bulls are known for their strength and endurance. The breed is known to have originated in the areas drained by the Krishna, Ghataprabha and Malaprabha rivers of the Bijapur, Bagalkot and Belgaum districts. They were once very important breed of cattle, but their importance lost due to limited use of draught power and choice of farmers for high milk producing cattle breeds. Total number of the Krishna Valley cattle has decreased dramatically.

National Bureau of Animal Genetic Resources came to the rescue of this germplasm and a project to conserve the breed was initiated in X plan under Network project on AnGR through BAIF Development Research Foundation. Currently main breeding tract of this breed includes Raichur, Bijapur and Belgaum districts of Karnataka state. And Satara, Solapur and Sangli districts of Maharashtra state. It is believed that the Ongole cattle breed of Andhra Pradesh, Gir and Kankrej breeds of Gujarat and local cattle breed having Mysore type blood in them have contributed to the origin of the Krishna Valley cattle breed.

**Characteristics**

The Krishna Valley cattle are relatively large breed as compared to some other Indian cattle breeds. They have a massive frame with deep and loosely built short body. Common color of their body is grey-white with a darker shade on fore and hindquarters in bulls. And the mature cows are more whitish in appearance than the bulls. Sometimes brown and white, black and white and mottled colored animals are also often seen. Distinct bulging forehead and massive body are the main characteristics of this breed.

Both bulls and cows usually have small curved horns which usually emerge in an outward direction from the outer angles of the poll and curve slightly upwards and inwards. Neck of the Krishna Valley
cattle is short and thick. And their dewlap is well-developed and pendulous. The sheath of the animals is also slightly pendulous. They have small and pointed ears. Their body is short but the barrel is large and well-developed. Legs of the animals are short and thick and look powerful, but the hooves are said to be soft. Krishna Valley cattle are a dual-purpose breed of cattle. They are used for both milk production and agricultural work purposes. The bulls are known for their strength and endurance.

6. Malnad Gidda

The Malnad Gidda cattle are a dwarf breed of cattle from India. It is also called Malenadu Gidda, Gidda, Uradana and Varshagandhi. The word Malnad means hilly region and Gidda means dwarf or small. The breed is native to the hilly, rainy and densely forested Malenadu region of the Western Ghats in the state of Karnataka in India. It plays a very important role in the rural economy of this region by providing milk, manure and draft power with negligible inputs.

Main breeding tract of the Malnad Gidda cattle include Chikmagalur, Dakshin Kannada, Hassan, Kodagu, Shimoga, Uttar Kannada and Udupi districts of Karnataka.

Characteristics

The Malnad Gidda cattle are small animals with predominant black coat color with light shades of fawn on thigh and shoulder area. They have a small and compact body frame. Both bulls and cows usually have horns, and their horns are generally small in size, straight, outward, upward and inward. Their tail switch is black in color. They have small hump and udder of the cows is small and bowl shaped. Malnad Gidda cattle are draught animals. They are also raised for milk production.

Source: Animal Genetic Resources of India, Cattle and Buffalo, ICAR publication and Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India.

Significance of the breeds

Karnataka has six indigenous cattle breeds of which the Deoni cattle breed is the only dual breed. Deoni male animals are used for ploughing and transportation, whereas cows yield up to 1,500 kg of milk per lactation. As the state does not have any prominent milch breed, the dairy farmers use crossbred cattle for milk production.
<table>
<thead>
<tr>
<th>Breeds</th>
<th>Breeding Tract</th>
<th>Utility</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amritmahal</td>
<td>Southern Karnataka (Chikmagalur, Hassan, Chitradurga districts)</td>
<td>Draught</td>
<td>Mainly in Chikmagalur, Davanagere, Shimoga, Hassan, Chitradurga, Tumkur districts</td>
</tr>
<tr>
<td>Deoni</td>
<td>Marathwada region of Maharashtra and adjoining parts of Karnataka and Andhra Pradesh</td>
<td>Dual</td>
<td>Primarily in Bidar, Gulbarga districts</td>
</tr>
<tr>
<td>Hallikar</td>
<td>Mysore, Mandya, Bangalore, Kolar, Tumkur Hassan and Chitradurga districts of Karnataka</td>
<td>Draught</td>
<td>Hassan, Mysore, Mandya, Tumkur, Ramanagara, Chamarajanagar districts. Scattered distribution in other districts also.</td>
</tr>
<tr>
<td>Khilari</td>
<td>Southern Maharashtra (Solapur, Sangli, Kolhapur and Satara district) and Bijapur, Belgaum and Dharwad districts of Karnataka</td>
<td>Draught</td>
<td>Mainly Belgaum, Bijapur , Bagalkot, Dharwad, Haveri and Gulbarga districts</td>
</tr>
<tr>
<td>Krishna Valley</td>
<td>Belgaum, Raichur and Bijapur districts of Karnataka and Satara, Sangli and Solapur districts of Maharashtra</td>
<td>Draught</td>
<td>Mainly in Bagalkot, Raichur districts</td>
</tr>
<tr>
<td>Malnad Gidda</td>
<td>Malnad region of Karnataka</td>
<td>Draught</td>
<td>Primarily in Uttara Kannada, Dakshina Kannada, Udupi, Shimoga, Chikmagalur, Haveri and Hassan, Kodagu districts</td>
</tr>
</tbody>
</table>

Table 1: Distribution of Cattle Breeds of Karnataka

The balance five registered breeds are Amritmahal, Hallikar, Khilari, Krishna Valley and Malnad Gidda which are draught breeds. The male animal of these breeds is excellent for ploughing and transportation, whereas cows are poor milk yielders with an average milk yield of less than 500 kg per lactation. These animals are sturdy and can withstand adverse climatic conditions. Historically, Amritmahal cattle was used by Nawab Hyder Ali and Tipu Sultan for carrying ammunition into the battlefield on rough roads and across difficult terrains. Both Amritmahal and Krishna Valley breeds are being considered for conservation under recently launched ‘Rashtriya Gokul Mission’ (Nivsarkar et al., 2000).

Buffalo Breed of Karnataka

1. Pandharpuri/Dharwari
The Pandharpuri buffalo is a breed of water buffalo originated from India. It is native to the dry regions of Kolhapur, Solapur, Sangli and Satara districts of Maharashtra, India. It is known to have been kept for more than 150 years in the breeding tract. It is named from the town Pandharpur in Solapur, and also known as Dharwari in the districts of North Karnataka.

The Pandharpuri buffalo is dairy buffalo breed and raised mainly for milk production. It had royal patronage from Kolhapur for supply of fresh milk to the wrestlers of Kolhapur. These animals are also famous for their better reproductive ability, producing a calf every 12-13 months. Pandharpuri buffaloes are reared mostly in northern Karnataka. The breed is popular due to rapid reproductive ability. Normally, this buffalo yields 6-7 liters of milk per day. But under good management, the yield can go up to 15 liters.

**Characteristics**

The Pandharpuri buffaloes are medium sized animals. They are easily identified by their long, sword shaped and sometimes twisted horns. The horns measure from 45 to 50 cm and also up to 1-1.5 meter of length. In case of coloration, the majority of the animal are black with white markings found on the forehead, legs and switch of tail. Udder of the females is compact, trough shaped with cylindrical teats. The Pandharpuri buffalo is a dairy buffalo breed. It is raised mainly for milk production.

The head of the Pandharpuri buffalo is long, narrow with prominent nasal bone and the ears are horizontal. Average live body weight of these animals is between 450 and 470 kg.

**Table 2: Distribution of Buffalo Breed of Karnataka**

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Breeding Tract</th>
<th>Utility</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pandharpuri/Dharwari</td>
<td>Maharashtra (Kolhapur, Sangli and Solapur districts)</td>
<td>Milch</td>
<td>Belgaum, Bidar, Bijapur, Dharwad and Gulbarga</td>
</tr>
</tbody>
</table>

**Significance of Buffalo breed**

The buffalo holds an important place and role in Indian rural economy. Buffalo is the premier animal in Indian dairy industry contributing about 60% of total milk production in the country. Buffaloes are preferred over cattle in India because of their distinctive qualities such as better feed conversion efficiency, more resistance to diseases and higher milk fat percentage than in cows (Bandyopadhyay et al 2003). However they suffer from many reproductive issues; mainly delayed puberty, postpartum ovarian inactivity and seasonality cause great economic loss to the farmer and are the main obstacles in rearing this species.

Age at puberty is a major determinant of future productivity of an animal as it enables breeding at a younger age thus reducing generation intervals and increasing genetic gains. The age of attaining puberty in cows is 18-24 months and the same in buffaloes is 36-40 months (Misra, 2004), thus making buffalo heifer rearing uneconomical. This ultimately is leading to shortage of availability of buffalo heifers of high genetic potential in the state. Early onset of puberty in buffalo heifers will cut short their cost of rearing.
In buffaloes, many factors including breed, climate, nutrition, hormones and management affect age and weight at onset of puberty leading to large differentiation for reproductive performance in buffalo heifers. Among these factors nutrition is one of the major factors affecting puberty of buffalo heifers.

**Sheep and goats**

**Sheep**

Sheep farming is among the traditional business and occupations of the people of some countries around the world. Sheep have been rearing as a domestic animal from the ancient time. Usually sheep farming means ‘rearing sheep commercially for the purpose of meat, milk and wool production’. Although sheep farming for commercial milk production is not a good decision. Sheep are suitable for meat and wool production. If you have proper facilities, then you can raise sheep in both small and large scale.

According to the FAO (2000), there are 60 sheep breeds in India including well-recognized, lesser known and some wild species. Karnataka, an Indian state lying in its Southern peninsular agro-ecological zone, has sheep as a socio-economically important livestock reared primarily as a source of mutton in rural areas. The state enjoys tropical monsoon type climate and hosts four well adapted sheep breeds viz. Bellary, Kenguri, Hassan and Mandya. Mandya breed is perhaps the best mutton breed of the country as far as conformation is concerned, although body weights, weight gains, feed conversion efficiency and carcass yield are not very superior to most other breeds (Acharya 1982).

**Goat**

Goat is a very important component in dry land farming system. There are nearly 102 breeds of goats in the world, of which 20 breeds are in India. As per the 18th livestock census the total goat population of India is 140 million (MOSPI). Goats are among the main meat-producing animals in India, whose meat (chevon) is one of the choicest meats and has huge domestic demand. The goat is an animal that adapts itself readily to almost any climate especially in arid region. It is hardy, prolific and can be cheaply reared (Banerjee, 2004). Osmanabadi goat has great demand in the market for their meat. Besides good quality meat, this breed also produce superior quality skin which has huge demand in the market. Osmanabadi goat is called as farmers true breed. Because it makes more profits in less time and without expending too much for feeding and caring.

The goat eats a class of fodder on which other animals would starve and for that reason, goat-rearing is followed as an occupation by a large section of small holders and landless laborers in rural areas (Singh et al., 2000 and FAO, 1991). Marginal or undulating lands unsuitable for other types of animals like cow or buffalo, goat is the best alternative. Goats provide a dependable source of income to 40 percent of the rural population below the poverty line in India (Maske and Phule, 2011). With very low investments goat rearing can be made in to a profitable venture for small and marginal farmers.

Goat farming is not a new enterprise. Rearing goats is a profitable business. Goat has been rearing since the time immemorial. Generally goat farming means rearing goats for the purpose of harvesting milk, meat and fiber. At present, goat farming has become a profitable business and it requires a very low investment because of its multi-functional utility. Commercial goat farming business is contributing greatly to the economy and nutrition of a country.

Goats are multi-functional animals. You can produce a wide variety of products from goats, such as milk, meat, fiber, manure etc. Goat’s milk is used for producing full cream goat powder, skimmed goat milk powder, goat butter, goat milk cream, fresh goat milk etc. Goat meat is a great source of
consumable meat which is very testy, nutritious and healthy. And goat’s wool is being used in many purposes and skin of goat plays a vital role in leather industry.

**Significance of sheep and goats**

Sheep and goats have adapted themselves to the natural conditions prevailing in all regions of the country. They also have lower feed requirements compared to cattle because of their small body size. This allows easy integration of small ruminants into different farming systems. In certain areas, milch types of goats have been developed, goat milk have lots of medicinal value and traditional ayurvedic practitioner are using to treat various ailments using goat milk in rural places, but the majority of the herds are raised mainly for the meat markets. Raising large ruminants is becoming increasingly difficult as a result of the ensuing lack of grazing areas. Land holdings in densely populated areas are below 0.5 ha. In such places, the importance of sheep and goats in fulfilling the role once played by cattle for meat, milk and manure production is being increasingly recognized. The increased demand for sheep and goat meat has also increased their importance in lowland pastoral areas as a source of cash income, food security, etc.

In villages, for breed improvement few rams or bucks are reared exclusively for breeding purposes. They become massive and serve the female from different flocks and after 1 to 2 years these are sacrificed. In some villages in southern Karnataka, an improvised castrator made of wooden sticks is used for castration of young rams and bucks, because they cannot disturb the flock by attempting frequently for mating.

**Pigs**

The indigenous pigs are of non-descript type, but are resistant to many diseases. Nomads and economically weaker sections of the society rear them. Though these pigs are highly neglected for some taboos and sentiments, the existence of this unique germplasm is because of these traditional communities, who own them for many decades. The stud boars are often changed in the village piggery units to improve their production and thereby avoiding inbreeding. Similar approach is also practised for sheep and goats.

Pig farming has been adopted by small and landless farmers, and in tribal areas. Production is small-scale, backyard, marketed-oriented enterprise. Pigs are mainly dependent on locally available feed resources/vegetations, crop residues and kitchen waste, which are of low or no cost. It is low-external input activity relying mainly upon women’s labour for rearing. There is lack of proper housing and shelter under low-input traditional system thus exposing pigs to adverse weather conditions like high temperatures and rain. Most of the pigs stay are located in backyard of house and the unhygienic conditions of these building predispose pigs to diseases. Best breeding stock rarely goes to the market, resulting in the use of a foundation stock with poor breeding qualities. There is non-utilization of improved breeds from government farms and increased use of own stock and that of neighbors, which gives rise to inbreeding and consequently low productivity (Nath et al., 2013).

**Significance of Pig Breed**

Pigs are potential source of animal proteins and avenues for additional income and employment that can improve the livelihood in a sustainable manner. Presently, our pig production system has many lacunae namely absence of sufficient number of breeder farmers, tendency of the pig grower to raise pig to marketable age on negligible inputs and lesser preference of the consumers for pork from the local pigs etc. Absence of sufficient number of breeder farmers throughout the country is also a major
constraint leading to lesser availability of quality pigs for fattener farmers and market. Therefore, genetic improvement of indigenous pigs must be undertaken on priority for production of superior germplasm. Selective breeding and crossbreeding has to be expanded for improving production and productivity. There is need for strengthening the pork marketing mechanisms at the local level to the marketing channels, and integrate production programme with slaughterhouses to ensure better sustainability. Given its prospects, piggery has the potential to have a positive impact on the livelihood of millions of resource poor, under-privileged, landless and marginal farmers.

CONCLUSION

The traditional practices have led to the evolution of new much finer breeds such as Amritmahal cattle, Phandarpuri buffaloes, Bannur sheep, Osmanbadi goat and indigenous pig breed in Karnataka. Subsequent selection procedures have brought improvement of these breeds over the years. However, a few crude techniques such as mulling could be replaced by Burdizoo Castrator. Still, modern livestock rearing method could not penetrate the tradition-bound by the tribe people of Karnataka. The basic practices followed in animal husbandry today also have some traditional backup. Hence, preserving the traditional practices would reflect our unique culture and definitely help to achieve sustainable production in animal husbandry sector.

REFERENCE


BOVINE MASTITIS AND ITS CONTROL MEASURES FOR THE PRODUCTION OF QUALITY MILK

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ABSTRACT

India ranks first in the world in milk production and dairying in India are a characteristic example of production by masses rather than mass production. At the existing rate of growth in milk production, supply is likely to fall short of the demand in next ten years. Among the several barriers in achieving the production targets, mastitis continues to remain as a challenging impediment, since the affected quarters may have 30 per cent less productivity and cow may lose about 15 per cent production. Milk is one of the most important foods of human beings. It is universally recognized as a complete diet due to its essential components and it is directly available for consumption. Its role is to nourish and provide immunological protection. Milk has distinct physical, chemical and biological characteristics, which justifies its high quality for consumption. These characteristics present a favourable environment for the multiplication of various bacteria. It is well known that freshly obtained milk contains some bacteria and somatic cells, which represent the biological constituent of the milk. The world-wide contamination of milk with undesirable substances via animal feeds, heavy metals, mycotoxins, dioxins and similar pollutants is considered to be of great concern to public health due to their toxic effects on humans and wildlife. Production of milk has been affected by various factors like mastitis and lower in food value due to a higher prevalence of mastitis. When a cow is diagnosed with mastitis, it is helpful to the dairy farmer to know what type of mastitis agent is causing the disease. The bacterial species causing the inflammation is partly responsible for the inflammatory response and clinical severity of a mastitis case. Mastitis is a difficult disease to control because many different bacteria are capable of infecting the udder and producing the disease. Production of better-quality milk will place a much greater emphasis on strategies for the prevention and control of mastitis to reduce the number of somatic cells in milk. Effective milking-time hygiene, proper milking machine function, pre- and post-milking teat disinfection, lactation therapy, antibiotic dry cow therapy, and culling of chronically infected cows are time-tested management strategies for controlling mastitis and are used extensively throughout the world. Use of effective mastitis control strategies will help dairy producers achieve these important goals.

Keywords: Bovine mastitis, Milk production, Bacteria, Somatic cells and control measures

INTRODUCTION

India ranks first in the world in milk production and dairying in India are a characteristic example of production by masses rather than mass production. Due to changes in human food consumption patterns, demands for fruits, vegetables, milk and milk products,
meat, poultry and fisheries have been increasing over the period in recent years. Among the different food sectors, the growth in dairy sector has been commendable (National Academy of Agricultural Sciences, 2013). The rate of growth in milk production in India is additionally well higher (3.6 per cent) than the world’s average of 1.5 percent. Even though, the total projected demand of milk by the year 2030 would be concerning two hundred million tonnes, looking on assumptions concerning financial gain, population, urban growth, and expenditure physical property parameters, which might imply Associate in Nursing annual increase of around four million tonnes throughout consequent two decades. At the prevailing rate of growth in milk production, offer is probably going to let down of the demand in next 10 years. Among the many barriers in achieving the assembly targets, rubor continues to stay as a difficult impediment, since the affected quarters could have thirty per cent less productivity and cow could lose concerning 15 per cent production (Radistitis et al., 2000). Mastitis in farm animals is taken into account jointly of the foremost necessary economic diseases ensuing into vast economic loss to the country. Globally, it accounts for concerning 30 per cent of the entire direct prices of the common production diseases. (Kossaibati and Esslemont, 1997). In India, the economic losses due to mastitis have increased about 115 times, in the last five decades (Dua, 2001). But, the lack of awareness, delay in detection of sub-clinical mastitis, lack of markers tools for detecting and ensuing mastitis, unhygienic milking practices, diverse production systems, inadequate treatment etc. are some of the important contributing factors in making higher incidence of mastitis.

**Epidemiological status of bovine mastitis**

The lactation procedure has been amazingly fruitful since the earliest mammals, enabling them to involve a huge scope of environmental specialties. Nonetheless, lactation is truly affected by the advancement of mastitis among most, if not every, mammalian species (Michie et al., 2003). This condition alters milk composition and reduces milk secretion, facts that impair infant/offspring growth and development. In sustenance creature species, it is one of the sicknesses with most noteworthy financial effect and a noteworthy creature welfare concern. A wide meaning of mastitis is aggravation of the mammary organ, including intramammary tissues as well as related anatomical structures, for example, areolas, mammary areolas, milk ducts, and so on. In veterinary medicine, mastitis is referred to an intramammary inflammatory reaction caused by an infectious agent (Fetherston, 2001).

**Milk and its components**

Milk is one of the most important foods of human beings. It is universally recognized as a complete diet due to its essential components and it is directly available for consumption (Grimaud et al., 2009). All types of milk contain proteins in colloidal dispersion as micelles; fats in emulsified globules coated with a membrane and easily digested minerals, vitamins and other components. Each of these components plays beneficial roles to the host. Milk may be defined as the whole, fresh, clean lacteal secretion obtained by the complete milking of one or more healthy milchy animals, excluding that obtained within 15 days before or 5 days after calving or such periods as may be necessary to render the milk practically colostrum free, and
containing the minimum prescribed percentage of milk fat and milk-solids not fat. In India, the term 'milk' when unqualified, refers to cow or buffalo milk or a combination of the two.

Its role is to sustain and give immunological insurance. Milk has particular physical, compound and natural attributes, which legitimizes its high calibre for utilization. These qualities display a good situation for the augmentation of different microorganisms. It is outstanding that newly acquired milk contains a few microorganisms and somatic cells, which speak to the natural constituent of the milk (Hemalatha et al., 2010). The biological constituents easily change depending on production conditions, the health status of the cattle, hygiene practices during milking, keeping and transportation of milk (Turner et al., 1990).

Numerous constituents of bovines’ milk can be comprehensively categorised by their physical properties or/and physiological functions. In this complex biological fluid, minerals occur in chemical equilibrium between the free ions and complexes with various components, for example, protein, lipids, starches and low atomic weight ligands like citrate and amino acids (Vegarud et al., 2000). Mineral and trace element concentrations in raw cows’ milk are not constant but mainly vary according to two kinds of factors, those related with secretion from the mammary gland, such as the lactation state, animal species and health status, and extrinsic factors, such as season, dairy cattle ration (nutritional status of cow), environment (nature of soil and locality of the farm). In this respect, several studies have been carried out to assess mineral content of cows’ milk from different areas (Muniz-Naveiro et al., 2005), as well as to evaluate preliminary correlations between animal feeding, manufacturing process and elemental profile in cows’ milk and dairy products (Coni, et al., 1995).

The world-wide contamination of milk with undesirable substances via animal feeds, heavy metals, mycotoxins, dioxins and similar pollutants is considered to be of great concern to public health due to their toxic effects on humans and wildlife. Milk products are very important human nutrients and their consumption has increased in recent years. It is known as an excellent source of calcium, magnesium and zinc and hence supply very small amount of Fe and Cu (Ali et al., 2011). Its role is to nourish and provide immunological protection (Hemalatha et al., 2010). Milk contains a wide range of dietary components of vital importance like water, proteins, lactose, minerals and vitamins. The exact composition of milk varies with the breed, species, feeding regimes, the stage of lactation and udder health (Uallah et al., 2005). The nutritional significance of milk is indicated by the fact that daily consumption of a quart (1.14 liters) of milk furnishes approximately all the fat, calcium, phosphorus, riboflavin, one half of the protein, one third of vitamin A, ascorbic acid, thiamine and one fourth of calories needed daily by an average individual (Bilal and Ahmad, 2004).

Milk has distinct physical, compound and organic attributes, which legitimizes its high caliber for utilization. These qualities introduce a great domain for the duplication of different microorganisms. It is notable that newly got milk contains a few microorganisms and somatic cells, which speak to the natural constituent of the milk (Hemalatha et al., 2010). The biological constituents easily change depending on production conditions, the health status of the cattle, hygiene practices during milking, keeping and transportation of milk (Turner et al., 1990).
The nature of milk and in addition its wellbeing in the utilization relies upon its chemical composition, microbiological, physical and organoleptic properties. A tasteful nature of milk implies it is high in nutritious esteem and that it is free of any types of bodies and of outside constituents which can cause infections (Ismail et al., 2010).

Mastitis and milk production

With mastitis there is a danger that the bacterial contamination of milk from mastitis influenced cows that may render it unsatisfactory for human utilization by causing nourishment harming and gives an instrument of spread of sickness to people through utilization of crude milk. Many farm families simply consume raw milk, since it is a customary practice and it is more affordable to take raw milk from the mass tank than purchasing purified retail milk. Some believe that crude milk has a higher dietary incentive than processed milk. The bacteria that are transmitted through milk and cause disease problems in man are bacteria causing mastitis in cattle and transmissible to man when man uses raw milk from infected udder (Mersha and Ayalew, 2017).

Production of milk has been affected by various factors like mastitis and lower in food value due to a higher prevalence of mastitis (Payne and Wilson, 1999). The most critical changes in milk incorporate discoloration, nearness of clusters and swelling of udder in clinical mastitis, which causes loss of generation as well as brings down the nature of milk. Another adversity is that danger of mastitis is more noteworthy in high producer animals when compared with normal and low producers. It leads to lessening of yield, lactose and butter fat. Milk protein levels will increase slightly with mastitis, however the protein is of lower quality, with expanded levels of globulin and decreased casein (Andrews et al., 2003).

Macro-minerals in milk provide the primary mineral requirements of the neonate calf during the critical period after birth when it cannot forage for itself (Anderson et al., 1988). Mineral and trace element concentrations in cow’s milk are not constant but mainly vary according to two kinds of factors, those related with secretion from the mammary gland, such as the lactation state, animal species and health status, and extrinsic factors, such as season, dairy cattle ration (nutritional status of cow), environment (nature of soil and locality of the farm). In this respect, several studies have been carried out to assess mineral content of the milk (Dobrzarnski et al., 2005) as well as to evaluate preliminary correlations between animal feeding, animal health manufacturing process and elemental profile in cows’ milk and dairy products (Coni et al., 1996).

At the point when a cow is determined to have mastitis, it is useful to the dairy farmers to realize what kind of mastitis agent is causing the sickness. The bacterial species causing the inflammation is mostly in charge of the provocative reaction and clinical seriousness of a mastitis case (Bannerman, 2008). The species frequently determine the seriousness of the immune response of the bovine and are regularly identified with the measure of milk severity and seriousness of more systemic effects (Gröhn et al., 2004). Mastitis lessens milk yield and modifies milk organization. The extent of decreased milk yield and changes in milk creation
is affected by seriousness of the incendiary reaction, which thus is impacted by the mastitis pathogens causing the infection (Nadeem et al., 2013).

Inflammatory diseases of mammary glands lead to the change of various milk compositions either because of local effects and entering serum component into the milk or the movement of some normal milk component from extra alveolar lumen into the perivascular space (Harmon, 1994) also it lowers the milk yield. The magnitude of these changes in individual cows varies with the severity and duration of the infection and the causative microorganisms. Mastitis is almost and always caused by bacteria. These microorganisms produce toxins that can directly damage milk producing tissue of the mammary gland, and the presence of bacteria initiates inflammation within the mammary tissue in an attempt to eliminate the invading microorganisms, in general, compositional changes involve an increase in blood components present in milk and a decrease in normal milk constituents (Mona et al., 2008). The presence of major pathogens in milk quarters induced very significant modifications of milk biochemical composition.

Controlling Mastitis

Prevention and Control of Mastitis: Mastitis is a troublesome illness to control in light of the fact that a wide range of microscopic organisms are fit for tainting the udder and creating the malady. Microorganisms that most much of the time cause mastitis can be isolated into two general classifications, i.e., infectious pathogens, which are spread from bovine to cow principally amid the draining procedure; and ecological pathogens, which are found all through the territory of dairy cows.

Mastitis Control Strategies: Current mastitis control programs depend on cleanliness and incorporate nipple cleansing, anti-toxin treatment, and winnowing of incessantly tainted dairy animals. Acknowledgment and utilization of these measures all through the world has prompted impressive advance in controlling mastitis caused by infectious mastitis pathogens. Notwithstanding, as the predominance of infectious mastitis pathogens was lessened, the extent of IMI caused by ecological pathogens. In this manner, it isn't astounding that mastitis caused by coliforms and ecological Streptococcus species has turned into a noteworthy issue in some very much oversaw dairy cultivates that have effectively controlled infectious pathogens.

Current Methods of Mastitis Prevention and Control: As a result of the expansive number of pathogens equipped for causing mastitis and the way that these pathogens act in an unexpected way, a one-estimate fits-all way to deal with mastitis administration isn't achievable. Focusing on the little points of interest portrayed above will keep on being vital in each mastitis control program. Since pathogenic microscopic organisms get access into the mammary organ through the nipple channel, the more prominent the bacterial load at the nipple end, the more noteworthy the likelihood of a contamination happening, in this manner underscoring the significance of keeping up a spotless, dry condition and udder cleanliness at
milking time. Any method that decreases the quantity of microbes to which the nipple end is uncovered will probably be useful. Legitimate milking cleanliness and great milking practices comprise of the accompanying components: milk in a perfect, tranquil condition; check foremilk and udder for indications of clinical mastitis; limit utilization of water in the milking parlor; wash nipples with warm purifying arrangement, if vital; apply premilking nipple purification; dry nipples completely 30 to 45 seconds in the wake of premilking nipple disinfectant application; join nipple mugs inside one moment in the wake of cleaning; give stable vacuum at hook amid top milk stream; abstain from cackling or slipping of nipple container liners amid milking; modify milking units as important, stop vacuum before expelling machine; and apply post milking nipple disinfectant not long after milking machine expulsion.

**Antibiotic therapy:** Antibiotic treatment at getting dry assumes a critical part in the control of mastitis amid the dry time frame. Dry bovine treatment is especially successful against streptococci and to a lesser degree against *S. aureus*. Studies have exhibited that anti-infection treatment at getting dry decreased the rate of new ecological streptococcal disease amid the early dry time frame just and that the rate of new coliform IMI was not influenced by any means. In this manner, two noteworthy restrictions of present anti-infection plans utilized for dry bovine treatment are: inadequacy against coliform microscopic organisms, which can cause a high extent of IMI amid the early dry time frame and close calving, and insufficiency in averting new IMI by a wide range of mastitis pathogens amid the period close calving when mammary organs are exceedingly defenceless to new contamination.

**CONCLUSION**

In conclusion, creation of most extreme amounts of fantastic milk is a critical objective of each dairy activity. Then again, poor milk quality influences all fragments of the dairy business, at last bringing about milk with diminished assembling properties and dairy items with decreased timeframe of realistic usability. One essential measure of milk quality is the quantity of physical cells in milk. Milk with a high SCC is created by dairy animals with mastitis and is of second rate quality. SCC limits for crude milk to be adequate at dairy handling plants may lessening to levels much lower than they are presently, making it progressively risky for dairy makers to meet these higher benchmarks. Generation of better-quality milk will put a substantially more noteworthy accentuation on procedures for the avoidance and control of mastitis to lessen the quantity of physical cells in milk. Viable milking time cleanliness, appropriate milking machine work, pre-and post- milking nipple sanitization, lactation treatment, anti-infection dry dairy animal’s treatment, and winnowing of constantly contaminated bovines are time-tried administration methodologies for controlling mastitis and are utilized broadly all through the world. Advances in biotechnology have brought energizing new advances that can/will be utilized to take care of complex issues standing up to creature agribusiness. New advancements, methodologies, systems, and advances in mastitis analysis, treatment, and anticipation will significantly enhance dairy crowd wellbeing projects and result underway of greatest amounts of astounding milk at bring down expenses. A protected, healthy, plentiful, and nutritious milk supply ought to be the
objective of each dairy maker on the planet. Utilization of viable mastitis control procedures will help dairy makers accomplish these vital objectives.

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BIOREMEDIATION A TOOL IN WASTE MANAGEMENT

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ABSTRACT

The use of living organisms in the cleanup of polluted or contaminated environment is called bioremediation. The environment especially the soil and water get polluted with a large amount of wastes from the chemical and petrochemical industries. Some chemicals are toxic and some are carcinogenic. The usual methods using chemicals is not able to meet the specifications of the Environment Protection Act, 1986. These methods can be very effective in reducing a range of pollutants, but have several drawbacks, like technological complexity, cost and also they add to the pollution. Bioremediation is a good alternative to the conventional clean-up technology. Microbes are used in bioremediation. They lead to the complete mineralization of the complex and toxic pollutants to simpler and non-toxic compounds like carbon-dioxide, water and inorganic compounds. The treatment of the oil spill in Alaskan shoreline in 1989 is one common example in which bioremediation got public attention. There are different types of bioremediation. Most of the microbes used are indigenous to the contaminated sites. Some organisms are genetically modified for the task. Thus, bioremediation is an innovative technology in environmental pollution and definitely a tool in waste management. This review highlights the different types of bioremediation and its advantage over the other usual methods.

Key words: Bioremediation, mineralization, non-toxic, innovative technology.

INTRODUCTION

Due to civilization, urbanization and industrialization a large amount of waste is generated and dumped into the environment. Around $6 \times 10^6$ chemical compounds have been synthesized, with 1,000 new chemicals being synthesized annually. As per the third world network reports, more than one billion pounds (450 million kilograms) of toxins are released globally in air and water. These pollutants cause ecological problems leading to imbalance in nature which is of global concern. The dumping of hazardous waste into the environment like rubber, plastics, agricultural waste, and industrial waste is harmful to living creature. Solid-waste management is a major challenge in urban areas throughout the world. Without an effective and efficient solid-waste management program, the waste generated from various human activities, can result in health hazards and have a negative impact on the environment. Continuously and uncontrolled discharge of industrial and urban wastes into the environmental sink has become an issue of major global concern. The industrial and anthropogenic activities has also led to the contamination of agricultural lands which results in the loss of biodiversity. The use of pesticides, herbicides increases the productivity of crop but they also increase the contamination in the soil, water and air. (Garima & Singh, 2014)
Waste management is the processing or treating solid wastes. It offers a variety of solutions for recyclable items. It is about how waste can be used as a valuable resource. Waste management is something that each and every household and business owner in the world needs. Waste management disposes of the products and substances that you have used in a safe and efficient manner.

Bioremediation is the use of either naturally occurring or deliberately introduced microorganisms to consume and break down environmental pollutants, in order to clean a polluted site.

The treatment of waste materials, which arise from human activities by use of microorganisms has a long and well-documented history. Interest in the application of the technologies involved in such processes to problems of hazardous waste has increased in recent years with the growing legislative and economic pressures to develop destructive and cost-effective solutions for environmental clean-up. The application of biological techniques to clean-up elements of the natural environment, such as contaminated land and groundwater is now a rapidly expanding field. The use of Genetically modified microorganisms (GEMMOs) in the treatment of hazardous waste is also a possibility. Strict control on the release of genetically modified organisms is to be maintained. That is the reason even field trials are restricted. (Bewley, 1992) The treatment of the oil spill in Alaskan shoreline in 1989 is one common example in which bioremediation got public attention. There are numerous other success stories of bioremediation in cleaning up chemical spills, leaking underground storage tanks of gasoline, and many toxic industrial effluents. There are various factors which include scientific, non-scientific, and regulatory, that limit the use of bioremediation technologies. (Boopathy, 2000)

Bioremediation is a general concept that includes all those processes and actions that take place in order to biotransform an environment, already altered by contaminants, to its original status. Although the processes that can be used in order to achieve the desirable results vary, they still have the same principles; the use of microorganisms or their enzymes, that are either indigenous and are stimulated by the addition of nutrients or optimization of conditions, or are seeded into the soil. Although the application of bioremediation to the food industry is not new, developments in microbiology and genetic engineering have given a valuable instrument to scientists to deal with contaminants in the environment. Pesticides, herbicides, insecticides, cleaning chemicals and chemicals used in the food chain are among the new contaminants which have entered the biogeochemical cycles. Bioremediating methods transform the contaminants into substances that can be absorbed and used by the autotrophic organisms with no toxic effect on them. (Thassitou, 2001)

The ligninolytic enzymes of white-rot fungi have a broad substrate specificity and have been implicated in the transformation and mineralization of organopollutants with structural similarities to lignin. (Pointing, 2001). The purpose of bioremediation is to make environment free from pollution with help of environmental friendly microbes.
How it works:
Bioremediation involves the use of techniques for enhancing naturally occurring or indigenous microorganisms that can biologically transform and/or eliminate the pollutants. Bacteria and Fungi have been effective in bioremediation. In almost all cases, the bioremediation process relies on diverse populations of microorganism species, rather than on one or a few species.

The Bioremediation Process
Naturally the number of indigenous microbes which can eliminate the pollutants are less in number. Bioremediation is achieved through bio-enhancement, that is the addition of large numbers of selected naturally occurring microorganisms, to give an initial population of approximately one million per gram of soil. Studies have revealed that this count increases up to one thousand fold as they start using the contaminant as their nutrient. that this concentration This further enhances the rate of degradation compared to what can happen by natural process because of the low numbers of the microbes in nature. The contaminant has to move through waste/ soil and pass the cell membrane of the microbes for it to be digested. Although in some cases the extracellular enzymes produced by the microbes transform the contaminants.
Several physical and chemical parameters must be controlled in order to obtain optimum biological activity and maximum degradation of contaminants. These parameters include soil, oxygen and nutrient concentrations, as well as temperature and moisture conditions.

Operating Conditions for Bioremediation:
Soil – Types and conditions of soil play an important role in the bioremediation process because they can affect the interaction between contaminant compounds and microorganisms. Waste compounds which have low solubility in water are slow in moving from soil adsorption sites or free phase droplets into the soil water and from there into the microorganisms.
Wastes in solid matrices (soil) have less solvent (water) in which to be dissolved for mobility, are more likely to have highly variable concentrations throughout the matrix and are harder to mix thoroughly. To insure optimum penetration and coverage, contaminated soils must be treated appropriately.
Nutrients – In most soil treatment, bioremediation will be accelerated only when the concentration of nutrients is more and therefore a constant addition of nutrients to the contaminated soil is necessary.
Oxygen – Many contaminants are degraded aerobically by the microbes, which requires oxygen. The oxygen concentration is the rate limiting factor in the biodegradation of many contaminants such as petroleum products. Microbial activity is most frequently limited by insufficient oxygen due to slow rates of diffusion into the interior of the soil layers. Generally, the more the oxygen the more the rate of bioremediation.
Temperature & Moisture – Studies have shown 28 degrees centigrade to be the optimum temperature for growth of soil derived microorganisms. Growth rates will slow as the temperature decreases. Similar studies have shown that soil moisture should be maintained at 20 – 30%.
Areas of Application
Bioremediation has been successfully used in a variety of applications to date. The methods of application vary depending on specific site conditions.

- **Surface Soil Contamination**: Where the contaminated soils are limited to the upper two feet, rot tilling or dicing the soil to provide even distribution of the microorganisms and other components has proven effective. The finer the soil, the more surface area available to the microorganisms to get access to the contaminants. Repeated tilling provides aeration to further accelerate the process.

- **Sub-Surface Soil Contamination**: the layer of soil next in depth to the surface soil. The type and compactness of soil will determine the method of application needed to deliver the microorganisms into the contaminated zone, pressure jetting or ponding.

- **Lagoon Contamination**: Hazardous waste lagoons usually require treatment. Special application systems have been developed for this purpose.

- **Water Contamination**: Ground or stored water containing contaminants can be treated by establishing a means of circulating the water through a bioreactor where it is acted upon by a combination of microorganisms and then returned to the source when cleaned.

- **Water Body Contamination**: Water bodies such as ponds, small lakes, canals and aquaculture farms can suffer from the build-up of sludge and high mineral concentrations. Special bioremediation systems have been developed for reducing these types of contaminants.

**Bioremediation of PAH contaminated soil:**
Polynuclear aromatic hydrocarbons (PAHs) constitute a group of pollutants which are present at high concentrations in the industrial waste contaminated soil. Criteria established for the removal or treatment or both of soils contaminated with PAHs vary widely within and between nations. Currently in-situ remediation techniques are considered ineffective for the removal of most PAHs from contaminated soil. On-site ‘landforming’ methods have been used successfully (and within a reasonable period of time) to degrade only those PAHs with three or fewer aromatic rings. Bioreactors have proved most effective for soil remediation, since conditions for enhanced degradation can be achieved most readily. Biodegradation of the more recalcitrant high-molecular-weight PAHs in contaminated soil has not been successful to date. Further research needs are identified to help develop bioremediation into a most cost-effective manner. (Wilson & Jones, 1993)

**Bioremediation of Heavy Metals**
Heavy metals contaminating the soil and ground water through leaching is of great concern as it can enter the food chain and cause adverse effects in humans. These metals can be removed by the use of yeast, fungi, bacteria, and algae etc. by a process called as biosorption. The microbes take up the metal from the contaminated site and accumulate within their cell. Biosorption is nothing but it is a reaction between the positive charged heavy metals and negative charged microbial cell membrane, in which metals are then transported to cell cytoplasm through cell membrane with the aid of transporter proteins and get bio
accumulated. Biosorption of metal ions is strongly affected pH. *Pseudomonas aeruginosa* and *Aspergillus niger* are the microbes which remove almost every toxic heavy metal.

**Bioremediation of Rubber waste:**
About 12% solid waste is rubber. Rubber can neither be degraded nor recycled easily due to its composition. Maximum rubber waste comes from the tires of the vehicles. Rubber is composed of synthetic polymers and a high grade of black carbon. A major environmental problem due to rubber is, because on burning it gives a large amount of toxic fumes along with carbon monoxide. Its toxic chemical composition like zinc oxides inhibit the growth of sulfur oxidizing and other naturally occurring bacteria, which leads to slow natural degradation of rubber. So for the degradation of rubber first the toxic component of rubber is removed by fungi like *Recinicium bicolour*. After that the rubber can be devulcanized by sulfur reducing or oxidizing bacteria like *Pyrococcus furiosus* & *Thiobacillus ferroxidans*. These devulcanized rubbers can be recycled. The calorific value of rubber is same as coal that is of about 3.3 x 104 KJ/kg. So control combustion of rubber can be a best waste management and the heat can be use for energy generation.

**Bioremediation of Agricultural waste:**
Agricultural waste is the organic waste which is produced by humans, livestock and crops. Approximately 38 billion metric tons of organic waste is produced worldwide. Disposal and environmental friendly management of these wastes has become a global priority. Efficient technologies have been used to convert this organic rich waste into value added products for sustainable land practices. They can be treated by vermicomposting too.

**Degradation of xenobiotics:**
Xenobiotics are organic in nature and many of the xenobiotic compounds released into the environment and accumulate because they are only degraded very slowly and in some cases so slowly that it renders them effectively permanent. There are no microbes or group of microbes that degrade all compounds. So there should be a group of organism, metabolically versatile that is applicable for the degradation of large no of compound.

**Bioremediation from an ecological perspective,**

**In situ bioremediation: When does it work**

**Methods of Bioremediation:**
Bioremediation is divided broadly into two category i.e In-situ bioremediation and ex-situ bioremediation.
In situ Bioremediation:
In-situ techniques are applied to soil and groundwater at the site with minimal disturbance. These methods include biostimulation, bioleaching, biosorption, and bioventing. It can be expensive due to specialized equipment.

In situ bioremediation provides the treatment at contaminated sites, avoiding excavation and transport of contaminants, for remediation. The nutrients are added to the contaminated site in the form of aqueous solution to enhance bioremediation. It can be used for soil and groundwater.
Generally, this technique includes conditions such as the infiltration of water containing nutrients and oxygen or other electron acceptors for groundwater treatment. It is a superior method to cleaning contaminated environments since it is cheaper and uses harmless microbial organisms to degrade the chemicals. The method depends on chemotactic abilities of the microbes for the contaminant. This in-situ bioremediation further sub divided into following category.

Bioventing:
Bioventing is the pumping of oxygen and nutrients into the contaminated soil above the water table. It is used for removal of gasoline, oil, petroleum etc. The rate of removal depends on the texture of the soil as the distribution of oxygen and nutrients which is pumped in depends on the texture of the soil.

Biosparging:
In biosparging air is injected below the ground water under pressure to increase the concentration of oxygen. The oxygen is injected for microbial degradation of pollutant. Biosparging increase the aerobic degradation and volatilization. Therefore this also depends on the soil texture. It is effective in reducing petroleum products at underground storage tank (UST) sites. Biosparging is most often used at sites with mid-weight petroleum products (e.g., diesel fuel, jet fuel); lighter petroleum products (e.g., gasoline) tend to volatilize readily and to be removed more rapidly using air sparging. Heavier products (e.g., lubricating oils) generally take longer to biodegrade than the lighter products, but biosparging can still be used at these sites.

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<th>Advantages</th>
<th>Disadvantages</th>
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<td>It is readily available and easy to install</td>
<td>It can be used in environmental where air sparging is uniform, permeable soil, unconfined aquifer etc</td>
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<td>Treatment time is short and very minimal disturbance to the operation site</td>
<td>There is no field and laboratory data to support design consideration</td>
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Bioaugmentation:
Microorganisms having specific metabolic capability are introduced to the contaminated site for enhancing the degradation of waste. The number of indigenous and also non-native microbes having the capacity to degrade the contaminant is increased. At sites where soil and groundwater are contaminated with chlorinated ethenes, such as tetrachloroethylene and trichloroethylene, bioaugmentation is used to ensure that the in situ microorganisms can completely degrade these contaminants to ethylene and chloride, which are non-toxic. Monitoring of this system is difficult. There are problems, such as the survival of strains introduced to soil. The number of introduced microorganisms usually decreases shortly after soil inoculation. The success of bioaugmentation strongly depends on the ability of inoculants to survive in contaminated soil, which depends on factors like predation, environmental conditions and nutrients. In some cases, the environment may be toxic to the added organism.

**Biostimulation**

This method involves the addition of nutrients to a polluted site in order to encourage the growth of naturally occurring chemical-degrading microorganisms. Biostimulation is primarily done by the addition of various nutrients that are limited in the soil as well as electron acceptors, such as phosphorus, nitrogen and oxygen, or increasing the amount of available carbon in order to increase the population or activity of naturally occurring microorganisms. Other approaches are to optimize environmental conditions such as aeration, the addition of nutrients, altering pH and temperature control. The primary advantage of biostimulation is that it is done by native microorganisms that are well-suited to the environment, and are already well-distributed spatially. The challenge is delivering additives so they are readily available to the subsurface microbes.

**Metal Biosorption**

Metals are directly and/or indirectly involved in all aspects of microbial growth, metabolism and differentiation. Metals and their compounds interact with the microbes in various ways which depend on the type of metal, the microbe and the environment. Metabolism of the microbe also affects the mobility of the metal, its solubility and therefore its availability. Many metals are essential for life, e.g. Na, K, Cu, Zn, Co, Ca, Mg, Mn and Fe, but all can exert toxicity when present above certain threshold concentrations. Despite the toxicity, many microbes grow and even flourish in apparently metal-polluted locations, and a wide variety of mechanisms contribute to their resistance. (Gadd, 2010)

Adsorption of metals and other ions of an aqueous solution by the use of microbes. Biosorption processes are very important in the environment, and has been utilized for conventional biotreatment processes. Biosorption is primarily aimed at the removal or recovery of organic and inorganic substances from solution. The commercialization of biosorption technologies has been limited so far.

**Ex-situ Bioremediation**

Ex-situ techniques are those that are applied to soil and groundwater which has been removed from the site via excavation or pumping. The methods used include composting, biofilters,
and biopiling. Ex-situ is used for smaller projects, primarily because larger excavation of soil is not preferred. The movement of the soil can be more detrimental by destroying the pre-establish horizons in the soil.

**Composting**

Nutrients are added to soil that is mixed to increase aeration and activation of indigenous microorganisms. Composting is done in a separate container, then when composting is complete it is incorporated into the soil. Bioremediation by the utilization of compost relies on the adsorption capabilities of organic matter and the degradation capabilities of microorganisms present. Composting is recognized as as one of the most cost-effective technologies for soil bioremediation and it can be done on large and small scales. The use of composting is a very versatile technique for soil polluted by a wide range of organic pollutants and heavy metals, making it great for easier remediation involving various pollutants. The utilization of organic wastes for soil remediation is also helpful in decreasing the need for their storage and treatment. Organic matter that is generated from composting offers the benefit of improving soil quality and structure. Composting is primarily used for remediation over a longer period of time, as the nutrients for the microbes are released gradually and require more time compared to quicker treatments such as biostimulation. Composting is a process in which microorganism degrades the waste at elevated temperature that is ranges from 55-65. During the process of degradation microbes release heat and increase the temperature which leads to the more solubility of waste and higher metabolic activity in composts. In windrow composting remove the rocks and other larger particles from excavated contaminated soil. The soil is transported to a composting pad with a temporary structure to provide containment and protection from weather extremes. Amendments (straw, alfalfa, manure, agricultural wastes and wood chips) are used for bulking agents and as a supplemental carbon source. Soil and amendments are layered into long piles known as windrows.

**Biopiling:**

It is a hybrid form of composting and land farming. The basic biopile system includes a treatment bed, an aeration system, an irrigation/nutrient system and a leachate collection system. For proper degradation there should be control of moisture, heat, nutrients, oxygen, and pH. The irrigation system is buried under the soil and provides air and nutrient through vacuum. To prevent the run off the soil is covered with plastic and due to which evaporation and volatilization is also prevented and promote the solar heating. Biopile treatment takes 20 to 3 month to complete the procedure. Excavated soils are mixed with soil amendments and placed on a treatment area. Biopiles are aerated with the use of perforated pipes and blowers in order to control the progression of biodegradation more efficiently by controlling the supply of oxygen, which in turn may affect other factors such as pH. This system is primarily used to remediate systems with oil and hydrocarbon contamination. The remediated soil is placed in a liner to prevent further contamination of the soil, they may also be covered with plastic to control runoff, evaporation, and volatilization.
Bioreactors:
Slurry reactors or aqueous reactors are used for ex situ treatment of contaminated soil and water pumped up from a contaminated plume. The contaminated plume is transported from the site of contamination and processed in the bioreactor. A slurry bioreactor may be defined as a containment vessel and apparatus used to create a three-phase (solid, liquid, and gas) mixing condition to increase the bioremediation rate of soil bound and water-soluble pollutants as a water slurry of the contaminated soil and biomass (usually indigenous microorganisms) capable of degrading target contaminants. In general, the rate and extent of biodegradation are greater in a bioreactor system than in situ or in solid-phase systems because the contained environment is more manageable and hence more controllable and predictable. Despite the advantages of reactor systems, there are some disadvantages. The contaminated soil requires pre-treatment (e.g., excavation) or alternatively the contaminant can be stripped from the soil via soil washing or physical extraction (e.g., vacuum extraction) before being placed in a bioreactor. (Vidali, 2001).

Ex-situ or In-situ
Some methods can be used by either in-situ or ex-situ methods. The soil or water can be removed from the contamination source and treated, or treated at the source, the method chosen can be based on many factors such as how expensive the project may be or how much contaminant needs to be treated. These methods include bioaugmentation, land farming and biofiltration.

Biofilter
Biofilters are primarily the use of micro-algal/bacterial growth as filters. They are used for the filtration of contaminated groundwater in the soil. Biofilters can be used above soil, where the water will be pumped aboveground for treatment, or a filter can be placed in the soil near an outflow. It is used for the detoxification of copper and cadmium metal wastes. Biofilters have been used in larger industry environments to treat contaminated outflow of water. Chromobacterium violaceum, is used to treat water and soil contaminated with silver nanoparticles, reducing its concentration.

The application of a micro-algal/bacterial biofilter in the primary outflow of soil water (Tiedje et al, 1993)
Land farming:
In land forming make a sandwich layer of excavated soil between a clean soil and a clay and concrete. The clean soil at bottom and concrete layer should be the upper most layers. After this allow it for natural degradation. In it also provide oxygen, nutrition and moisture and pH should also maintain near the pH 7 by using lime. Land forming is useful mainly for pesticides. Contaminated soil is mixed with amendments such as nutrients, and then they are tilled into the earth, or the contaminated soil is applied into lined beds and periodically turned over or tilled to aerate the waste. The topmost layer is the area of concentration for this method, so it is not ideal for deeper remediation. Land farming differs from composting because it actually incorporates contaminated soil into soil that is uncontaminated. The higher zone of remediation will typically contain primarily lighter hydrocarbons that can be volatilized. The material is periodically tilled for aeration to hasten remediation of any nutrients and allow more oxygen to act as electron acceptors, as well as allowing volatilization to occur. Contaminants are degraded, transformed, and immobilized by microbiological processes and oxidation. Soil conditions are controlled to optimize the rate of contaminant degradation, moisture content, frequency of aeration, and pH are all conditions that may be controlled.

Phytoremediation:
Contaminated soils and waters can also be cleaned up by a technology called phytoremediation. It is an emerging technology in bioremediation. It is a cost-effective plant based approach to cleanup polluted sites. It takes advantage of the ability of plants to concentrate elements and compounds from the environment and to metabolize these compounds in their tissues. Toxic heavy metals and organic pollutants are the major targets for phytoremediation. In recent years, knowledge of the physiological and molecular mechanisms of phytoremediation began to emerge together with biological and engineering strategies designed to optimize and improve phytoremediation. Several field trials have confirmed the feasibility of using plants for environmental cleanup. (Salt et al., 1998).

<table>
<thead>
<tr>
<th>Plant</th>
<th>Nature of pollutant</th>
<th>Initial concentration</th>
<th>Mechanism of removal</th>
<th>% Removal</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ludwigia octovalvis</td>
<td>Gasoline</td>
<td>2,07,800 mg/kg TPH</td>
<td>Biosurfactant enhanced rhizodegradation</td>
<td>93.5</td>
<td>Almansoory et al. (2015)</td>
</tr>
<tr>
<td>Aegiceras corniculatum</td>
<td>Brominated diphenyl ethers (BDE-47)</td>
<td>5 μg/gdw</td>
<td>Biostimulated degradation</td>
<td>58.2</td>
<td>Chen et al. (2015)</td>
</tr>
<tr>
<td>Spartina maritima</td>
<td>As, Cu, Pb, Zn</td>
<td>5–2153 mg/kg</td>
<td>Bioaugmented rhizoaccumulation</td>
<td>19–65</td>
<td>Mesa et al. (2015)</td>
</tr>
<tr>
<td>Plant</td>
<td>Metal/compound</td>
<td>Concentration/Concentration Range</td>
<td>Remediation Method</td>
<td>Efficiency</td>
<td>Reference</td>
</tr>
<tr>
<td>-------------------------------------------</td>
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<td>---------------------------------------------</td>
</tr>
<tr>
<td><em>Arundo donax</em></td>
<td>Cd and Zn</td>
<td>78.9 and 66.6 kBq/dm³ respectively</td>
<td>Rhizofiltration</td>
<td>100</td>
<td>Dürešová et al. (2014)</td>
</tr>
<tr>
<td><em>Eichhorina crassipes</em> (water hyacinth)</td>
<td>Heavy metals (Fe, Zn, Cd, Cu, B, and Cr)</td>
<td>0.02–20 mg/L</td>
<td>Rhizofiltration</td>
<td>99.3</td>
<td>Elias et al. (2014)</td>
</tr>
<tr>
<td><em>Phragmites australis</em></td>
<td>PAHs</td>
<td>229.67 ± 15.56 µg/g</td>
<td>Rhizodegradation</td>
<td>58.47</td>
<td>Gregorio et al. (2014)</td>
</tr>
<tr>
<td><em>Plectranthus amboinicus</em></td>
<td>Pb</td>
<td>5–200 mg/kg</td>
<td>Rhizofiltration</td>
<td>50–100</td>
<td>Ignatius et al. (2014)</td>
</tr>
<tr>
<td><em>Luffa acutangula</em></td>
<td>Anthracene and fluoranthene</td>
<td>50 mg/kg</td>
<td>Phytostimulation*</td>
<td>85.9–99.5</td>
<td>Somtrakoon et al. (2014)</td>
</tr>
<tr>
<td><em>Dracaena reflexa</em></td>
<td>Diesel</td>
<td>1–5 wt%</td>
<td>Rhizodegradation</td>
<td>90–98</td>
<td>Dadrasnia and Agamuthu (2013)</td>
</tr>
<tr>
<td><em>Sparganium sp.</em></td>
<td>Polychlorinated biphenyls</td>
<td>6.260 ± 9.3 10⁻³ µg/g</td>
<td>Biostimulated rhizodegradation</td>
<td>91.5</td>
<td>Gregorio et al. (2013)</td>
</tr>
<tr>
<td><em>Amaranthus paniculatus</em></td>
<td>Ni</td>
<td>25–150 µM</td>
<td>Phytoaccumulation</td>
<td>25–60</td>
<td>Iori et al. (2013)</td>
</tr>
<tr>
<td><em>Rizophora mangle</em></td>
<td>TPH</td>
<td>33,215.16 mg/kg</td>
<td>Phytoextraction and phytostimulation</td>
<td>87</td>
<td>Moreira et al. (2013)</td>
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<tr>
<td><em>Populus deltoides x nigra</em> and <em>Arabidopsis thaliana</em></td>
<td>Silver nanoparticles and Ag⁺</td>
<td>0.01–100 mg/L</td>
<td>Phytoaccumulation</td>
<td>20–70</td>
<td>Wang et al. (2013)</td>
</tr>
<tr>
<td><em>Carex pendula</em></td>
<td>Pb</td>
<td>1.0–10 mg/L</td>
<td>Rhizofiltration</td>
<td></td>
<td>Yadav et al. (2011)</td>
</tr>
</tbody>
</table>

**Some plants with phytoremediation potentials:** Azubuike, et al.,2016

**CONCLUSION**
Bioremediation is a biotechnical process, which cleans up contamination in the environment. It is a type of waste management technique which involves the use of organisms to remove or utilize the pollutants from a polluted area. There are other types of waste management techniques apart from incineration and landfilling, which include solid waste management, nuclear waste management, etc. Bioremediation is different as it uses no toxic chemicals.

Microorganisms like Bacteria and Fungi play a main role in executing the process of Bioremediation. Even though this is an efficient process of waste management but bioremediation cannot destroy 100% contaminants. Bacteria can easily digest contaminants like chlorinated pesticides or clean oil spills but microorganisms fail to destroy heavy metals like lead and cadmium.

**Advantages**

1. Bioremediation is a natural process. Microbes that metabolize contaminants often increase in population when the contaminant is present and thus rates of biodegradation may increase over time, up to a point. The products of complete biodegradation are harmless; such as carbon dioxide, water, and cellular biomass.

2. In situ bioremediation can result in complete degradation of pollutants into harmless products on site. This removes the risks involved in transportation of contaminants for treatment.

3. Bioremediation can be a cheaper alternative to other technologies used for pollution mitigation.

**Disadvantages**

1. Only biodegradable compounds are capable of undergoing bioremediation. Not every compound is capable of fully being biodegraded.

2. The products of biodegradation may potentially be even more persistent or toxic than the original contaminant.

3. Biological functions are usually extremely specific and require the presence of microbes that are capable of metabolizing the contaminants. In order for the correct microbes to be present, the appropriate environmental conditions, levels of nutrients, and contaminants need to be met.

4. Scaling up the size of studies from small initial studies to commercial-scale field operations is difficult.

5. The real environment contains contaminants that are mixed, unevenly distributed, and in different phases (solid, liquid, gas). More research needs to be completed to create technologies that can adapt.

6. Bioremediation often takes more time compared to the other methods.

7. Problems ensuring adequate contact between the microbes and the contaminant is preferential soil structure causes uncertainty in remediation dispersal.
Bioremediation vs. Conventional Methods:

The normal practice of treating wastes has been excavating it and dumping it into waste land which is the landfill or treating it using an incinerator facility. Landfills are becoming more restrictive and incineration costs are high and expected to increase. Cost is involved for excavation, loading, transportation and replacement. Moving contaminants is also a matter of risk. Bioremediation – accelerating the natural on-site biological cleanup processes offers a safer and less expensive alternative in most cases.

Limitations of Bioremediation:

Some of the limitations of bioremediation are the toxicity of the contaminant or the pollutant to the microbes used in bioremediation. It may inhibit the growth of the microbes or sometimes kill them. For the proper growth and for the enhancement of growth of the microbes proper pH, nutrient concentration, temperature are required, once achieved enrichment of the desired microbe is achieved. Besides these solubility of waste, nature and chemical composition of waste and microbial interaction with them also matters. Hence the researchers should search genetically different type of microbes which can also work on slightly adverse condition. Therefore, bioremediation is still considered as a developing technology to regulate the day to day environmental problems faced by man residing in an area.

REFERENCES


**HOMOSEXUALITY ISN'T A CHOICE IT'S A CHEMICAL MODIFICATION OF DNA – AN EPIGENETIC MUTATION**

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**ABSTRACT**

There have been a lot of speculations regarding homosexuality over years. Recent research reveals that homosexuality is not a life style choice. It is caused by a genetic mutation – a chemical modification in our DNA. During development some chemical changes
occurs in our DNA that don't affect the nucleotide sequence but can turn genes on or off; the best known example is methylation, in which a methyl group is attached to specific DNA regions. These chemical changes are known as epigenetic modifications. Such “epigenetic-marks” can remain in place for our lifetime, but most are erased when eggs and sperm are produced i.e. during oogenesis and spermatogenesis, so that a fetus starts with a blank slate. Unerased epigenetic-marks lead to homosexuality when they are passed on from father to daughter or from mother to son. Inherited marks that influence a fetus's sensitivity to testosterone in the womb might “masculinize” the brains of girls and “feminize” those of boys, leading to same-sex attraction or homosexuality. Five regions in the human genome have been identified where the methylation pattern appears very closely linked to sexual orientation. Identical twins sometimes end up with different methylation patterns. DNA methylation is determined by subtle differences in the environment each fetus experiences during gestation, such as their exact locations within the womb and how much of the maternal blood supply each receives. Due to this difference in womb environment in one of the twins, mothers' epigenetic-marks might have been erased but not in the other. The one with the erased mark will be normal and the other child carrying the unerased marks will turn into a homosexual.

Epigenetics in Sexual orientation

The first indication of involvement of epigenetic mechanisms in sexual orientation emerged from the twin studies. The concordance rate between monozygotic twins was higher than in dizygotic twins. The highest observed rate of concordance was found to be 52% (Bailey & Pillard, 1991). The concordance data proves that the trait is not exclusively genetically influenced but suggests a role for environmental effects in influencing sexual orientation. Many researchers increasingly believe that environmental effects are translated into biological consequences through epigenetic mechanisms (Jirtle & Skinner, 2007).

The environment which plays a crucial role in sexual orientation was variations between each twin during development, which can include differences of the intrauterine environment. Differences in nutrient (intrauterine) could affect epigenetic markers on genes relevant to sexual orientation. Even DNA methylation profile is not identical between MZ twins at the time of birth (Gordon et al., 2012). There is also increasing evidence that discordance among MZ twins in other traits is related to DNA methylation differences (Dempster et al., 2011; Kuratomi et al., 2008).

The fraternal birth order effect is one of the most crucial factors in sexual orientation research. Each son increases the odds of homosexuality in the next son by 33% relative to the baseline population rate. The probability of a gay son reaches 50% only after 10 older brothers. The birth-order effect only holds true if all the brothers are from the same mother—if the older brothers are from another mother, there is no effect. The number of older sisters does not have an effect either. The biological mechanism underlying fraternal birth order is still unclear. One hypothesis that male pregnancy triggers male-specific antigens in the mother, and each successive male child increases this immune response (Blanchard & Bogaert, 1996;
Blanchard & Klassen, 1997). Another hypothesis states that epigenetic mechanisms mediate the long term consequences of in utero events.

**Linkage of male homosexuality to 10q26**

10q26 contains a region that is differentially methylated in the germline based on parent-of-origin which plays an important role in male sexual orientation.

**Epigenetic mechanisms that specifically affect the X chromosome have also been implicated in sexual orientation.**

According to lyonization theory any human individuals born with more than one copy of X chromosome will partially inactivate the extra copy or copies. In normal female choice of X chromosomal inactivation is random and happens independently in each cell. Therefore, at the population level, the maternal X should be inactivated in 50% of cells, and the paternal X should be inactivated in the other 50%. A slight deviation from this 1:1 ratio (or skewing) is not uncommon. However, mothers of gay men show extreme skewing of X inactivation (ratios of $\geq 9:1$) at rates far higher than mothers with only heterosexual sons (Bocklandt, Horvath, Vilain, & Hamer, 2006). The rate of extreme skewing seems to be positively correlated with the number of gay sons.

**Three models about role of epigenetic markers leading to homosexuality**

The first is that sex-specific epigenetic marks (histone modifications, DNA methylation, noncoding RNAs) lead to sex-specific traits. The sex-specific marks that are present in the parents are usually erased during gametogenesis (so that the “correct” sex-specific mark can be placed during embryogenesis). If these marks are not erased it will be passed on to the developing zygote which may lead to homosexuality. For instance, if a feminizing epigenetic mark remains in the ovum, and it is fertilized, then the trait under the control of that mark in the offspring might also be feminized.

The second core assertion is that sensitivity to fetal androgen signaling is sexually dimorphic due to sex-specific epigenetic marks with XX fetuses being less sensitive than XY ones. In both rats and humans, about 5% of XX fetuses have testosterone levels that are in the lower end of the male range during the prenatal testosterone surge, which is important for genital development. Since the incidence of discordance between the genitals and gonads is much lower than they would be if testosterone levels were the only determinant, thus it is conclude that there is sexual dimorphism in sensitivity levels to testosterone.

The third concept is that by sex-reversing sensitivity to androgen, sexual orientation will be sex reversed as well. This means that feminizing epigenetic marks will make XY fetuses less sensitive to the effects of androgens and therefore more likely to develop as homosexual men.
Other Genetic link to homosexuality - *SLITRK6* & *TSHR*

A study has found possible clues about genetic differences between heterosexual and homosexual men. Whole genome sequencing of around 1000 homosexual men and 1200 heterosexual men reveals that there are stretches of DNA which vary between the two groups and are delimited in a specific region. The two regions of the genome with majority of differences were near genes whose roles are linked to sexual orientation. One gene is linked to the development of a brain region which can differ in men depending on their sexual orientation while the other gene is linked to thyroid function, which is also linked to male homosexuality.

Gene *SLITRK6*, which is located on chromosome 13, is expressed in the region of the brain - the diencephalon, containing the hypothalamus. The hypothalamus of heterosexual men is nearly twice the size as that of homosexual men. The gene has been found to be active a few days prior to the birth of male mice which is considered to be a crucial time for sexual differentiation in this part of the brain. So this particular finding is a potential link between the neuroanatomy and molecular genetics of sexual orientation.

The second gene, *TSHR*, is known to produce a receptor protein that, together with a hormone, stimulates the thyroid, another organ believed to be involved in sexual orientation. There are evidences of gay men suffering from Graves disease - the disease is caused by the over activation of thyroid.

**X chromosomal genes in determining sexual preference in men**

National Institutes of Health published a study in the year 1993 that proposed that Xq28, a region of the X chromosome, might play a role in determining sexual orientation in men. There were lots of controversies regarding the initial findings but approximately 20 years later it has been validated. Single nucleotide polymorphisms (SNPs) were observed in the DNA of the twin gay brothers. Those SNPs are clustered in the Xq28 region on the X chromosome and in the 8q12 region of chromosome 8.

**Prenatal androgen exposure in women could affect their sexual orientation**

Female fetuses that have congenital adrenal hyperplasia (CAH) experience increased levels of androgen exposure. The exposure levels sometimes exceed female-typical levels. Such high levels of androgen are high enough to cause masculinization of their external genitalia. CAH can be fatal if uncontrolled (for reasons unrelated to the level of circulating testosterone), so these girls start treatment immediately after birth, which brings their postnatal testosterone levels back into the female-typical range.

The proportion of adult CAH women who are identified as lesbian is many times higher than in the general population and is correlated with prenatal androgenization Studies of CAH girls...
have repeatedly shown that they are masculinized on other sexually dimorphic cognitive and behavioral traits.

CONCLUSION

Different studies have proved that the biological factors that affect sexual orientation differ between the sexes but the genetic network that underlies this trait is common to them. It is unlikely to have a “straight male genes,” “straight female genes,” “gay genes,” or a “lesbian genes.” Instead, it has been hypothesize that a network of genes underlies sexual attraction, and that this network can predispose for attraction to men, women, or both

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**DRUG DELIVERY SYSTEM INCREASE THE CLINICAL EFFICACY AND EFFICIENCY**

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**ABSTRACT**

Discovery of new drug molecule is very expensive and time consuming so we can improve the safety efficacy ratio of “old” drugs by using different methods such as drug
therapy, dose titration, therapeutic drug monitoring and delivering drug at controlled rate, targeted delivery methods has been used. The Nano biomaterials because of its unique physicochemical properties such as small size, large surface area to mass ratio, high reactivity and functionalizable structure which can change and improve the pharmacokinetic and pharmacodynamic properties of various types of drug molecules that are capable of targeted delivery of both imaging agents and anticancer drugs. By using targeted delivery method has helped us to detect cancer lesions, molecular signatures of the tumor by noninvasive imaging and molecular targeted cancer therapy. These properties were applied to overcome some of the limitations in traditional therapeutics. They have been used in vivo to protect the drug entity in the systemic circulation, restrict access amount of the drug to the target sites and to deliver the drug at a controlled and limited rate to the site of action which will minimize side effects of the drugs and increase the efficacy of the drug.

Keywords: Drug delivery, Nano - technology, Therapeutic drug, Toxicity

INTRODUCTION

Evolution of a novel drug is exorbitant and time consuming. Refining safety efficacy ratio of “primitive” drugs has been ventured using different technologies such as individualizing drug therapy, dose titration, and therapeutic drug monitoring, transporting drug at administered rate, slow delivery, targeted delivery. Countless animal and human examinations have anticipated an increased interpretation of the pharmacokinetic and pharmacodynamic postulates that command the activity and disposition of influential opioid analgesics, inhalation anesthetic agents, sedative/hypnotics, and muscle relaxants. These researches suggest that skin and buccal and nasal mucous membranes might have use as substituted routes of analgesic and anesthetic delivery. Similar progresses with other compounds have catalyzed a plethora of new devices, notions, and procedures that have collectively been termed controlled-release technology (CRT). Some examples of CRTs are transdermal and transmucosal CRTs, ml6 nasal and buccal aero sprays, drug-infused lozenges, enclosed cells, oral soft gels, iontophoretic devices to supervise drugs through skin, and diverse programmable, embedded drug-delivery devices. There are multiple elements restoration interest in the manufacture of these modern devices, concepts, and techniques. Standard drug imposition methods, while widely exploited, have several complications that may be likely controlled by these methods. These approaches appear appealing in comparison to the costs of novel drug development. Rising R&D costs, different investment scope for drug firms, minimal firms regulating pharmaceutical research, and abrasion of effectual patent life have led to a decrease in the introduction of new chemical entities since the late 1950s. Launching a novel drug through discovery, clinical research, development, and regulatory approval is contemporarily estimated to take a period of 10 years and the budget is expected over $ 120 million. New drug delivery systems may account for as much as 40% of US marketed drug products by 2000.

Drug Delivery Route
There are diverse modes of routes by which drugs can be apportioned into human body. The route stipulation depends majorly on three factors: the desired effect, the disease and finally the type of the product. Medical drug will be provided either directly to the organ which suffers from disorder or it can be targeted to the organ infected. The most common routes of drug administration are:

**Oral route**
The most primitive route which has been used for novel drug delivery is by the oral mode. The two crucial factors for taking this route into consideration are ease of administration to the patients and their comfort.

![Fig 1: Modes of oral drug administration](image)

**Parenteral route**
In this mode of drug delivery the medical drug is introduced into the human body through any other different routes except the oral avenue. For example: intramuscular, intravenous, intra-arterial and subcutaneous modes of drug administration.
Transdermal route
In this mode of administration medical drug is applied on the surface of the body such as skin or mucous membrane. This route transfers the active components directly to the systematic circulation without gastrointestinal or liver metabolism.

Inhalation route
In this treatment method the drug directly reaches the lungs and increases the bioavailability of the drug in the human system. This mode of treatment is contemplated to be the primary choice in the treatment of respiratory diseases.
Classification of rate controlled drug delivery systems

Based on their technical advancement – controlled drug delivery systems can be classified into the following categories:
1. Rate – pre programmed drug delivery systems
2. Activation modulated drug delivery systems
3. Feed back regulated drug delivery systems
4. Site-targeting drug delivery systems.

Advantages of Controlled Release Dosage
Engage less total drug.
Reduction of local, systemic side effects.
Minimal drug assembly on chronic usage.
Improve efficacy of treatment.
Control the situation more expeditiously.
Diminish the variation in drug level.
Rectification in the bioavailability of some drugs.

Disadvantages
The physician has reduced pliability in adjusting the dosage dominion. This is stabilized by dosage form design. Apportion of this type of dosage form does not allow the instant termination of therapy. Economic reasons include more expensive methods and equipments that are employed in manufacturing many controlled release dosage forms. Drugs with enhanced biological half-life (e.g. Digoxin-34 hours) are innately long lasting and thus are viewed as questionable candidates for endured release formulations. Drugs like Riboflavin
and iron salt, which are not successfully absorbed in lower intestine are considered as poor candidates.

**Nanotechnology for drug delivery**

For more than a decade, nanoparticle formulations have been prepared and tested for their presumed ability to provide better treatment, especially treatment of tumors. The promise of nanoparticle formulations is that nanoparticles, due to their huge surface area, may have unique properties that larger drug delivery systems do not have. The whole field of nanotechnology-based drug delivery systems began with this assumption, but this assumption still remains hypothetical even more than a decade later. If nanoparticles possess unique properties, they should be clearly understood by now. But it is still not clear what unique properties nanoparticles possess in drug delivery. Simply speaking, what are we missing if the current nanoparticle formulations do not exist? Nanotechnology is often labeled as an enabling technology that revolutionizes the field. In the drug delivery field, nanotechnology-based drug delivery systems, i.e., nanoparticle formulations, are supposed to enable formulation scientists to develop unique formulations that were not possible before. If nanotechnology is such an enabling technology, why have there been no advances in the field where breakthrough advances are desperately needed? For example, nanotechnology has not been able to contribute to treating diabetes, giving up smoking, managing Alzheimer's disease, or preventing a heart attack.

![Fig 5: Nanotechnology in drug delivery](image)

The only area that nanoparticles have been used has been targeted drug delivery to tumors. Frequently, antibody-grafted nanoparticles are used for improved targeting ability, but the increase in drug accumulation at the target tumor has been marginal [10–13]. The drug delivery scientists have been placing blind trust in nanotechnology without any evidence or proof that nanotechnology indeed brings new approaches to disease treatment. The drug delivery scientists should break out of the nanotechnology shell. Research on nanoparticles will continue for another decade or so due to its huge inertia, but the underlying assumptions, and thus the limitations, have to be understood before further investment is made. The persistence of never giving up is a virtue resulting in ultimate success, but it may be counterproductive if the current non-productive approach is repeated. 4 Research vs. clinical product development Like in any scientific discipline, research on drug delivery systems is
hard. Advances in the field have been slow and incremental. Over time, however, cumulated technologies allow development of novel drug delivery systems benefiting patients. During the last six decades, many controlled release formulations have been developed with clinical realization. But most of the clinically successful formulations are oral and transdermal delivery systems of the 1G. There are literally hundreds of oral and transdermal sustained release formulations with commercial success. For other routes of drug delivery, however, only a limited number of formulations have been clinically used. The number of long-term depot formulations is still very low, and also the drug release kinetics is not desirable with high initial burst release. The intravenous formulations, especially targeted drug delivery systems, are still under the research stage. The difficulty becomes even greater if a drug to be delivered has high molecular weight and hydrophilicity, such as proteins or genes. It is time to review the great achievements that the controlled drug delivery field has made to date, as well as the challenges facing us. Without clear understanding of the difficulties facing the field, no solution can be found. One limitation that the drug delivery scientists are facing is the use of generally regarded as safe (GRAS) materials. If a new material is used, then its safety has to be proven by clinical studies and this is beyond the realm of the drug delivery scientists. If a new material is shown to have drastically better properties in treating diseases, it can be justified to invest a large amount of resources for clinical studies. The bottom line is that the drug delivery scientists need to work in the boundaries of materials that can be approved by FDA, i.e., safe and effective. At the same time, formulation scientists should not be afraid of using new polymers as long as they improve the drug efficacy substantially

CONCLUSION

Development of drug delivery system is being done enthusiasm in many laboratories in India. These are being investigated in vitro and in vivo in animals for pharmacokinetics but not for efficacy. It is necessary that pharmacologists should be involved in the investigation of pharmacokinetics and pharmacodynamics of drug delivery system if the products have reached outcome - the clinical use.

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Patient Safety Standards: Awareness for Safety

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ABSTRACT

When it comes to patient safety, it is all about prevention of harm to patients while receiving medication or healthcare. It means, eliminating preventable medical mistakes, guarding against the impact of human errors, establishing systems to safeguard patients. Patient safety and reduction of preventable medical error is one of the major challenges of 21st century. When we compare the statistical data of deaths in hospitals due to medical errors with India, the figure would be irresistible, but most of the ones have not documented evidences. NABH accreditations play a major role in healthcare delivery systems in India. Challenges in patient safety is lack of systems in our hospital, lack of awareness, no availability of scientific data base and lack of findings for promoting patient safety. NABH is internationally acclaimed society for quality and standards in healthcare. A recent survey from WHO showed that India comes in the top 10 with the deaths due to medical errors. Safety and errors are like two arms of an individual; with one arm we make mistakes and the other arm pull us out from that mistake. Innovation and technology can save lives but also introduces complexities and risk element, id used unsafely. Research reveals that this is because the healthcare system frequently falls short in its ability to translate knowledge into practice and fails to apply the new technology safety and approximately. This result into overuse, underuse, misuse of the healthcare services and subsequently this conclude into loss of life, major or minor impairments, pain and sufferings. This does not end here, further it results millions of money, which is extra burden on patient and family. Education and validation of competency are critical components in the quest to improve patient safety. At the very least, all healthcare and their organization must have mechanisms to check this system. Education needs to be broadened to include explicit patient safety topics, such as human factors and methods like stimulation, designed to create a generation of healthcare workers who deliver consistently safe care.

Keywords: Healthcare system, Medical errors, Patient safety standards, Innovation and Technology

INTRODUCTION

Patient Safety has become one of the most important factor and concern in healthcare. Patient safety is the freedom for a patient from accidental or potential harm associated with healthcare. Reports in medical literature indicate that large numbers of deaths occur worldwide due to errors in medical care. To ensure the patient safety communication between physicians, hospital staff, patients and their families is required. Patient safety improvement
also demands a complex system-wide effort, involving a broad range of actions in performance improvement, environmental safety and risk management which includes infection control, safe use of medicines, equipment safety and safe clinical practices. To understand the concept of patient safety, one must understand the concept of reliability. Deaths and Harm from medical errors are not inevitable but preventable. India needs a healthcare system that can meet the demand over a billion people. Each year millions of people will be unable to meet good medical care due to their inability to meet healthcare costs which pushes them into poverty. India leads the world in terms of maternal deaths. According to a report there were 57,000 maternal deaths in 2010. Mostly lack of qualified medical professionals in rural area is observed. We must look to build a bridge, to fill the gap between hospital’s works to meet accreditation and efforts to improve patient safety and quality of care.

DISCUSSION

Patient Safety standards are a variety of standards aimed to ensure patient safety. In health care settings, the goal of patient is perused through appropriate efforts to avoid adverse events related to errors in diagnosis, medication or treatment. But errors also can result harm in patients. An adverse clinical event would occur from switching two similar medications and giving the wrong one to a patient. This could be avoided through follow-up of patient safety standards.

Patient safety system use redundancy procedures to minimize errors and prevent adverse and near-miss clinical events. However, the redundancy and back-up procedures
alone cannot guarantee that patient’s morbidity and mortality will be reduced. It has been identified that the Human Factor is an essential element in patient safety. The human factors include personal issues, task-oriented issues and interactions among staff. Those who lack the knowledge, skill or motivation to improve patient safety are often part of the problem. Unfortunately, some of the health professionals do not fully appreciate these risks but some of them do care but due to poor understanding or heavy work load, they skip the steps designed to prevent errors. Changes in attitude come when administrators will employ strategies to help healthcare professionals to maintain their interest in quality and safety. Training and interaction sessions will provide good opportunities to build this culture. Staff meetings should always reinforce the message that patient safety matters and staff must be strongly encouraged to speak up and promptly report errors or problems that compromise safety. To achieve this, it is important that there be no dominant heads to take action towards those who report errors.

Patient safety concerns are not only limited to medication or administration errors, they may also cause due to the distractions and interruptions in clinical workflow. Distractions could result in record keeping; clinician communication etc. simply by an environment with slamming steel doors, poorly illuminated examination rooms etc. Distracted health staff may be root cause of patient falls, hurried staff might skip hand hygiene or an overworked clinician might forgot to follow-up on scanning.

Communication among the staff is essential to deliver safe healthcare. When communication is disrupted or is unclear, safety suffers. The disruptive behaviours of staff can lead to adverse effects. A recent study shows 77% of disruptive behaviour by physicians and 65% by nurses which were linked with medical errors and patient mortality. A large number of people receiving health care should be aware of Reconciling Medication Information. Patients who take multiple medications face the complexity in managing those medications, which becomes an important safety issue. In medication reconciliation, a clinician compares the medications of a patient, what the patient was prescribed and what medication he patient is actually using. It can be difficult to obtain a complete list from every patient and the accuracy also depends upon patient’s ability and willingness to provide this information.

CONCLUSION

A Healthcare culture of safety should be an integrated part of individual, one should report the errors and incidents to promote and understand the safety. Healthcare providers should routinely conduct self-assessments or audits to identify error-probe or high risk processes, systems or settings. A proactive risk assessment ensures the hazards by which the risks get identified before they occur. Safe practices are published by National and International accreditation agencies which should be implemented and practiced by organizations to ensure the error processes.
In India, there is an increase in the magnitude of digitization of healthcare system services in various healthcare delivery institutions. It has been claimed by practitioners and clinicians that electronic health records have the ability to enhance quality and safety of care besides health information and clinical data. This system also enabled improved services and reduced the redundant clinical tests and also helped to understand diseases and their diagnosis.

RESULTS

In India there are many programmes launched by Indian govt. to help public in terms of healthcare. We can easily access Indian Government’s National health Portal, where we will find major health initiatives such as Disease A-Z, MyHealthRecord, Mera Aspataal etc. Disease A-Z is an initiative through which we can understand diseases, their causes, symptoms and suitable diagnosis tests for respective diseases. MyHealthRecord is an initiative launched by Indian govt. since 1st December 2017, where we can upload personal health records and secure them so that it will be able to access by the one who we allow like our physicians, friends, family etc. There are also several mobile apps launched by Indian govt. which are user friendly. IPSO is offering a range of online, classroom and certified courses in patient safety, improvement capability, quality, cost, value, person and family centred care, for healthcare workers. IPSO is also offering E-learning patient safety course content which will be online modules to equip the learner with fundamental understanding of the patient safety and skills that are applied in everyday practice.

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INCREASING AWARENESS ABOUT DIABETES MANAGEMENT AS A KEY GROWTH DRIVER TO THE DYNAMIC INCREASE IN GLOBAL INSULIN MARKET

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ABSTRACT

Insulin, a hormone produced by the β cells of Langerhans in the pancreas, regulates metabolism by allowing glucose uptake in our body from carbohydrates and hence helps in maintaining the blood glucose level. During diabetes treatment, insulin injections are provided to allow the body to process sugar and avoid complications from hyperglycemia. Growth of the global insulin market is propelled by several factors like increasing global prevalence of diabetes; rise in decrepit and obese populations and most importantly by propagation of diabetes management awareness and government impetus. According to 2017 census, Chengamanad, having a total population of 29,576 revealed, out of 14,475 males and 15,101 females, 25,132 are literates who are aware about Diabetes, its types and the necessity of insulin uptake for its treatment. The global insulin therapeutics market is expected to register a CAGR of 8.0% during forecast period, 2018 to 2023. North America dominates the market, due to its growing diabetic and obesity instances and even India is among the top five market leaders for insulin today. The increasing trend of awareness about diabetes and insulin is majorly due to the knowledge transfer about the disease through mass media such as television and newspapers that has wholeheartedly contributed to public awareness. Family members and friends followed by doctors also play a very important role in distributing information about the disease especially to the people of the backward community. Although increasing literacy rate and distribution of knowledge is contributing to better public awareness; emphasis still needs to be given on periodic screening for diabetes and intake of insulin dosages correctly by patients if at all necessary. This report focusses on the contribution of knowledge transfer through different sources towards the increasing awareness of diabetes leading to the dynamic increase in Global insulin market.

Keywords: Insulin, Diabetes, Knowledge Transfer, increase, market

INTRODUCTION
Diabetes is a medical disorder that sparks off due to insufficient insulin production by the β cells of Langerhans of the pancreas (Type I) or due to its defective response (Type II). Under normal conditions, level of blood glucose in the body is tightly controlled by insulin, a hormone produced by the pancreas. When the blood glucose hauls up, the hormone insulin is released from the β cells of pancreas to standardize the glucose level. In diabetic patients, the absence or insufficient production or faulty response of insulin causes hyperglycemia.

Patients diagnosed predominantly by Type II Diabetes are advised lifestyle and diet changes which include routine exercises and nutritional balanced diet. But lifestyle changes and oral drugs for Type 2 diabetes are dubious to be a perpetual resolution. Over time, the pancreas tends to produce further less insulin until eventually it cannot meet the body’s entail. Ultimately insulin, either in injected or infused dosage, is the most efficacious treatment for Type 2 diabetes.

With the growing graph of Diabetes all over the world the demands for insulin products are also at its heights. This has led to flourished insulin market in recent years. The key driver behind this established market is the increasing awareness about the disease and its treatment methods. North America dominates the market, due to its growing diabetic and obesity instances and even India is among the top five market leaders for insulin today.
Knowledge transfer is a key element of increasing awareness. Education and spreading information about the disease, its root cause, its symptoms and treatment through communication between doctors and patients or through mass media is termed as knowledge transfer. The necessity of knowledge transfer and its contribution towards the increasing insulin market and diabetes prevention is prodigious.

RESULTS AND DISCUSSION

- The increasing Worldwide Statistics of Diabetes is a concern

Diabetes is one of the most endemic diseases across the world and India being termed as the “Diabetic capital of the world” with as many as 50 million people suffering from type-2 diabetes; indeed has a challenge to face in the forthcoming years. A common illusion states that diabetes is non-fatal; but WHO reckons deaths of 80% diabetics in low and middle-income countries and projects that such deaths will double between 2019 and 2030.

Not only in India, it is surmised that approximately 415 million people are diabetic worldwide which implies 1 out of 11 in the world's adult population suffer from this malady.
out of which 46% cases are undiagnosed. This figure is expected to soar up to 642 million people worldwide by 2040.

![Graph showing current and projected prevalence rates for diabetes worldwide.](image)

**Fig 2: Current and Projected Prevalence Rates for Diabetes Worldwide.**

- **The escalating Insulin demand reflects in the flourishing market**
  Currently, approximately 100 million people around the world need insulin, the unavailability of which may lead to premature death. Hence it is now essential to establish a market to meet the demands of this 100 million and more population of diabetics. Rising ubiquity of diabetes is one of the important factors that revitalize the growth of the CIS insulin market. With the increasing demand and the flourishing market, the government supports and rising R&D in insulin product is projected to unveil remunerative growth in this industry.
The CIS insulin market is predominated by North America followed by European regions. Regional segmentation includes the current and forecast demand of CIS insulin in Asia Pacific, Latin America, and Middle East & Africa with its further bifurcation into major countries including U.S. Germany, France, UK, China, Japan, India and Brazil. Asia Pacific is expected to witness significant growth over the prognostication period.

**INSULIN MARKET SHARE (%) BY REGION (2016)**

- NORTH AMERICA
- LATIN AMERICA
- EUROPE
- ASIA PACIFIC

Fig 4: Global Insulin market leaders
Knowledge Transfer plays the pivotal role in increasing awareness about Diabetes and Insulin; in turn contributing towards the growing market

Knowledge transfer in simple words designates promulgating knowledge and providing inputs towards solving a problem. Diabetes indeed is a huge problem and insulin is one of the most imperative solutions to it. But neither Diabetes can be ameliorated by insulin consumption, nor can insulin market see an increasing graph until the mass diabetics are aware about the disease and insulin as its mode of treatment. Here reflects the contribution of knowledge transfer.

Fig: Knowledge Transfer at a glance

Knowledge Transfer through Awareness Campaigns

Every year on the 14th of November “World Diabetes Day” is celebrated. Not only on this very particular day numerous awareness campaigns about diabetes has been organized across years in collaboration with doctors, hospitals, nutritionists to spread knowledge about the disease and its treatment to common masses. Australia organized “Diabetes; its time you open your eyes to the risk” campaign in 2005 and “Measure Yourself” campaign in 2007. They also observe “National Diabetes week” every year. On 7th April 2016, on the occasion of World Health Day, World Health Organization launched the “Best Diabetes” Campaign with a mission to shift the focus of the common mass towards Diabetes. Such campaigns include Doctors interacting with the masses and spreading information about the disease, the dos and don’ts for the diabetics, the necessity of insulin and also sometimes complementary detection of diabetes through free blood tests. These small attempts to transfer knowledge from doctors to common people can save lots of deaths because being aware about a disease can help in timely detection and correct medication of the same. With the common people being more aware about insulin products, the diabetics switch towards the treatment and hence the demand for the products boom up the market as well.
• Knowledge Transfer through mass media

In addition to traditional forms of advertisements, diabetes advocacy groups have taken their case to social media. Many organizations are using social media as a platform where they can bring about diabetes awareness, support and education. The American Diabetes Association’s (ADA) mission is to prevent and cure diabetes and to improve the lives of all people affected by diabetes website, YouTube, Twitter (English, Spanish), Facebook. Diabetes Social Media Advocacy (DSMA) is involved with and promotes social media in all its forms to empower people affected by diabetes and to connect them with each other to foster support and education. Twitter, Facebook. Even in India social media makes sure to promote about diabetes awareness campaigns and doctors, nutritionists and practitioners often spread out knowledge through newspaper columns about the disease and its treatments.
Family and Friends can Transfer Knowledge too

People often suffer from type 2 Diabetes due to genetic susceptibility. If someone in the family is already a diabetic it is always advisable for his immediate next family generations to undergo tests to confirm their blood sugar level. Any diabetic family member should spread the necessary information about the disease and its treatments to the other family members to increase their awareness about the ailments.

Lack of awareness about any disease can be fatal. So it is always very important to know the root cause, symptoms as well as the necessary treatment steps for any disease or disorders. Diabetes is also not different. The growing mortality due to diabetes is only because of lack of knowledge about it. Hence transfer of knowledge from the known to the unknown and proper education about it can save millions of life.

CONCLUSION

The International Diabetes Federation (IDF) has recently concluded its World Diabetes Day campaign. This year-long awareness campaign, run by the IDF with the support of the World Health Organization (WHO), aims at informing the public of the causes, symptoms, complications and treatments associated with the condition. There are many such organizations that conduct such campaigns with the motive of transferring and spreading knowledge believing in “Prevention is better than cure”. Following the motto of helping each other just by transferring knowledge and spreading awareness we can save million lives and build up a healthy anti-diabetic India.

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PATIENT SAFETY IN TERMS OF QUALITY CARE AND DOCUMENTATION

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ABSTRACT

Patient safety was defined by the IOM as “the prevention of harm to patients.” Special importance is given to the system of care delivery that (1) avert errors; (2) learns from the errors that take place; and (3) is built on a refined understanding of safety that involves health care professionals, organizations, and patients. Patient safety standards include the practices those lower the degree of harmful events related to exposure to medical care across a range of diagnosis. Quality health care is seen as an ambient umbrella under which patient’s safety resides. Quality care includes the dimensions of providing service or care to the patients, looking at the effectiveness of the services provided, and if maximum efficiency is provided at the lowest cost. Nursing is the key to improve the quality care and there by the patient safety by forming a communication bridge between the services provided and the patients. In 2004 World Health Organization (WHO) launched a patient safety programme in order to address the issue of the quality care at global and collaborative manner. Many organizations and Public policies impede hospitals to upgrade the quality care of the patients. Documentation system promotes the flow of information that reinforces the continuity, quality, and safety of care. The Health care record policy make sure that the high standards for documentation of health care records are maintained consistent with legislation, common law, ethical and current best practical requirements across the public health organisations. Auditing of the health care records involves a team based approach that facilitates the Public Health Organisation to improve quality. The entire patient’s information in the health records is highly confidential and is subjected to privacy laws, policies and is protected by the legislation. Patient safety is an important aspect of health care quality and documentation.

Keywords: Patient Safety, Quality care, Documentation, Nursing, World Health Organization, Privacy laws, Auditing

INTRODUCTION

Patient safety is defined as the term used nationally and internationally to narrate the freedom from potential harm related to the healthcare services and the scaling down of the risk of unwanted harm to a satisfactory minimum level (World Health Organization, 2009). Patient Safety encompasses the investigations of possible harm, incidents that actually occur, and chance for learning from mistakes. It creates a safe place to learn and share for the benefit of patients and staff. Patients safety mainly deals and focusing on safety of the patients rather than dealing with the patients after injury. It tries to create a safe background and place to
learn and share knowledge for the benefit. The main goal of the successful patient safety programs are to authorise the staff to report the issues that would cause injury and help in the investigations of the mistakes that can lead to the system changes which facilitates patients outcomes, safety and experiences. Patient safety department encourages safety in the clinical areas by their constant education and support. There are several duties involved in accomplishing patient safety keeping the entire staff and providers know of improvement initiatives taken for the patient safety and communication of updates as needed, investigating the possible mistakes reported for learning and discovery of system failures, making teams to work on the present patient safety issues in the organization, it is necessary to keep all records on the patient safety events confidential, creating an environment of authority for the patients, providers and staff to actively participate in the patient safety program, to make improvement in the patient safety policies and procedures by analyzing data from the patients records and safety event analysis.

PATIENT SAFETY PROGRAM

The concept of quality care is multidimensional. It is defined as the process that ensures each patient that the therapeutic and diagnostic tests will give the best results in terms of health. The concept of the quality care includes the dimensions which ensures that care or services are appropriate according to the need of the patient, the care or services provided have a positive outcome on the patients and the maximum efficiency is achieved at low cost. Quality control is a dynamic concept that involves the combination of science, technology and healthcare. The concept changes with respect to time and space and must utilise all the resources available in context at that particular given time. Quality care involves a big challenge as it needs consultation and patient interdisciplinary collaboration. In order to provide quality service, all the members of the particular institute should work together to focus on the patients and avoid any negative effects on the quality care.

The Health Care Records Policy defines the need for the documentation and management of health care records across public health organisations. The policy makes sure that the records are maintained under high standards of documentation and management with common ethical, law, legislation and current best practice requirements. The main purpose of
the policy is that it defines a need for the documentation and management of the records. Accurate description of each patient episodes of care with the doctors and nurses must be provided by the documentation in the health care records. The policy requires that the health care records of each and every patients needs to be documented along with the assessment and treatment, patient safety, education, funding and statutory requirements. The health care records, documentation and management must work in accordance with this policy. The documentation of the health care records helps to encourage patient’s safety. The health care records are considered to be the means of communication that provides safe care and treatment of patient/client. The records are seen as the repository of the important information that includes the medical and therapeutic treatment and involvement for the well being of the patients during the period of care. The documented Health care reports involve the health care plans and investigations, diagnosis, treatments, progress and health outcome for each of the health service provided.

DISCUSSION

Patient safety in terms of quality care

Patient safety practices have been defined as those which minimises the risk of harmful events related to the diagnosis and condition. There are other practices which have a sufficient evidence to be included in the category of patient safety such as

- Administration of prophylaxis that can prevent venous thromboembolism in patients which are at risk
- Perioperative morbidity and mortality can be prevented by the use of perioperative beta-blockers in the suitable patients.
- Sterile barriers needs to be used while placing the intravenous catheters
- the understanding of the patients is verified by asking them to recall and restate what was told during the informed consent process
- Pressure ulcers are prevented by using pressure-relieving bedding materials
- Provision of appropriate nutrition to the patients

The patient safety practices also include the use of stimulators, bar coding, computerized physician order entry and crew resource management, are seen as the strategies to avoid the patient safety errors and thereby help to improve the process of health care.

Nursing key element in quality care

Nurses are the foundation of most of the health care services. The nurses are the hard core work force of the health care system. They deal on daily basis with the patient safety. It was previously seen that the responsibility of the nursing in terms of the patient safety is narrow, for example to avoid medication errors and preventing the patients to fall. Though these dimensions are important in terms of quality healthcare, the most critical role of the nursing in the patient safety is to correlate and integrate the multiple aspects of quality within the care is
directly provided by nursing, and across the care delivered by others in the setting. Nursing plays a key role as a communication link in all health care settings becomes evident.

According to the International literature the nursing professions should be capitalised in order to improve the quality care of the patients in the health care system. According to the literature date the optimal use of the nurses has led to the following improvements in patient’s safety.

- Quality care is improved
- Lives are prolonged and lives are saved
- Patient health and quality life improved
- Lesser adverse events
- Complications avoided
- Reduced the use of more cost care
- Chronic diseases are better maintained
- Patient wellbeing is increased
- Pain management was improved
- Rapid diagnosis and treatment

**Role of international agencies in patient safety**

The World Health Organisation (WHO) has made patient safety its priority. It has been estimated by WHO that one out of ten patients are harmed errors that can cause health consequences such as disability, pain, death and trauma. WHO will optimise the competence of the professionals to meets the increasing health care needs. It also calls upon the government to take actions to make sure that high quality safety, efficient health care and services are provided to the patients. Patient Safety Program was launched by WHO in the year 2004 to address the issue of the patient safety and quality care at the global and collaborative manner.

The West African Health Organisation (WAHO) they developed a Strategic plan in 2009-2013 which was recommended to improve the quality of the health care system and stressed on the importance of improving the education of the healthcare professionals. The need for giving training to the trainers was identified.

**Patient safety in terms of documentation**

Maintaining the health care records in the form of documentation is important for the following reasons

- The history of the service user is maintained
- Decisions relation to the care plan of the service user is recorded
- Helps to support the communication of the medical information with laboratories and the other external sources.
- Explain care delivery in the context of legislation, professional standards, guidelines, evidence, research and professional and ethical conduct.
The health care records are considered to the essential part of care that allows communication between the healthcare professionals. It contains all the information collected, processed and held in both manual and electronic formats concerning to the service user and their care. These records contain a unique identification, clinical date, images, samples etc. The records provide the overview of the service user’s state of health before, during and after the particular treatment. The health record is a legal document and there are chances of data loss if the data is not documented immediately.

There are certain standards followed for the documentation:

- Be clear and accurate.
- Legible and in English.
- Approved abbreviations and symbols should be used
- Dark ink that is readily reproducible, clearly visible and difficult to erase should be used to write
- Time of entry (using a 24-hour clock – hhmm).
- Date of entry (using ddmmyy or ddmmyyyy).
- Documentation should be signed by the higher authority and also include their printed name and designation. Appropriate identification system is required in case of computerised system.
- The student’s supervising clinician must sign the entries done by the students involved in the care
- There are not separate sections for each professional group to entry
- Do not include demeaning remarks and write in an objective way.

Privacy and confidentiality of the data and information provided by the patients should be maintained. The information is subjected to prevailing privacy laws and policies. Legislation protects the health care records that contain the health care information. The records should only be accessed by the health care personnel. Health care reports need to be audited across all settings and clinical areas. PHOs establish a schedule and the framework for auditing the health care records and approve and designate the audit tools to be used and the processes.

**CONCLUSION**

Patient safety is considered to be the important cornerstone of the high-quality health care. Patient safety and its practices that avoid the adverse effects have focused mainly on the negative results of care such as mortality and morbidity. Nurses play a very important role by forming a bridge communication that reduces the negative outcomes.

It is important that the standards are followed while the documentation is done. The records documented paper wise or on the electronic system should be disposed in such a manner that it will preserve the privacy and confidentiality of any information they contain. These records need to dispose in such a way that they are rendered unreadable and leave then
in such a form from which they cannot be reconstructed. The techniques used for disposal are shredding, pulping or burning.

The health care records must be maintained retrievable and readable form and should be available on demand. Make sure that the entries are not faded or erased or deleted over a period of time. There by the use of thermal papers that fade over time is restricted.

Security in terms of documentation is very important, personal health information should have an appropriate security safeguards to prevent an unauthorised use, loss of data or the misuse of information. Patient safety in terms of quality care and documentation is the important task to be carried out by every health care system.

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