DIGITIZATION OF INTENSIVE CARE UNIT: A REVIEW

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

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(Batch- 2019-2021)

Under the Supervision and Guidance of

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled Digitization of intensive care unit: a review is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Name of Student: Prerana payal

Date: 2/07/2021

CERTIFICATE

CERTIFICATE

This is to certify that dissertation titled Digitization of intensive care unit: a review is a record of the research work undertaken by Prerana Payal in partial fulfillment of the requirements for the award of the degree of**,** MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, and analytical.

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Capter 1 Introduction

Digitization is defined as the socio- economic conversion that responded from the vast acceptance of digital technologies to exhibit, process, and circulate facts. It has been seen in varied nations that digitization has come a pivotal economic motorist presently as it provides economic development and creates abundant job openings. In the report of the World Economic Forum, it's stated that if there's a rise of 10% the digitization score of any nation, either it would respond in 0.75% growth in its GDP per capita. It's also sort of assumed that since the last two decades India has been on a growth ascent [1]. The complex environment of ICU requires healthcare providers to balance competing tasks and responsibilities in their care for patients. a descent communication and interaction of several healthcare workers along with the team is essential for taking care of critical patients also circulation in work routine enhances the high quality care along with safety, about 5 million patients admitted to the ICU wards every year in India.it is very big task to give the particular skill set training to the workers in overly populated country and hence In demand with that growing necessities, the emergency or intensive care medicine in India still an developing area. The not- so- distant future displays the possibilities of advancements in networking. These advances will review the internal and external boundaries of the intensive care unit. However, these new end to end results may turn the ideal result to staffing scarcities, if everything goes well. To manage the inchmeal acquired and acute ICUs, the hospitalists and intensive care experts on- where can place eICU with smart alert systems, physiologic status boards, and color- translated assessments of response to protocoled care [2]. The complex nature of critical illness calls for an investigation of compulsory approaches to backstop clinicians in their timely determination and intendance. An Intensive Care Unit (ICU) field-workers and treats the most critically ill cases in a sanitorium.

ICUs normally have a high staff-to- case rate and the most advanced medical pocket compared to

other units. Very complex cases are often transferred to ICUs from Head or Surgery forcon unceasing monitoring and support. The attainability of digitized clinical data in hospitals via Electronic Medical Records (EMR) is augmenting all over the world. particularly, ICUs are data- rich climes where various parameters of cases are continuously covered at evolved speed and volume compared to other infirmary units. This data presents a novel chance to study and gain a deeper understanding of complaints, develop up to the minute treatments, and reduces medicine errors and better healthcare systems. There is naturally, tremendous interest in connecting high- hazard entities unseasonably, at an earlier time before the onset of complaint, to feed precautionary care and reduce the morbidity and mortality of complication [3]. Patients nowadays want pre informed and punctual healthcare services that fit their riotous schedules as they have number of priorities. People those were in rural areas may as-well live in distance with Hospitals. Virtual consultations with physical devices helps and Outpatients can induct quality care associated. According to the assessment by McKinsey india can save upto $5 billion if telemedicine go over to replace half of all in-person consultations.

1.1 Research Question

Whether the digitization improved the critical care experience for patients in Intensive care unit?

1.2 Research Objectives

The objective of this paper is to study the changes having the Intensive care unit due to digitization.

Capter 2- Methodology

A rigorous and comprehensive literature review was undertaken, where a detailed search strategy was employed to identify studies about data analytics in healthcare between 2013- 2021. All the relevant information had been retrieved from recognized database reports, journals, articles, and papers. A total writing examination of the comprehensive article reviewed with the title impact of digitization in ICU. The review of papers was based on a thorough search of articles concerning digitization in ICU between 2013 and 2021 have been utilized for the audit. It incorporates the peer-reviewed articles from the major publishers such as Science Coordinate, PubMed, Springer, Taylor, & Francis, Google researchers' reports on digitization. 104 papers have been included for title survey after expelling insignificant sections After perusing the title, 46 papers on digitization that don't utilize the word critical care in their title have been avoided. 31 papers were removed since they were not straightforwardly linked to healthcare and 27 papers significant to healthcare full-text criteria were looked into. At long last, the remaining 23 papers that met all the requiring criteria have been held. (Figure 1)

3.1 Keywords used- Digitization*OR digitalization*, new in intensive care unit*, digitalization*, patient experience*, digital*, patient and staff experience*.

3.2 Selection criteria were-

(a)Inclusion criteria

1. Studies that deal with digitization and ICU.
2. Articles and studies published any time between 2013 and 2021.
3. Full text of studies available in English.

(b)Exclusion criteria

1. Duplicate studies from the searches.
2. The publications with a central objective on physically functioning in ICUs are being omitted from the literature relevant to the research criteria.

3.3Study selection

- The following 3 processes comprise the strategy for searching and selecting research data.

- Having research with publications on digital dataset consists of keywords "digitization'' or "digitization in ICU" and "doctors intervention", "discharge summary".
- Examining the headlines, summaries, & terms from recognised publications, as well as selecting a most important ones based on selection criteria.
- Scanning cross- reference articles (**reference** to information located somewhere else in the same document) for detailed study.

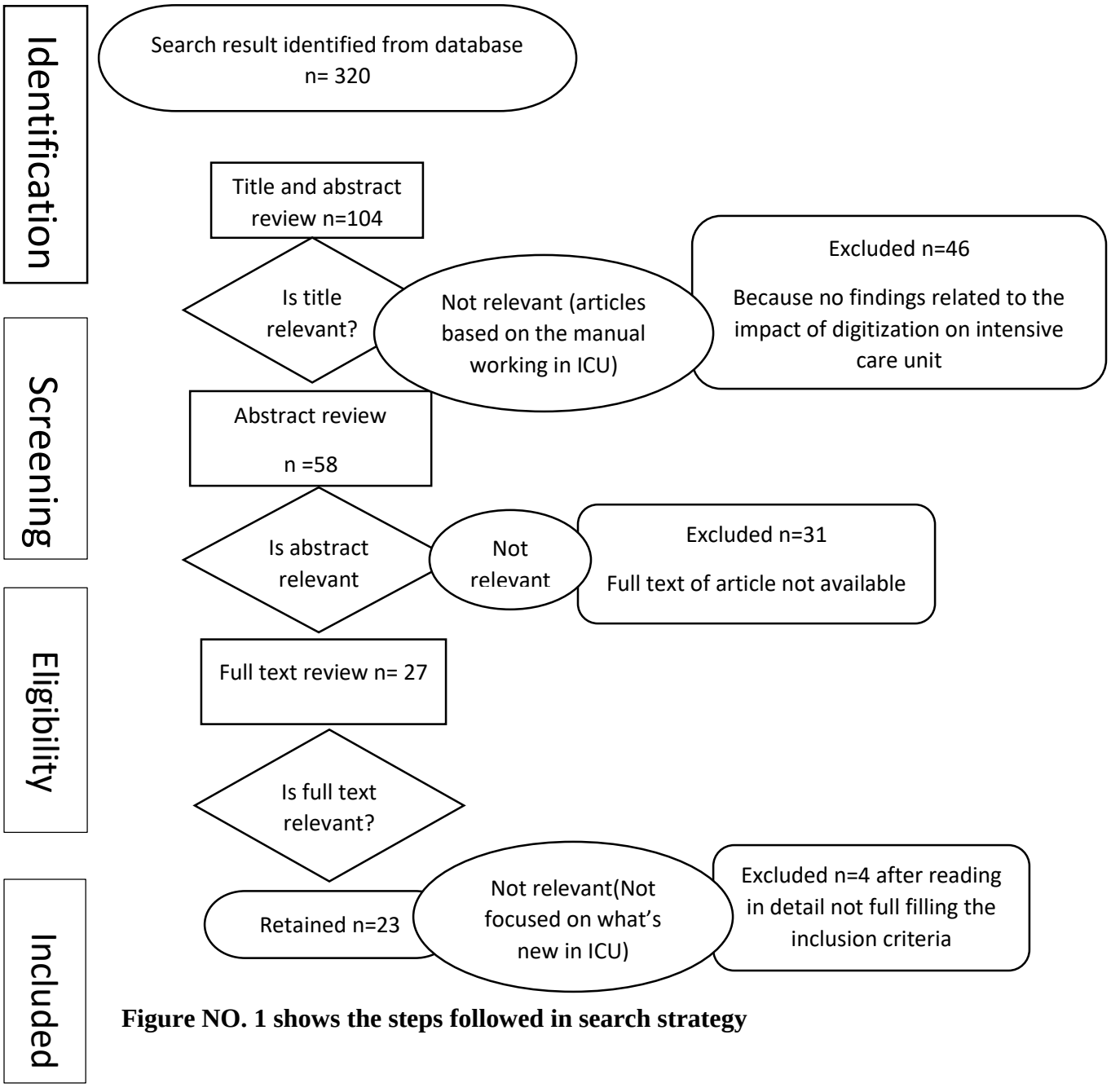

Figure NO. 1 shows the steps followed in search strategy

Chapter 3- Digitalization: An introduction

Acording to Clerk J (2017) It is described as the implementation of digital technology and knowledge for revenue generation, make strides in business, consider replacing business operations, & make a digital business working environment with digital data at the core. Corinne B (2021) explains that Digital health, often known as digital healthcare may be a wide, multidisciplinary concept that incorporates ideas from the interface of technology and medicine. Digital health is the application of advanced changes by digital transformation to the field of healthcare, which includes Operating system, devices, and applications. Mobile health (mHealth) apps, electronic health records (EHRs), & electrified health records are all examples of digital health (EHRs). Including Mobile health (mHealth) apps, electronic health records (EHRs), electronic medical records (EMRs), wearable gadgets, tele-health, & telemedicine, & even some targeted therapies, all fall under the banner of digital healthcare medicine. Further study by Nuckols et al. (2014) stated that operating a operating provider order entry system (CPOE), in order to avoid harm and maximise the benefits for enhanced patient safety in ICU by decreasing hospital medical misdeeds and adverse medication events. Compared with paper- order entry, the utilization of CPOE was related to half as multiple preventable Adverse Drug Events. The healthcare industry lag behind comparatively to the other industry less or more. Productivity in clinical settings (as well as patient outcomes) drastically changed by introduction of technology driven interventions and inevitably cause to the mechanization of activities associated to health care conveyance. Essential to progressing productivity rather than merely defrayal extra money on technology is distinguishing a transparent set of utilize cases and assessing their potential return on venture (ROI).

i. Automatic digital recording of patient data from medical devices has successfully improved time efficiencies and finances to put patient care firmly back at the heart of ICU management also, reduction in human errors and elimination of handwriting illegibility issues
ii. An increasing average of 3500 patients per year across 3 different ICU areas. Facing ever growing demands, a digital transformation project was rolled out to improve productivity of patient beds, rather than needing to build more bed capacity.

iii. Financial income had increased and nursing staff had more time to focus on the patient. 2 hours of nurse time saved every 24 hours which is equivalent of 17.5 whole time nurses each year.

iv. The digitalization of critical care has helped in finding information more efficiently, helping to reduce errors in misdiagnosis, reduced documentation time up to 30.

(a)The Evolution of critical care through digitization between sixties to twenties.

Technology	**Utilization**	**YEARS**
Electronic Medical record	Clinical decision support for blood disorders evaluation (Lipkin)	1961
Improved Monitoring for Brain Dysfunction in Intensive Care and Surgery (IBIS)	mathematical repository that incorporates almost all of the information and other diagnostic information gathered from critically ill patients throughout surgeries and critical care. The goal of the DL is to lay the groundwork for the project Improved Monitoring for Brain Dysfunction in Intensive Care Unit and Surgery to create biosignal interpretation tools	2000
GE's Centricity Critical Care system(clinical information system in ICU management solution)	It enhances quality care in ICU by lower the likelihood of errors, save time, & significantly reduce costs & provide strategic framework to healthcare workers	2003
intelligent System for Neuro-Critical-Care (iSyNCC)	iSyNCC collects and stores patient information like demography, clinical and treatment records, and ceaseless physiological observing data, permitting for farther and centralized patient observing and	2011

	computational insights to help clinical decision-making. To dodge patients from suffering subsequent brain damage, to address this a formulated and coordinated intelligent innovation designed tto improve the effectiveness of monitoring patients and decision support in NICUs.	
Phillip Clinical Dicission Support	It includes patient monitoring system in ICU to visualize clinical relevant information make informed dicisions and intervin early by providing horizon trends,ST map in acute coronary syndrome patients	2014
Telemedicine Software	permits doctors to examine, evaluate, and monitor illness without having to see them in person by centralized tele-ICU. In intensive care units it providing proactive care by making quick catches around subtle changes in patient care.	2017
Vital sky system by phillips	light-based medical device to reduce delirium in intensive-care patients.	2018
	Royal Philips introduced a mobile Intensive Care Units (ICUs), designed to meet the critical-care requirements of patients.	2020

Table 1: shows Up gradation of digitalization in ICU

(b)Utilization of digital services in Intensive Care Unit

Desautels et al., (2016)study explains that Insight, the retrospective Multipara meter Intelligent Monitoring in medical Care dataset a machine learning arrangement system that uses multivariable

combinations of easily obtained patient data (vital signs, peripheral capillary oxygen saturation, Glasgow Coma Score, and age), using the retrospective Multipara meter Intelligent Monitoring in Intensive Care dataset, to predict sepsis restricted to intensive care unit (ICU) patients aged 15 years or above and despite using little more vitals, it is an up to mark tool for guestimating sepsis onset and convey out well even with randomly missing data. Further Ramos et al., (2016) conducted a study during which 40 clinical illustrations supported on actual cases valued by 9 senior physicians. The mention instructions was defined because the priorities assigned by two investigators with complete access to cases records. Agreement of algorithm- based priorities with the mentioned standard and with priorities supplied by the physicians were evaluated. Correlations between algorithm prioritization and physicians' judgment of the suitability of ICU admissions in shortage and non-shortage settings were also assessed. This ICU admission triage algorithm demonstrated good reliability and validity. According to The British Institute of Radiology 3D printing technology for Congenital heart disease is used to remove the defect which is mostly challenging for the healthcare professionals because of less chnces of practicing it into the paediatric patients, but with the help of technology it is easy to deliver well standardized treatment to the patient and also a convenient way of communication between surgeon-patient and parents as it is a very delicate procedure. It provides the presence of rare birth defects, visualisation of the size of diseased structures which is necessary for Visualization of intracoronary structures in three dimensions & Identifying the structural link between the major vessels in situations with complicated CHD, especially in post-surgical anatomies(Milano et al., 2019). Further Digitized health information systems with in the ICU have played an important role in enabling clinician access to patients, which is specially evident in tele-health systems. Tele-health applied to critical care settings can reduce physician isolation, and improve the collaboration of providers. Avera health for instance, connected 36 hospitals across nine US states, reducing length of stay, mortality, cost of care, and clinician burnout (www.philips.com). Dabliz et al., (2019) also explains the impact on users in intensive care units by electronic medication management system (EMMS) using the unified theory and use of technology constructs. It also explains the impact of getting a continues EMMS hospital wide to use an equivalent EMMS hospital. By conducting survey data from 100 nurses the research model was evaluated, clinicians and pharmacists were consulted in the ICU & externally to review the program's use as well as acceptance. Overall user comfort was reported to be associated with performance expectancy, effort expectancy, media influence, &

enabling circumstance. Overall, the ICU and therefore the external team are in strong favor of its implementation. (www.medica-tradefair.com) Keller and her team demonestrated using big data that is generated daily with in the ICU more effectively. The early detection of risk constellations and most critical complications also supports an earlier therapeutic intervention, which may improve patient care in the future using Artficaial intelligence platform.[11]

I.Ultilization Areas

(a)Electronic Health Record for ICU

- An Electronic Health Record (EHR) is a digital form of a medical history of patient that is based on the fact & maintained by the service provider and may include all of the administrative support clinical evidence related to the patients underneath that provider, including demography, treatment plans, vital signs, problems, treatments, past medical history, vaccinations, examination findings, and radiological data.
- Desautels, Thomas et al. explains that the Using retrospective data comprised of minimum, widely distributed EHR characteristics, the Foresight sepsis prediction algorithm for the revised Sepsis-3 parameters was developed. Furthermore, overall prediction ability of InSight will be evaluated to that of other available metrics and systems. To analyse and test a sepsis prediction approach, Insight, in retrospective data for such revised Sepsis-3 classifications, predict things using a analyzed the accuracy of this approach to current grading systems, as well as compare the impact of information and data limited resources on Insight productivity). make predictions using a relatively low number of indicators within the electronic health record documentation, evaluate the results of the whole strategy to original scoring systems, and study the effect of awareness and data shortage on Insight productivity).
- Electronic health records are used in Intensive Care Units because of the quantity of data that must be handled for patient care, the high turnover of patients, and the need for reliability and review processes. Clinical data on patient development can be reported by each ICU day using the day's most significant elements: biological and microbiological results, pulmonary and hemodynamic status, and the outcomes of the most recent

supplementary investigations. An integrated healthcare professional order entry system can be used to prescribe and amend ’s treatment and therapeutic strategies.

II. Critical care services via telemedicine

- The information system transmits all relevant patient data from the hospital to a centralized tele-ICU center through digitalization which allows intensive care physicians and other specialists to continuously monitor the patients in different, geographically distributed ICUs, supporting local medical staff. While the patients remain in familiar surroundings, they benefit from the care provided by an interdisciplinary team of experts.

III. Enhancing healthcare proffessionals efficiency to Critical cases

(a) Philips IntelliSpace Critical Care & Anesthesia (ICCA) is often a clinical information technology with patient safety system that aims to improve patient care there in ICU by simplifying professional workload plus providing clinical decision making.[21] COVID-19 customised service with high centric approach and accuracy out of the box is very quickely tailored by GE Healthcare,which automatically acquires information by observing, respiratory systems with different samples,saves the nursing staffs documenting time manually at the bedside, it includes online training and remote support which is implemented within weeks.

(b) Providing fast and up to notch COVID-19 clinical data, it also grasps and depicts this same details as patterns which can be merged with prescription or treatment & care documentary evidence that provide a single overall view at one quick glimpse, as well as healthcare workers continuing to be able to observe patients just at bedside as well as remote location managed to make process much clearer while under intense pressure, and having a set of data capture aids clinicians from not leaving any aspect of care delivery unattended, which increases patient safety as well as quality[22] .

IV.treatment in ICU with the help of robotics

(a) The tele-intensivist, who is liberated from a specific command centre and can be almost everywhere, controls the ICU robotics electronically. The robot walks from place to place, evaluating patients and engaging with professionals as needed based on the intensivist's orders. Latter contact is now thought to be considerably more accurate, as it takes place only once the intensivist has given his or her input Providing strong virtual interacting capacity between a provider and patient is all that is required.

(b) Illustrations of such utilize cases as of now exist as an example of robotic innovation, is getting used to reinforce the accuracy of percutaneous coronary intercessions which progresses the heart circulation and decreases significant demands on the clinical staff, brings down stent utilization, and diminishes radiation introduction amid the method for both bunches. Scaled down electroceutical gadgets that can invigorate nerves within the physical structure of human body are being created to treat diabetes, joint pain, and asthma. Digitization is that the driven drive behind healthcare advancement, having the ability to accumulate up to lab comes about, records of imperative signs and other complex information into one centralized region has transformed the level of care and efficiency a persistent can anticipate getting once they enter the healthcare framework.

V.The impact of digitalization in ICU in hospitals

(a)Patient Care

- The electronic physiological surveillance system (EPSS), which was created to facilitate the gathering & clinical application of vital sign data, lowered hospital mortality. The EPSS, which uses a cordless handheld computer equipment, replaces the paper-based vital sign charting and clinical assessment system. During EPSS implementation, crude mortality decreases by a baseline of 7.75% (2168/27,959) to 6.42% (1904/29,676) in hospitals (which is 397 fewer deaths),& from 7.57% (1648/21,771) to 6.15% (1614/26,241) at the other hospital (which is 372 fewer deaths). The sum of increased

mortality declined within overall departments by upgraded usage of the system in the hospital.

- 30 to 80 percent of patients in intensive care units is suffering from delirium which is a confusional condition of a patient.it is a cerebral impairment which not only causes mental confusion and emotional disruption but also drastically increases the mortality risk of patients. continuous night's uninterrupted sleep is the prerequisite for delirium prevention. It is such an important aspect because people who develop delirium have a much higher 1-year mortality rate. Older patients with cognitive impairments are especially at risk but by introducing the 24-hour light therapy with Vital Sky an artificial sky reduces delirium incidences by over 50 percent and the circadian rhythm is maintained even in ventilated intensive care patients. On average 700 alarms sound In ICU patient monitoring system out of which the maximum were false alarms which disturbs patients as well healthcare workers and most importantly negative impact on treatment but by using artificial intelligence and analyzing the whole data the early detection of critical events in real-time and reduces the fatigue tasks of doctors, nurses and prevent ICU delirium, and improve the intensive care experience.
- Ascom Minco 2 smartphone that's purpose built for healthcare. It is linked to the nurse call system, displays color-coded alerts on the touchscreen, and shows all mobile staff the status of the response. The Myco2 sends alerts directly to the responsible doctors and nurses reduces their burden. From the physicians' point of view, a recent survey of European Healthcare systems showed that more than 75% of physicians believe that digitalization of patient data could help them improve the quality of care in the next three to five years [20].

(b) healthcare workforce

- A monitoring centre or an independent doctor tracks data produced from equipment that measure physiological parameters. This procedure is supported by integrated algorithms, standardized written guidelines, and sound expertise. The evaluation process produces an information in the form of an alarm, communication with a professional, or even some type of assistance to the patients whenever an irregular occurrence occurs.Improve clinical

judgement and prescribing accuracy by facilitating communication amongst health-care professionals. Reduce the cost of personalized, hospital care & improves the efficiency of chronic disease management in both long-term treatment as well as at home

- eHealth / mHealth (EM) utilization augments the efficiency of clinical practitioners thanks to time-saving practices, less paper work and more rapid access to information means effects positively on the performance and practice of healthcare workers. increased productivity converts into accelerated availability and capacity to provide services to number of users, even if the absolute numbers of health workers remain constant. with the increased capacity to diagnose problems and assess patient conditions through degitaly improves the accessibility even if healthcare providers are at distance, healthcare professional who concentrate and invest their time mostly in urban areas now can easily interact, communicate and accessible to their colleagues and patients also irrespective of distance. This has the potential to enable the expansion of homecare and service integration. It make communication much easier, and more direct and adapted to each individual and patient needs, thereby potentially boosting the acceptability of providers. This is more likely with younger persons who are more familiar with the utilization of computers and mobile devices; strategies to facilitate their use by older patients may therefore be needed. EM give providers rapid access to valid information, second opinions and guidelines, all of which contribute to scaling-up the quality, competencies and compliance with professional standards, and thereby improving patient safety.

(c) revenue & nurses efficiency

- In critical care units nurse fills form manually to collect organ support data which sometimes led to the missing information of organ intervention that occurs for the short time period during 24 hours causes missing or incomplete information and increases the financial burden also, but after digital data collection by GE Healthcare's Centricity (Critical Care Information System) much better reflection of the intensity of organ support and has increased income received by £0.5 million in year one. This improvement in finances has generated a profit for the department that can be reinvested to support the overall financial health of the institution and now the nurse time also freed up approximately 5 minutes every hour which is equal to 2 hours over a 24 hour period, or

730 hours annually which means nurse work can be again relocated to the patient care from paper-based form filling work by automatic data collection from medical devices with the accumulation of organizational and operational data at both patient and departmental levels.

Chapter 4 Conclusion

Recent scientific development in technology transformed healthcare and medicaid drastically. Ranging from electronic medical records and progressing to the introduction of advanced robotic system, all have contributed potentially in transforming scenario of critical care worldwide, because of digital intervention, doctors can now proceed and raise for their cases while sitting at different places, recent incident has generated many learning experience and usefull dataset for the longer term. The worth and advantage of each & every clinical dataset from COVID-19 incidence is very precious similar to gold. It explains how the oxygenation, hemodynamics, sedation and treatment advanced persistently, which is concrete or actual figures shows what truely occured in order which will be immensely very often usefull comparatively a collective report conferred through a clinician after the sessions. This dataset are going to be critical and can be allow with other alternative group & healthcare workers, even with further nations, to be ready to make prognostic or prescient models with decision support tools that would might be consolidated into the clinical data system itself. Radiological progression have created understanding of various organ systems easier in an exceedingly method and less difficult in a way that wasn't conceivable and potential prior**.** less complex in a way that wasn't conceivable or pottential prior, innovation has impercolated each facet and area of medicine. Medication is currently really an admixture of craftsmanship, understanding and skill. excludingly the, technological and innovative headways haven't solely made a difference restorative examples & helped medical exponents in performing wisely but have moreover made a difference cases get data almost their affliction unreservedly. There's a rider in spite of the fact that to this comfort.Technology has proved to be a double- edgy blade Digitization of hospitals is vital in delivering quality and cost- effective services to cases and amending support services. The increased digital espousal in the healthcare sector moment has brought in major advancements in information sharing, disquisition, treatment fashions, and communication models of the healthcare providers. Notwithstanding, the use of digitization in hospitals isn't well understood and well structured. There's a need for a common armature that will support all stakeholders of the infirmary. The Digitization of infirmary operations and services. Now healthcare system is facing multifold challenges widely, including growing elderly populations, an increase in

confirmed conditions and co-morbidities, and compounding constraints on the healthcare help. Critical care management systems scalability and standardisation of ICU have passed the final word test with flying colours.. The automated gathering of patient dataset, remote access and management of rules-based tasks have allowed employees to try to do the seemingly impossible: be in multiple locations at just once. we will now see that when we are pushed to our boundaries anything is feasible. Shrewdly, cooperative and connective health being similar to the conversion of the unit will mix ancient active care and virtual work to show the tide against a worldwide crisis, and control the battle for hopeful understanding and positive patient result. The utilization of innovation particularly planned to enhance strides the exactness, unwavering quality and accessibility of patients' crucial signs and early caution scores, and in this manner the acknowledgment of and reaction to quiet patient deterioration, is related to decreased mortality. The furious care unit (ICU) is related to a number of the highest mortality, morbidity, and error rates, creating it a vicinity or region wherever digitization is especially fundamental to assist and enhance the standard of care because the diligence works towards achieving the fourfold objectives to assist & address these issues-the point of superior case advancement and improved understanding which enhances patient and practitioner experiences, all at a lower cost-there is an excellent got to optimize funds and increase productiveness to try and do this, the diligence should embrace the shift to digitisation

Future of digitalization of ICU

(a) To enhancing the efficiency of care and controlling rising costs of critical care or intensive care unit is particularly most important area where digitization needed. It is also the most expensive, technically advanced and human-resource intensive sector of treatment as well as with the highest number of errors. Because of the susceptibility of patients, who may have co-morbidities as well as decline rapidly, critical care outcome and diagnosis become particularly difficult.

(b) In addition to digitization enabling the development of these algorithms and tools, it is a requirement for deploying them and achieving improved outcomes, especially in new clinics. Many of these algorithms require a set of input parameters that are available in information systems usually in a standard data format. This standardization is key in

enabling the integration and scaling of these algorithms across different sites. The monitoring of the effect of decision support on performance indicators is also enabled by careful digitization. Unnecessarily admitting patients to the ICU or keeping ICU patients longer than necessary, can be potentially harmful, as ICU stays have been linked to hospital acquired infections (HAI) occurring in approximately 10% of all ICU patients.

(c) Globally, there is a general shortage of intensivists and suffering from burnout due to long hours and high time-pressure tasks. However, the demand of acute care is predicted to grow, with an increase in the elderly population, certain conditions (e.g. cardiac disease), and co-morbidities. To meet the higher demand for ICU beds, there is a need for improved triaging/allocation, ICU organization, and improved clinical outcomes leading to less readmissions.

(d) Rich critical care databases have been essential in the development of new algorithms as well as discovering correlation between treatments, medications, co-morbidities, and outcomes. The development of algorithms for clinical decision support in critical care has only been possible through digitization and improvements in clinical data management. This is especially important for conditions that have a huge impact on mortality and morbidity for Examples sepsis, acute kidney injury and acute respiratory distress syndrome. By alerting clinicians to higher risk patients, treatments are often administered early (or harmful medications can be stopped) resulting in improved outcomes.

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