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REVIEW ARTICLE

A Review On the Importance of Plain Data Aggregation in Patient Care: The Vital Sign-Based Scenario

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Abstract

Medical data need to be managed appropriately as singly it is meaningless. Data aggregation is important as it may transform a plain data into a meaningful facts known as information. It is crucial to gather an authentic and accurate data analysis for making a critical decision in patient care. We intend to describe on how vital sign-based scenario data can become a meaningful information to assist healthcare in improving patient management. It was hoping that, through vital sign-based scenario medical data aggregation it will highlight or create a new information and knowledge towards diagnoses. This will help in quality patient care management as it may formulate an accurate diagnosis thus provides a support for an optimal medical treatment. In medicine, failure to analysed a correct information will lead to significant morbidity and mortality.

Keywords: Medical Data, Aggregation, Vital Signs, Patient Care

Introduction

Single medical data is a useless plain fact without a proper management for true meaning. They need to be processed, organized, structured or presented in an appropriate context so that they become a meaningful facts known as information. The process of gathering data and converting it into a simplified and summarized format is known as data aggregation. It may be originated from multiple sources and is gathered into a combination for easier data analysis. Data gathering is a crucial process as accuracy is largely dependent on the quantity and authenticity of the gathered data. It is of prime need to gather a quality, accurate and adequate amount of data to get or create a relevant outcome especially when making a crucial decision. Therefore, it is important to note that data aggregation is useful not only for finance and business strategies but also in providing a quality patient care such as correct diagnosis and best treatment option.

In medicine, vital signs are used as an objective assessment of physiological function for patient monitoring either in acute or chronic conditions. Healthcare practitioner commonly used vital signs as a communication tools to explain about the current stability of patient health condition. The aging process may result in numerous physiological and pathological changes that may alter the value of the vital signs measured. As the age is advancing, the ability of organ systems to adapt to physiological stressors is reduced particularly in high a risk co-morbidities group of patients. Factually, a single vital signs in some frail individual patients is insensitive to detect the disease progression. Never the less, a multiple vital sign assessment is found to increase sensitivity especially when charted serially in the context of individualized reference ranges (Chester & Rudolph, 2011)

Materials and Methods

We intend to describe on how plain medical data can become a meaningful information to help the healthcare in improving patient management. It was hoping that, through vital sign-based scenario medical data aggregation it will highlight or create a new information and knowledge towards diagnoses. This will help in quality patient care management as it may formulate an accurate diagnosis thus provides a support for an optimal medical treatment.

A narrative review was conducted in January 2023. The objective was to identify the vital signs used for patient assessment in medicine and evaluate its importance in providing the diagnosis for best treatment decisions. The Medline, PubMed, and the google scholar database was searched to get the relevant articles for evaluation. The keywords used includes patient vital signs or temperature or heart rate or blood pressure or respiratory rate pain score; diagnosis; treatment. Only few papers are retrieved and no evaluations of methodological quality were for papers exclusion as this is not a systematic review.

Results and discussions

Traditionally, there are four vital signs that was fundamentally used as an objective assessment of vital functions by healthcare practitioner namely pulse, temperature, blood pressure, and respiratory rate (Stedman's, 2005). The Joint Commission had recognised the importance of pain score assessment therefore emphasizes routine pain assessment and pain score was regarded as the 5th vital sign since 1990 (Lorenz, 2009)

The followings vital sign-based scenario is a common scenario in healthcare patient management. Based on data aggregation for vital signs (temperature, heart rate, blood pressure, respiratory rate, and pain score) few differential diagnoses was able to obtain. However, healthcare practitioner must aware of physiological change as the age of the patient progress because it may be subtle and difficult to recognise. However, specific change from the same patient of an individual reference range may indicate important warning signs and thus may require additional evaluation to understand potential underlying pathological processes (Chester & Rudolph, 2011).

Scenario 1 – Temperature

A high body temperature or fever is a physiological body response towards conditions such as infection etc. It is a common clinical phenomenon. Data on one reading of a high body temperature is significant but meaningless for formulating a differential diagnosis. If we do data gathering and summarised in a temperature chart format it helps to determine the differential diagnosis and appropriate specific treatment is possible. It will also help in terms of monitoring response to the

treatment rendered. Apart from that, the trends of temperature value will give new information for the possibility of having an infection from a new source or a new outbreak is occurring. Truthfully, majority of the cases can be diagnosed easily. The cause of fever can be classified as follows: infectious agent, neoplasm, immune or metabolic disorder, genetic abnormality and if no cause of fever is found after two weeks of appropriate investigation it is classified as fever of unknown origin (Kucharz EJ., 2010).

The description of fever is important such as type of fever, grade, and timing will help to narrow down the list of differential diagnoses (Munro N., 2014). The temperature data aggregation that showed the increase in temperature constantly above normal for more than 24 hours with no fluctuation of more than 1° Celsius is known as continuous fever. This data gathering is useful as the differential diagnoses are narrowed towards lobar pneumonia, brucellosis, urinary tract infection, cardiac infection, and scrub typhus. If the data aggregation showed a high temperature of above normal with a fluctuation of more than 2° Celsius within 24 hours, it is known as remittent fever. The possible causes or diagnosis is typhoid fever and infective endocarditis. Thus appropriate specific investigation can be executed early to confirm the differential diagnosis. Early management is possible and reduces the risk of disease complications.

The aggregation data on the temperature chart may suggest a Pel-Ebstein fever especially when there are some alternate periods of febrile illness and afebrile episodes especially if there is a trend of 3 days' high-grade fever alternate with 3 days of afebrile episodes. This condition is associated with a serious disease known as lymphoma. The patient may be categorized as having an intermittent fever when the data gathered on the temperature chart showing the spike of temperature for few hours then return to normal baseline. The spikes are repetitive and the possible diagnoses are malaria, pyuria, abscess, and severe septicaemia.

Scenario 2: Heart rate (HR)

Heart rate is one of the vital signs taken for patient monitoring. The normal HR for an adult is 60 to 100 beats per minute (bpm). Many factors affect HR which can be either physiological or pathological factors. The HR can be taken manually or using the physiological machine. The charting can be either in the electronic medical record or in the vital signs chart. The deviation and changing in trending in terms of the rate, regularities, the rhythm will signify certain disease, worsening of the condition, or death of a patient.

An increase in HR more than 100 is called tachycardia. The patient can have transient tachycardia due to physiological such as anxiety which will be resolved with reassurance and rest. If persistent tachycardia is noted on the chart, the investigation is warranted. The data aggregation of HR on the vital sign chart will determine the next step of investigation such as an echocardiogram, blood for thyroid function test, or blood for cardiac study. Healthcare practictioner must rapidly identify type and aetiology of the arrhythmia so that appropriate management strategies and disposition decisions can be made optimally (Al-Salamah T., et al., 2022)

In the management of trauma injury victims, HR is one of the vital parameters for observation. Physiologically, tachycardia is the earliest clinical sign in a blood loss situation. It is a sensitive indicator and can be used to determine the next step of action. The severity of tachycardia due to blood loss will guide the emergency management e.g. persistent tachycardia of more than 140 bpm after 500 cc of isotonic fluid infusion mandate or requires pack cells blood transfusion (Kumar A., et al., 2019)

Tachycardia without an obvious source of blood loss will require further investigation to rule out other possible causes such as drug overdose. The patient may be trying for suicide; thus security control is mandatory. Broad complex tachycardia mandate further investigation to rule out ventricular tachycardia (VT) condition which can be life-threatening. Once the diagnosis of VT is established, it is mandatory to determine hemodynamic stability. Stable VT requires drug medication whereas unstable VT requires electrical therapy. If a narrow complex tachycardia with

no P wave is noted on aggregated data of ECG, a diagnosis of supraventricular tachycardia needs to rule out. Serial aggregated data on ECG need to be established to guide or monitor the treatment rendered.

The patient's HR may be noted less than 60 bpm or known as bradycardia. It can be physiological such as in deep sleep. Pathological conditions may be due to cardiac diseases such as heart attack, heart block, or certain drugs especially beta-blocker group of drugs e.g. propranolol. Persistent and symptomatic tachycardia requires further investigation whereas transient and asymptomatic requires no further investigation. When a diagnosis of heart block is established based on aggregated data of ECG, the management must be tailored to types of heart block as obtained from the aggregated data of an ECG e.g. 3rd-degree heart block requires cardiac pacing.

Scenario 3: Blood pressure (BP)

Normal blood pressure in an adult is maintained at 120/80 mmHg. Few factors may affect BP such as the blood volume, the pump function of the heart, and the integrity of the blood vessels. Serial data on high blood pressure is important to serve as a guide for types of drugs to be used (Mayo Clinic, 2022). It also determines the dosage required and frequency of the drug to be prescribed either daily dosage or twice daily regime.

The BP post-operation is important to determine and monitor the ongoing blood loss. In an ongoing blood loss situation, the pulse pressure (Systolic blood pressure minus diastolic blood pressure, should be more than 90 mmHg) will be narrowed at the beginning before the blood pressure crashed (Whelton PK & Carey RM., 2017). This data analysis on blood pressure will help to early identify the emergency condition and to execute appropriate actions to save the patient life. Post-operation patient BP monitoring may determine pain killer adequacy. Inadequate pain relief after the operation may cause increased BP.

Physiologically when the blood pressure low, the HR will become tachycardia. In a head injury condition where the intracranial is high (more than 40cm H_2O), there will Hypertension with bradycardia. This condition is known as Cushing's Reflects and mandates urgent surgical intervention to reduce the intracranial pressure as delay will result in permanent brain damage. In contrast to neurogenic shock, both BP and HR are low (Mayo Clinic, 2022). The analysed data aggregation in this condition is important as it guides towards the diagnosis as the management is different in both situations.

Scenario 4: Respiratory rate (RR)

The normal respiratory rate in an adult is between 8-20 breaths per minute (bpm). Respiration is controlled by the respiratory center in the brain known as CTZ. RR is charted routinely in the vital sign chart. The increase in respiratory rate is known as tachypnea and may signify either physiological condition or pathological condition such as disease of the respiratory system or the brain. Physiological tachypnea will be resolved with a relaxation technique and breathing exercises.

The RR must be counted appropriately with adequate exposure to get accurate data. Tachypnea that is described as "air hunger" or increasing shortness of breath each time of inspiration is due to a condition known as tension pneumothorax. This is a life-threatening emergency and immediate release of the pressure inside the thoracic cavity is mandatory to save a life. Tachypnea initiated with exposure to dust or pollen may be due to a hypersensitive situation. Data gathered from the history will determine the next step of investigation such as the skin prick test to determine the responsible allergen. It will guide the next step of management and prevention measures.

In ward, patients with shortness of breath will undergo monitoring with the use of a pulse oximeter and peak flow meter. Data aggregation from the peak flow meter will be analyzed and the result will determine the treatment either the condition is due to obstructive or restrictive lung diseases. The use of systematic respiratory care protocol will save the overall cost of patient management (Nielson-Tietsort J. et al., 1981)

Scenario 5: Pain Score (PS)

Pain is *"an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage"* (IASP, 2020). Pain is the most common presentation at the emergency department which comprise up to 80 % of all the complaints by the patient. Pain is score using a pain scale and is regarded as the 5th vital sign.

Pain score will determine the types of pain medication to prescribe. Data aggregation on pain score when analysed will determine the adequacy of dosage of pain medication. It also may determine either combination therapy is indicated. Persistent pain score of data aggregation may indicate an ongoing process of the diseases thus mandate a thorough investigation to determine the exact cause. Certain types of pain may suggest certain pathology when analysed properly e.g. right hypochondriac pain associated with tenderness may be caused by acute appendicitis which requires surgical intervention.

A non-specific recurrent headache associated with relief of severity after bouts of vomiting may be due to space-occupying lesion in the brain which mandates urgent computed tomography of the brain. Sudden onset of severe chest pain that lasted for more than 30 minutes associated with sweating in a male of more than 45 years of age may be due to a heart attack which requires an urgent ECG to confirm the diagnosis.

Conclusion

There are five vital signs that form a foundation for patient assessment. It provides basic information of the patient conditions that will guide the next step of management options. There other data that can be obtained for patient assessment were imaging and laboratory investigation value. The patient's data aggregation will provide a meaningful information that is of prime importance to provide better treatment and decision for the next plan of action for future care. Furthermore, an analysed data will provide a correct understanding of the patient's treatment details thus the healthcare providers can render a more accurate and precise decision for future treatment onto the patient. In short, data aggregation and analyses will not only benefit patient care but also will make healthcare provision to be more transparent, accurate, efficient, safe, and reliable.

In a difference perspective, the analysed data aggregation may be converted into a reliable and significance tool such as medical algorithms. It can be used primarily as a tool to reduce overall burdens of healthcare practitioners not to replace them. The research and development of the medical algorithm is an exciting procedures and will benefit many especially in the era of information technology 5.0 where medical information is at the fingertip. Never the less, it will never replace the human touch and ultimately the responsibility of the patient care decision lies in the hand of the healthcare practitioners.

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