Summer Training Report

On

Hospital and Community Preparedness Planning to Overcome COVID like Pandemic

And

Data Analytics for Lean Six Sigma

By

Dr. Surbhi Verma

Under the guidance of

Dr Alok Mathur

MBA in Hospital & Health Management

2019-21

Institute of Health Management & Research, Jaipur

ACKNOWLEDGEMENTS

It is with a great sense of gratitude, I would like to acknowledge the efforts of entire hosts of well wishers who have in one way or the other contributed to the success and completion of this Summer Internship Project. Above all, I would like to thank the Almighty God who has guided me to work on the right path of life. Next to Him are my parents, who brought me up with love and encouragement to this stage.

I would like to convey sincere thanks to our University, **Institute of Health Management & Research, Jaipur** for the constant supervision as well as providing necessary information regarding the project report. I would like to express a deep sense of gratitude to my University mentor **Dr. Alok Mathur** for giving me his time, attention and always available with his valuable inputs which have been successfully incorporated in this report. Lastly I would like to thank my friends and well wishers who have encouraged me in completing this project.

TABLE OF CONTENTS

ACRONYMS/ ABBREVIATIONS

- COVID-19 – Corona Virus Disease 2019
- WHO – World Health Organization
- CHW - Community health workers
- HCW – Health Care Workers
- HCF – Health Care Facility
- PPE – Personal Protective Equipment
- AI – Artificial Intelligence
- IoT – Internet of Things
- CT – Computed Tomography
- HCP – Health Care Professionals
- IPC – Infection Prevention and Control
- UvA – University of Amsterdam
- CTQ – Critical To Quality
- ANOVA - Analysis Of Variance
- HRM – Human Resource Management
- LTCH – Long Term Care Hospital
- SOP – Standard Operating Procedures

PART-I

Hospital and Community Preparedness Planning to Overcome COVID like Pandemic

ABSTRACT

The coronavirus disease 2019 (COVID-19) outbreak has been identified as a public health emergency of international concern. To prepare for a pandemic, hospitals need a strategy to manage their space, staff, and supplies so that optimum care is provided to patients. Along with it, IP measures need to be implemented to decrease in-hospital transmission. The most potent weapon that society has against this virus that is affecting not just health but also economics, politics, and social order, is preventing its contamination in society by adopting measures like hand hygiene, social distancing and quarantine. Thus people should be educated and made aware of infection.

INTRODUCTION

The range of threats to public health faced by countries worldwide is broad and highly diverse that includes infectious disease outbreaks, chemical and radiation contamination, wars and the health consequences of climate change. To help meet these challenges, countries are encouraged to strengthen their capacities for health emergency and disaster risk management incorporating measures for prevention, mitigation, preparedness, response and recovery. In these settings, critical measures for COVID-19 prevention and control may be more difficult to implement and some of them potentially harmful to the survival of many community members.

The spread of the SARS-CoV-2, was officially defined as a pandemic by WHO on March 11, 2020 due to its sudden emergence and expansion around the world. A pandemic is defined as the "worldwide spread of a new disease. There are now more than 12 crore cases in the world and more than 5 lac people have lost their lives.

Transmission: The current worldwide outbreak of COVID-19 has left many people with concerns about the spread of this new disease. The virus that causes COVID-19 is thought to spread mainly from person to person, mainly through respiratory droplets produced when an infected person coughs or sneezes. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. Transmission of SARS-CoV-2 from asymptomatic individuals (or individuals within the incubation period) has also been described.

Recently, this virus has been declared **airborne** in specific conditions, closed, crowded, poor ventilated settings by WHO.

Governments of many countries have proposed policies to mitigate the impacts of the COVID-19 pandemic. Science and technology have contributed significantly to the implementations of these policies during this unprecedented and chaotic time. For example, robots are used in hospitals to deliver food and medicine to corona virus patients or drones are used to disinfect streets or public spaces. Computer science researchers on the other hand have managed to early detect infectious patients using techniques that can process and understand medical imaging data such as X-ray images and computed tomography (CT) scans. These computational techniques are part of artificial intelligence (AI), which has been applied successfully in various fields. The COVID-19 outbreak will test the resilience of our health care system. Planning for managing patients and our workforce must begin in full force.

RATIONALE

Emerging pandemics show that humans are not infallible and communities need to be prepared. Preparing for a pandemic is a community effort that we can all take part in to lessen the impact of the illness on our communities and around the world. Countries should take whole-of-government, whole-of-society approach and make a comprehensive strategy to prevent infections, save lives and minimize impact. They should activate and scale up their emergency response mechanisms. Healthcare centers everywhere should prepare to implement measures for an efficient hospital-wide approach to manage the imminent surge in hospitalized patients with COVID-19. The purpose of this research is to study the preparedness of hospitals for covid like pandemics and to prepare the communities against such outbreaks.

RESEARCH QUESTIONS

- How can hospitals overcome COVID like pandemic?
- How to prepare the community against a pandemic?

OBJECTIVES

- To prepare the hospitals against COVID like pandemic.
- To prepare and lessen the impact of the pandemic on our community and around the world.

METHODOLOGY

Study type – Descriptive study

Data collection method - Review of published articles

Data source - Secondary data is collected from Google Scholar and Pubmed to perform this research.

LITERATURE REVIEW

TITLE & DATE	LINK	KEY FACTS
"COVID-19 pandemic: Lessons learned and future directions" April 20, 2020	http://www.ijo.in/article.asp?issn=0301-4738;year=2020;volume=68;issue=5;spage=703;epage=710;aulast=Khanna	• "Based on the past experience with different epidemics and pandemics, as well as the current understanding of SARS-CoV-2, it is stated that, due to lack of herd immunity in the population and the highly contagious nature of the virus, 40-70% of the population can be infected unless strong containment measures are timely taken." • "At the community level, the most important measures for reducing infection spread rely on case detection, isolation, and contact tracing of positive cases, followed by quarantine for those exposed."
Digital healthcare: The only solution for better healthcare during COVID19-19 pandemic? April 11, 2020	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7151273/	– Telemedicine is being used for screening of COVID-19 cases and managing non COVID-19 cases. – "It has drastically reduced visitors load to the hospital. It reduces the spread of infection and avoids the need for a patient's visit."
"Why we should expand hospital-at-home during	https://www.weforum.o	o "Hospital-at-home programmes can reduce healthcare costs and mortality rates."

the COVID-19 pandemic" April 23, 2020	rg/agenda/2020/04/hospital-at-home-covid19-coronavirus-pandemic-nursing-care/	○ "During the pandemic, providing hospital care at home can reduce the risk of COVID-19 transmission, especially for vulnerable patients."
"Artificial Intelligence (AI) applications for COVID-19 pandemic" April 10, 2020	https://www.sciencedirect.com/science/article/pii/S1871402120300771	• "Cost savings of 19% to 30% compared to traditional inpatient care" • "Lower average length of stay" • "Fewer lab and diagnostic tests compared with similar patients in acute hospital care"
"The role of AI and IoT technologies in the Covid-19 situation" June 8, 2020	https://community.nasscom.in/communities/covid-19/the-role-of-ai-and-iot-technologies-in-the-covid-19-situation.html	• "AI is helpful for proper screening, tracking and predicting the current and future patients, early detection and diagnosis of the infection, development of drugs and vaccines, and the reduction of workload of healthcare workers."
"Covid-19 and community mitigation strategies in a pandemic" March 17, 2020	https://www.bmj.com/content/368/bmj.m1066	• "Technologies such as AI and IoT can be vital as they can help track the spread of the virus, identify high-risk patients, predict mortality rate, and control the infection in real-time." • "They can also minimize the need for physical human interaction and prevent the spread of viruses while enabling quicker recovery of patients."
"The COVID-19 pandemic and the Tata Memorial Centre response" April 4, 2020	http://www.indianjcancer.com/article.asp?issn=0019-509X;year=2020;volume=57;issue=2;spage=123;epage=128;aulast=The	- No specific drugs or vaccines are available, and health systems are overburdened everywhere. We have to rely on targeted, non-coercive, community interventions with sufficient transparency and public engagement and trust, and implement them urgently. - Community mitigation strategies may help delay the exponential spread of the outbreak until drugs become available.
"Time to revisit national response to	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7224629/	Simultaneously with all the patient and employee driven initiatives, we also had to deal with the reality that we would soon start seeing patients with either suspected or proven COVID-19 infection and had to prepare Standard Operating Procedures (SOP) for

pandemics" April 28, 2020 **"Improving Preparedness for and Response to Coronavirus Disease 19 (COVID-19) in Long-Term Care Hospitals in Korea"** June 25, 2020	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7335647/#B15	various scenarios. - "Community is the key to control pandemic." - "The reality is that preparedness for COVID-19 in LTCHs is inadequate, and there are barriers to improvements in preparedness." - "Number of healthcare facilities providing hospital-based home care service are decreasing. This is the major reason for overcrowding in LTCHs". - "The government should guide patients to choose home care service rather than LTCHs." - "public health and social measures need to be accompanied by efforts to mitigate social and economic impact to maximize the effectiveness of COVID-19 transmission reduction" - "approximately 20-30% of cases will require clinical care at a hospital with respiratory support, and this needs to be carefully planned in advance."
"Pandemic influenza Preparedness and Response: A WHO Guidance Document" 2009	https://www.ncbi.nlm.nih.gov/books/NBK143067/	• "A whole-of-society approach to pandemic influenza preparedness emphasizes the significant roles played not only by the health sector, but also by all other sectors, individuals, families, and communities, in mitigating the effects of a pandemic."
"WHO checklist for influenza pandemic preparedness planning" 2005	https://www.who.int/csr/resources/publications/influenza/FluCheck6web.pdf	"The checklist for pandemic preparedness is as follows: — Preparing for an emergency — Surveillance — Case investigation and treatment — Preventing spread of the disease in the community — Maintaining essential services — Research and evaluation — Implementation, testing and revision of the national plan"

FINDINGS

TO PREPARE THE HOSPITALS AGAINST A PANDEMIC

1. Emergency Risk Management

- Preparing a permanent Hospital Emergency Committee (including representatives of main activities of the hospital) responsible for establishing Hospital Emergency Risk Management Programme for maintaining a coordinated system for the overall management of the hospital's emergency risks covering risk assessment, prevention, preparedness, response and recovery. It includes:
    - the roles and responsibilities of each hospital department in an emergency
    - the role of hospital with respect to community and health sector response, including communion, functions and lines of communication
    - procedures for stimulating the Hospital Emergency Response Plan (following an early warning from health authorities, hospital-based or local emergencies, or a local or national declaration of an epidemic)
    - SOP applicable to emergency situations
    - the setting up of a Hospital Emergency Coordination Centre including its location; information and communication activities; HR issues; pharmacy and laboratory services; essential support services; psychosocial services.
    - the availability of other treatment sites;
    - IPC measures;
    - agreed convention for patient triage (including the designation of triage areas) and for patient traffic flow within and in the vicinity of the hospital; measures required to ensure the safety of hospital staff;
    - continuity of essential routine procedures and services
    - the capacity require to combat future emergencies

2. Infection prevention and control

- Establish the IPC component of the Hospital Emergency Response Plan
- Ensure that IPC staffs acquire training to enhance their ability to fulfill their roles in implementing the hospital's emergency response.
- Define infection control precautions for triage, flow and placement of patients, and early reporting and treatment.
- Evolve environmental and engineering controls, such as ensuring effective environmental ventilation and cleaning.
- Include in the hospital’s risk communication strategy messages aimed at reinforcing IPC efforts among hospital staff, patients and visitors, and the wider community
- Execute measures to address the welfare needs of IPC staff, such as leave and psychosocial support.
- Limit procedures that could facilitate the spread of infection.
- Use of PPE and hand hygiene to assure adequate protection of the hospital staff against infection and observe staff health status, IPC practices continuously and modify policies as necessary

3. Communication

- Establish the communications component of the Hospital Emergency Response Plan based on the hospital's all-hazards emergency risk assessment.
- Through their service functions, hospitals have privileged approach and therefore have an opportunity to pre-inform the community
- Notify about an epidemic and its likely impact through a single source (including media).
- Appoint official hospital spokespersons to address the public on behalf of the hospital about both the content of information to be communicated and the communication process itself that are consistent with health ministry policies. Inform the public, hospital staff and other concerned constituencies about:
    - who is at risk and how many people are affected and prognosis of those affected
    - what actions have been planned to minimize risk of injury, illness and death;
    - the role of the hospital and how to access hospital services in responding to the emergency
- Give the hospital staff:
    - mandatory information they require about personal and family health and welfare;
    - advancement reports on the management of the emergency, including actions planned in response to the emergency;
- Deliver messages to the public that:
    - are crisp, factually correct; taking into account the fears and emotions raised
    - confess official sources of information used in the message;
    - are delivered on time, at set intervals and through set trusted channels.

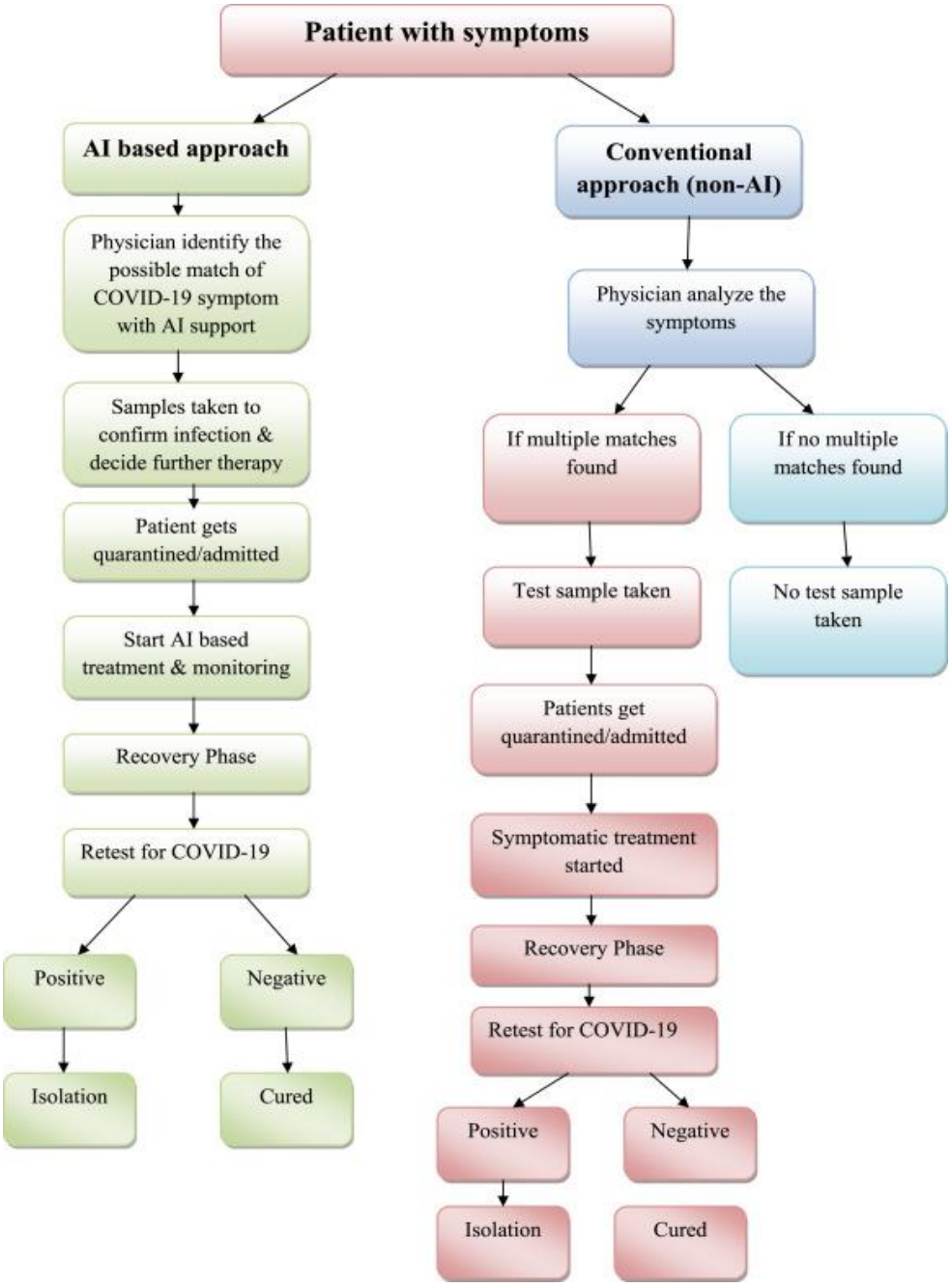
4. Human Resources

- Establish the HR component of the Hospital's Emergency Response Plan based on an assessment of the extra staff for HRM and make amenities for emergency situations to cover issues like staff and family welfare, working hours, overtime payments and compensatory time off once the emergency period has ended.
- Establish and execute a training programme based on an evaluation of staff roles in an emergency that takes into account the nature of the epidemic, covers training in the use of Standard and Additional IPC precautions, including the use of PPE, hand hygiene and respiratory hygiene.
- Ensure that HRM staff is trained and participate in regular exercises to test plans and procedures for their applicability in emergency conditions.
- Community support (e.g. providing assistance with domestic care for children, transportation) can provide relief and flexibility for working day and night irregularly. Contact community influencers to arrange for community support of hospital staff.
- Social mobilization and active community participation (eg. in providing volunteer staff) should be overseen as part of the overall national or local response
- Anxiety and stress among staff challenged with a calamity involving a highly contagious disease is to be expected and obligatory dynamic administration through personal protective procedures. Therefore, execute a plan for granting staff with social and psychological support.
- To decrease the overload of healthcare professionals, Healthcare delivery requires the support of new technologies like **Artificial Intelligence (AI), Internet of Things (IoT)**, Big Data and Machine Learning to fight and look ahead against the new diseases. We aim to review the role of AI as a decisive technology to analyze, prepare us for prevention and fight with COVID-19 and other pandemics.

General procedure of AI and non-AI based applications that help general physicians to identify

the COVID-19 symptoms.

The below flow chart informs and collates the functioning of non-AI treatment versus AI-based treatment. It explains the involvement of AI in the significant steps of treatment of high accuracy and reduces complexity and time taken. The physician is not only focused on the treatment of the patient, but also the control of disease with the AI application. Major symptoms and test analysis are done with the help of AI with the highest accuracy. It also shows the reduced number of steps taken in the whole process, making more attainable in nature.



Main applications of AI in COVID-19 pandemic

- Early detection and diagnosis of infection
- Observatory treatment
- Contact tracing of the individuals
- Prediction of cases and mortality
- Establishment of drugs and vaccines:
- Reduced workload of healthcare workers
- Disease prevention

Major advantages of using IoT against covid are-

- Reduced chances of mistakes
- Lesser expenses
- Superior treatment
- Enhanced diagnosis
- Effective control

5. Hospital pharmacy

- Develop the pharmacy component of the Hospital's Emergency Response Plan
- To make relevant drugs and other pharmaceutical stock available and continue to be available in the hospital during an emergency.
- Develop and implement Standard Operating Procedures and a supply chain for acquiring, stocking and distributing the necessary supplies in the quantities required. Antiviral and anti-inflammatory cytokine storm drugs such as Arbidol, Lopinavir, Ritonavir and Chloroquine are recommended. No more than three combined drugs should be used in order to avoid side effects.
- Establish and evaluate test procedures for departing the hospital pharmacy, laboratory and blood bank in order to ensure staff safety while assuring continuity of routine hospital services.
- Execute a plan for the role of the pharmacy in providing medicines to patients receiving outpatient and home-based care.
- Establish a contingency or surge capacity plan with HR for managing staff shortages and for increasing numbers of skilled staff required to meet increased demand for pharmaceutical services.

6. Hospital laboratory

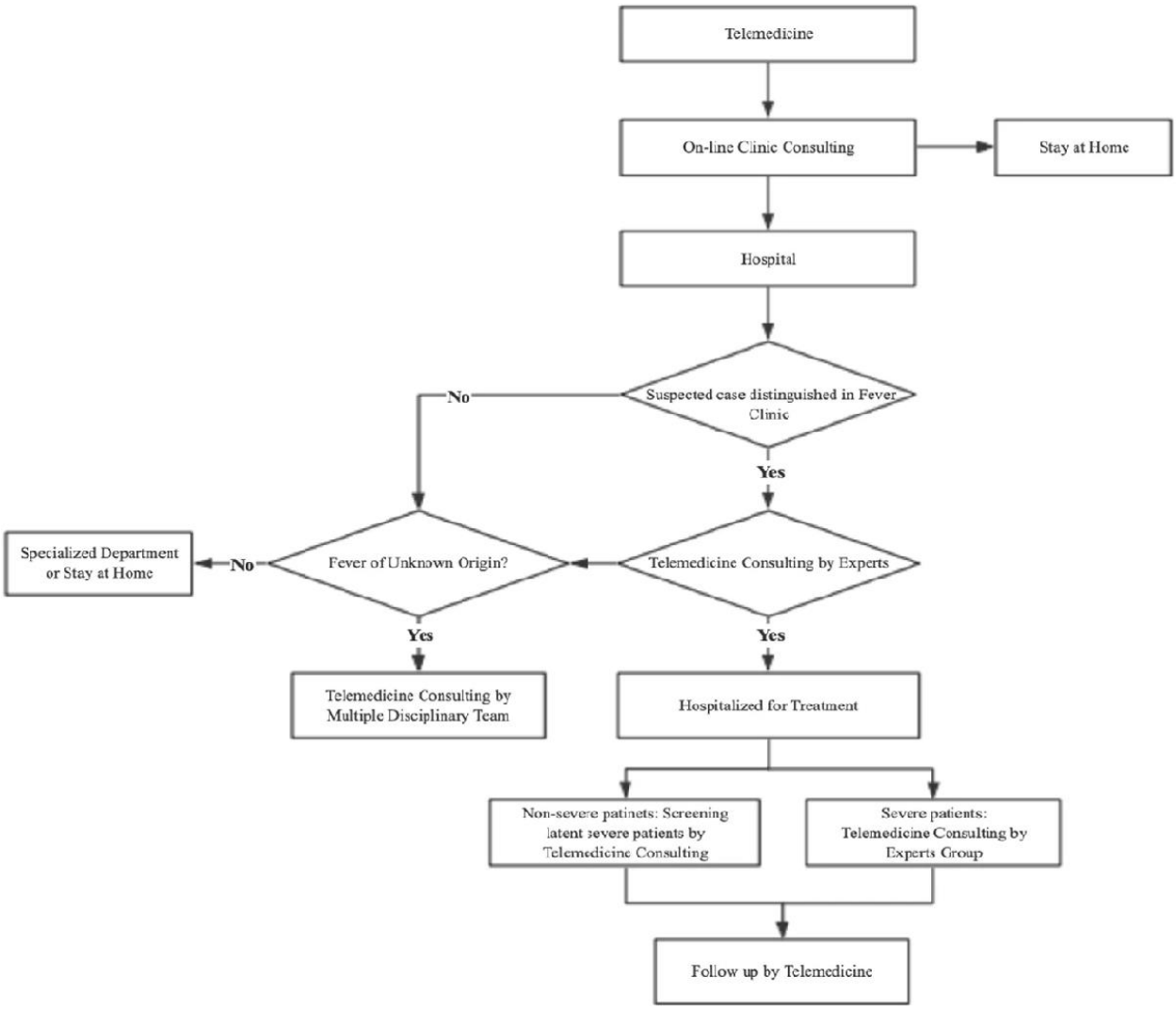
- The hospital laboratory provides critical services for several obligatory hospital activities such as surveillance, IPC, and management of patients.
- Laboratory biosafety measures, collecting, preserving, and shipping specimens should match up with suitable WHO guidelines
- Check that quality standards are being met for personal protection, IPC, and for cleaning, disinfection and laboratory waste management.

7. Patient management and surge capacity

- Appropriate measures (such as vaccination, administration of appropriate medications, use of PPE) for avoiding spread of infection to hospital patients, staff and visitors.
- Assign a suitable and well equipped triage area for epidemic patients that will be ideally be independent of the emergency department.
- **Surge capacity**—the ability of a hospital to meet an expanded demand for health
- Increase the number of staffed hospital beds and other in-patient resources.

- Accommodate strategies to build utilization of day-care center, develop and execute policies for early patient discharge.
- Reorganize and adapt triage criteria for patients not requiring hospital admission, develop or review mechanisms like **telemedicine**, for referring epidemic patients to other healthcare levels, potential providers, such as public health programmes, alternative care sites or home care(hospital at home) for patients not requiring in-patient services

- Telemedicine was demonstrated to be feasible, acceptable and effective and allowed for significant improvements in health care outcomes. Telemedicine can be broadly defined as the use of telecommunications technologies to administer medical information and services. It reduces the load on our secondary and tertiary care hospital. Telemedicine can also provide easy medical access to patients who live in rural communities many miles from good health care. For many common health problems or follow-up care, an in-office doctor visit may not be needed. Although this tool does not replace a medical examination, during Covid-19 pandemic, it decreases the contamination and avoids the need for a patient's visit. It is useful in the management of chronic disorders or for patients undergoing mollyfying treatment.



- Hospital at Home Programs allow delivery of hospital-level medical and social services in the home both for patients with COVID-19 and for patients with other conditions. This

frees up hospital beds and other resources for patients truly requiring aggressive inpatient therapy. After a patient is identified as qualifying for hospital care in the home, clinicians assess the patient in the home and can arrange for nursing, durable medical equipment, oxygen therapy and even home radiology, and use telemedicine technology to frequently reassess patients. The service has been found to be safe, cost-effective, better for patients' ability to complete activities of daily living and appreciated by patients. Interdisciplinary social and behavioral health services are necessary for effective hospital-at-home.

At the same time, it would keep contagious patients out of the hospital, protecting them from the infection. Hospitals have the potential to be epicenters in this pandemic. Moreover, this program permits the conveyance of care to patients who might otherwise not seek care at the hospital for fear of getting infected.

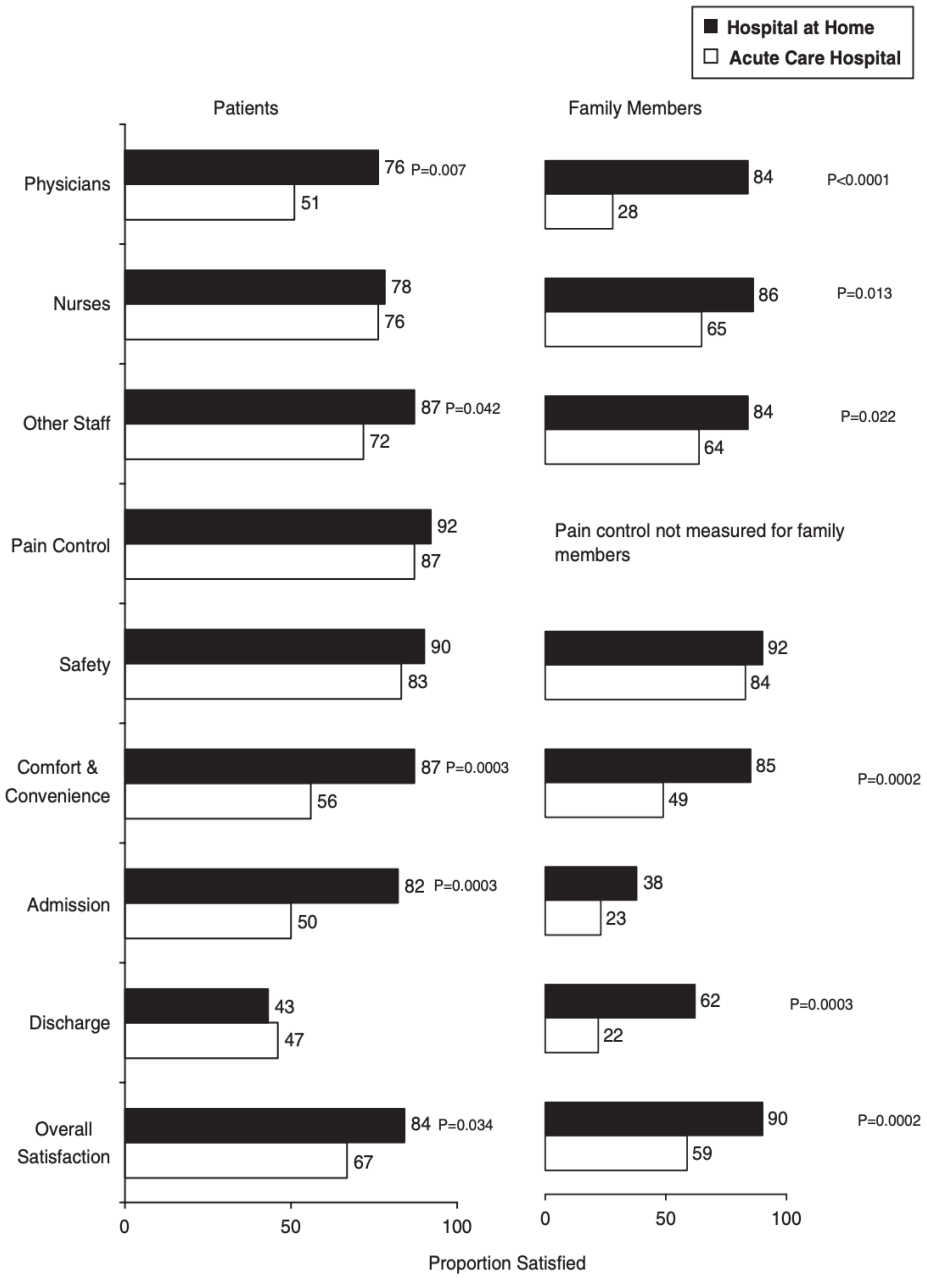


Figure 2. Proportion satisfied by site and domain of care.

Patients and their family members show high levels of satisfaction with hospital-at-home care.

TO PREPARE AND LESSEN THE IMPACT OF COVID PANDEMIC ON OUR COMMUNITY AND AROUND THE WORLD

1. Conduct risk assessment specific to a setting

In assessment of risk, we need to know who in the community is most prone based on demographics and co-morbidities. Consider present and future protection risks for most prone or borderlined groups as a consequence not only of COVID-19 but also of public health or social measures.

- Communication: correct and on time information at all levels is essential in order to decrease unwanted and unseen social disruption and economic consequences and to increase the effective response result.
    - Communicate risks clearly, honestly, on time and adjust community based approaches and measures according to feedback
    - Work with local reputed people (trusted people, religious leaders, teachers, role models, community volunteers, professional specialists women and adolescent groups) in the community and local networks to provide timely, accurate, user-friendly, audience appropriate and trusted information responding to different people's needs and focusing on what they can do to avoid the spread of the outbreak
    - Audit and respond to perceptions, rumors, questions and provide feedback through trusted channels and modify response approaches
    - Address social stigma through capacity development and providing support to those facing it**.**
    - Develop a communication plan for different target population.
    - Consider developing an official national or regional pandemic web site and linking this web site as developed by other countries, after evaluating the quality and relevance of information provided on these other sites
- Legal issues: It may be necessary to force existing legislation or (individual) human rights. Examples are imposing the quarantine (overruling individual freedom of movement), use of privately owned buildings for hospitals, off-license use of drugs, mandatory vaccination or implementation of emergency shifts in obligatory services. These policies need a legal framework to make sure transparent assessment and justification of the policies.
- Ethical issues: Ethical issues are part of the normative framework that is needed to assess the cultural acceptance of measures such as isolation or quarantine of predefined risk groups. Consider the ethical issues related to decreasing personal freedom, such as may occur with isolation and quarantine. Ensure the implementation of an ethical framework for research, especially when this involves human subjects.

2. Surveillance

It consists of ongoing collection, interpretation and dissemination of data to enable the development of evidence-based interventions.

- Ensure that there is dedicated funding and trained surveillance personnel.
- Establish a coordination centre during the response to a pandemic or outbreak with pandemic potential.
- Plan for emergency needs: training, staff mobilization, monitoring hospital admissions, deaths, workforce absenteeism, vaccine/drug usage and development of additional national tools or systems.
- Monitor the hospital admissions for suspected or confirmed cases of pandemic
- Ensure a mechanism for data collection and evaluation for decision making

3. Case investigation and treatment

- Ensuring access to basic diagnostic capacity implication of general bio-safety amendments and assess refining these protocols
- Laboratory facilities will need to be in place for evaluating antiviral drug resistance and should be aware of packing and transportation requirements for diagnostic specimens.
- To establish study amendments for basic and enhanced epidemiological studies and implement them. Provide clear guidance and on defining and managing possible contacts of the case
- Ensuring the establishment, change and implementation of clinical management guidelines for patients with suspected and confirmed infection.
- Consider the development of a clinical working group with experts from the public and private sectors to ensure broad expertise and commitment.

- Increasing testing capacity: To avoid the contamination of the disease throughout society increasing the number of tests and thus pinpoint more cases, isolate them, and trace those who have been in contact. For this reason, increasing laboratories' test capacity and inventing new testing strategies is important. Different methods such as rapid-testing kits, serologic methods and self-collected specimen tests are being used around the globe to detect cases which in turn help to stick on the isolation rules.
- Refining existing infection control guidelines and procedures for use in all levels of health-care facilities, including: — health centers — clinical laboratories — community health clinics — general practice facilities — hospitals — long-term care facilities — mortuaries.

4. Preventing spread of the disease in the community

COVID-19 prevention and control measures in community:

Quarantine

- Voluntary quarantine(self-quarantine)
- Mandatory quarantine
    - Private residence

Other measures:

Avoiding crowding
Hand hygiene
Cleanliness and Disinfection

- Hospital
- Public institution
- Others (cruise ships, etc)

Social distancing and Isolation
PPE
School measures/closures
Workplace measures/closures

- General personal hygiene**:**

- Increase general knowledge on personal hygiene and respiratory etiquette in the community.
- Regular hand washing is ought to be done before preparing food, before and after eating and after using the toilet (as per guidelines from departments/ministries)
- To make sure that personal advice about decreasing the risk of transmission is easily made public
- Mobilize resources and partners to make sure clean and safe drinking water is availability and hand sanitizers' provision should be ensured at all gathering places and in households.

- Limit movement: Assign different times for different groups to come back and go home where gatherings is not permissible. Identify alternatives to gatherings using locally accepted media

- Social distancing**:** Social distancing is useed to reduce interactions between people in a broader community, in which individuals may be infectious but neither have been identified hence nor isolated. As diseases transmitted by respiratory droplets, it requires certain proximity of people. Thus, social distancing of persons will reduce transmission.. Examples for social distancing include closure of schools and workplaces, one-way system for pedestrian, ground markings and set up physical barriers in the communal facilities to support physical distancing travel restrictions on visitors arriving from high-risk counties, suspension of public market; cancellation of gatherings and encouraging online shopping and home office working can reduce the amount of contact.

- Quarantine: Quarantine is one of the earliest and most efficient tools for controlling communicable disease outbreaks. It means preventing the activities or the segregation of persons who are not ill but who may been exposed to an infectious disease, with the objective of evaluating their symptoms and assuring the early detection of cases. It is different from isolation, which is the separation of ill or infected persons from others to avoid the getting contaminated. It is a powerful measure in decreasing both the number of infected and dead, quarantine for nationals returning from high-risk locations. Active evaluation of people who are quarantined is one of the essential points in restricting the epidemic in the society. Without strict quarantine rules the pandemic cannot be curbed.

Travel and trade restriction measures can include:

- The full or partial closure of educational institutions and workplaces,
- Decreasing the number of visitors and the contact within the resident settings, such as long-term care facilities and prisons,
- Cancellation, prohibition and restriction of mass gatherings and smaller meetings,
- Obligatory quarantine of buildings or residential areas,

- Internal or external border closures, and
- Stay-at-home restrictions for entire regions or countries.

- Establishing a detection, reporting and referral system for suspect cases
- Ensuring that contact tracing, confinement and quarantine that can be implemented both legally and practically.
- Define criteria for implementation and abrogation: — consider designation places where persons can be held in quarantine; — ensure medical care, food supply, social support and psychological assistance for these people; — ensure adequate transport of persons to these places, and from there to hospitals or mortuaries.

- Personal protective equipment: To reduce COVID-19 transmission from potentially asymptomatic or pre-symptomatic people, the ECDC recommends the use of face masks. It may primarily serve as a means of source control in the community. This measure can be particularly relevant in epidemic situations when the number of asymptomatic but infectious persons in the community can be assumed to be high. Wearing a face mask could be considered, especially when using public transport, for certain workplaces and professions that involve physical proximity to many other people. Individuals should be counseled to avoid touching the eyes, nose, and mouth when removing the covering, practice hand hygiene after handling it, and launder it routinely. The rationale for the face covering is primarily to contain secretions of and prevent transmission from individuals who have asymptomatic or pre-symptomatic infection.
- Cleaning and disinfection**:** High-touch areas like bedside tables and door handles should be disinfected daily with regular household disinfectant containing a diluted bleach solution (that is, 1-part bleach to 99 parts water). For surfaces that cannot be cleaned with bleach, 70% ethanol can be used. Toilets and bathrooms should be cleaned and disinfected with a diluted bleach solution. Disposable gloves should be used when cleaning or handling surfaces, clothing, or linen soiled with body fluids. All used disposable contaminated items should be placed in a lined container before disposing of them with other household waste. Clothes should be cleaned using detergent and water.

- Ensure adequate application of travel and trade restrictions and discuss possibilities and consequences.
- Make sure international transport authorities have clear instructions on dealing with various epidemiological situations, and handling possible human cases on board.
- Vaccine programs: vaccine invention is on human trials for COVID. Once it come in market it will be helpful in reduction of cases and deaths due to covid.

Excess mortality: Determine the maximum ability for storage and disposal of corpses using culturally acceptable methods.

- Adapt burial ceremonies to reduce contamination risks but meeting the local cultural, social and religious needs.
- At time of community burial, family members, traditional and religious leaders, healthcare workers involved in making the body ready for burial should be supported with the information and IPC supplies and equipment needed to reduce the risk of transmission

Recovery: After the tide of pandemic is over, it is expected that many people will be affected in many ways. Many may have lost friends or relatives, suffer from fatigue or have financial losses.

- Asking obligatory services to implement recovery plans for their service or organization.
- Defining responsibilities for social, psychological and practical support to affected families and companies.
- Assessing present community groups (religious groups/churches, sports groups) that can contribute to reconstruct the society. Find contact persons within these groups.
- Considering whether recovery after a pandemic needs financial support from the government.

6. Research and evaluation

- Inventing a defined strategy for evaluating antiviral drug resistance. Research may include: — evaluating the impact of a pandemic (morbidity and mortality rates, hospital admissions, etc.)
- Monitoring should target on the response at all levels and should provide suggestions for improvement. Ensuring that results of research studies, both local and international, are made public to support improvement of response strategies and evaluation.

7. Implementation, testing and revision of the national plan

- Set targets, define indicators or implement a set mark that can be used to evaluate improvement in implementation
- Revision of the plan based on experience with new outbreaks, for example after SARS, Nipah, swine flu etc. If the outbreaks are not present, choose a period after which the plan should be revised.

CONCLUSION

It is not possible to avoid cluster outbreaks in hospitals without implementing well-equipped facilities and trained staff members. It is a concern that cluster outbreaks in hospitals can lead to many deaths and rapid bed occupation meant for patients with severe COVID-19. Concerning, the government should provide institutional and policy support ensuring that hospitals are prepared for COVID-19 outbreaks. It can happen only with a spirit of solidarity and cooperation of government, public and private healthcare facilities.

In conclusion, India and the world have a high listed legacy of successful efforts to cure widespread infections. Remembering the successful smallpox and Influenza eradication, we realised the pivotal role of leadership and sound management to avoid this contagious disease. Hence, India has the opportunity to rewind this situation analysis by appropriate protocols

- Thus, hospitals can control the COVID pandemic by:
  - providing triage care
  - maintaining a communication plan
  - collaborating with local and regional hospitals

- Surge capacity to the ability of the hospital to ensure the super specialized health care which is required in an epidemic by incorporating telemedicine, hospital at home like programs and advanced technology like AI and IoT which will play an important role in offering more predictive and preventive healthcare. Thus it will become an obligatory technology in fighting against these epidemics and pandemics.

❋ At the community level, the most focused measures for decreasing contamination depends on case detection, isolation, and contact tracing of positive cases, followed by quarantine for those exposed. Other strategies include:

- Practicing hand hygiene and respiratory hygiene
- Proper use of PPE
- Implementing methods like quarantine, social distancing, cleaning and disinfection,
- Increasing testing capacity

RECOMMENDATIONS

✓ To prevent the hospital from becoming an epicenter in this epidemic, proper protocols of hygiene, cleanliness and disinfection should be followed.

✓ Innovations like telemedicine and hospital at home are highly recommended. Also, they can help in increasing bed capacity for critically ill patients.

✓ AI and IoT have the potential to improve the planning, treatment and reported results of the COVID-19 patient, being an evidence-based medical tool. Only recommendation for a hospital is to have uninterrupted high speed data connectivity. This technology has a very bright future ahead.

✓ Community Awareness towards Hygiene will have positive effect in the long-term, though in the short-term likely to increase PHC load significantly. Frequently washing hands with an alcohol-based sanitizer or soap and water, avoiding touching eyes, nose, and mouth, use of face masks and hygiene practices. Thus, it's the duty of government in educating its citizens to avoid catching infections.

REFERENCES

- https://www.healthline.com/health/what-is-a-pandemic#past-pandemics
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7212542/
- http://www.ijo.in/article.asp?issn=0301-4738;year=2020;volume=68;issue=5;spage=703;epage=710;aulast=Khanna

- https://healthmanagement.org/c/hospital/news/covid-19-how-can-hospitals-protect-workers-and-patients
- https://www.pulmonologyadvisor.com/home/topics/lung-infection/maintaining-icu-hospital-infection-control-during-the-covid-19-pandemic/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5331010/
- https://www.acpjournals.org/doi/full/10.7326/M20-0907
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7262310/
- https://pubmed.ncbi.nlm.nih.gov/32401218/
- https://pubmed.ncbi.nlm.nih.gov/32414379/
- https://www.sciencedirect.com/science/article/pii/S1871402120300771
- https://www.researchgate.net/publication/340487417_Artificial_Intelligence_in_the_Battle_against_Coronavirus_COVID-19_A_Survey_and_Future_Research_Directions
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7175897/
- https://news.cgtn.com/news/2020-06-04/COVID-19-Frontline-How-can-hospitals-better-prepare-for-the-pandemic--R2TPdIaK9a/index.html
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7195988/
- https://ccforum.biomedcentral.com/articles/10.1186/s13054-020-02884-9
- https://journals.sagepub.com/doi/abs/10.1177/0025817220926926?journalCode=mljc
- https://www.weforum.org/agenda/2020/04/hospital-at-home-covid19-coronavirus-pandemic-nursing-care/
- https://www.everbridge.com/blog/innovative-pandemic-response-strategies-for-hospitals-to-combat-covid-19/
- https://www.ncbi.nlm.nih.gov/books/NBK143067/
- https://www.ecdc.europa.eu/en/seasonal-influenza/preparedness/why-pandemic-preparedness
- https://www.who.int/csr/resources/publications/influenza/FluCheck6web.pdf

PART II

Data Analytics For Lean Six Sigma

COURSE DESCRIPTION

The course is available on Coursera and is offered by University of Amsterdam. It is one of the largest comprehensive universities in Europe. UvA is seen internationally as a centre of expertise in Lean Six Sigma, operations management and industrial statistics. This course introduces data analytics techniques that are typically useful within Lean Six Sigma improvement projects. It is a 5 week course and requires 16 hours to complete. However data analytics tools are very widely applicable. So you will find that you will learn techniques that you can use in a broader setting apart from improvement projects.

COURSE OBJECTIVES

- To analyze and interpret data gathered within Lean Six Sigma Improvement projects.
- To select appropriate tool for data based testing.
- To focus on use of data analytics tools and interpretation of the outcome.
- To learn techniques that can be used in a broader setting apart from improvement projects.
- To illustrate all the tools using different examples from actual lean six sigma projects.

COURSE CONTENT

WEEK1- Data and Lean Six Sigma

- **Introduction to Lean Six Sigma** Process improvement is important to organizations and Lean Six Sigma is a popular method to do this. Data is important when you want to improve your processes. Data can help you to diagnose the current processes or to investigate the effects of your improvement actions.
- **Data and DMAIC** The lean Six Sigma project consist of five DMAIC phases:

Define	Select project and establish objectives.
Measure	Make the problem quantifiable and measurable.
Analyze	Analyze the current situation and make a diagnosis.
Improve	Develop and implement improvement actions.
Control	Control the improved process performance and close the project.

- **CTQ-** Critical To Quality characterstics is the property of a product or a service that is relevant to your project objective. What we want to change determines our CTQ. In

statistics and other fields, this variable is called your Y-variable, the dependent variable, or the outcome variable.

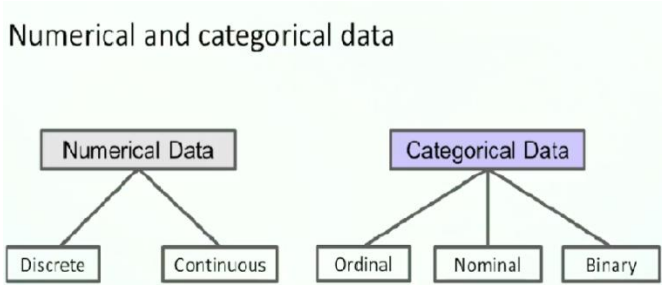
- **Units** are people, objects or phenomena you collect data on. It can be experimental units, observational units and measurement unit which is sometimes referred to as the unit of measurement. The measurement unit defines what a measurement means**.**

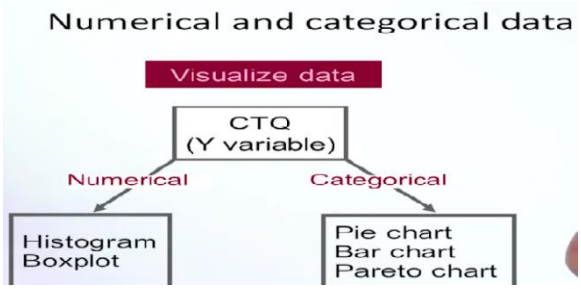
- **Sampling** It is important to select a representative sample. One way to obtain a representative sample is by randomly selecting the items.

WEEK2- Understanding and visualizing data

- **Numerical and Categorical data and Visualization** There are two types of data:

- Qualitative data (Categorical)
- Quantitative data (Numerical)

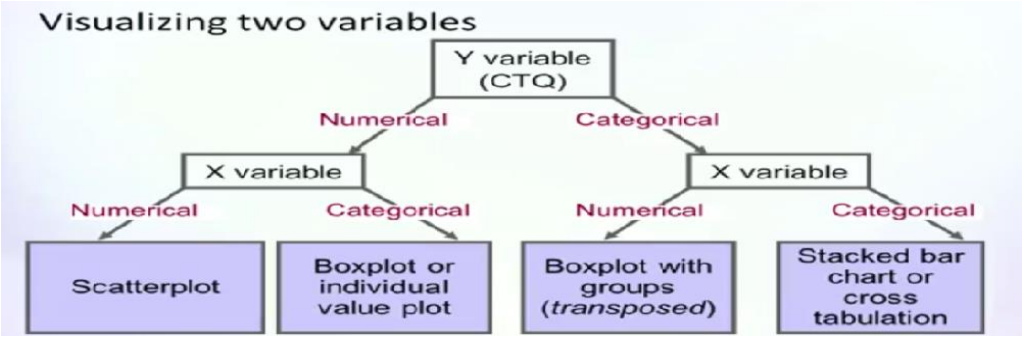




- **Descriptive Studies:** There is always a certain degree of variation or dispersion in the data. To measure dispersion we look at the **standard deviation**. As these deviations are both positive and negative, their average will be approximately zero. So, to solve this problem, we square the distance first because squaring will give us positive numbers. The average squared distance is called the **variance**. Taking the square root again will give us the standard deviation.

In some cases, the **range** is used to indicate dispersion. It is the difference between the highest and the lowest value, or your maximum and your minimum. Therefore, the distance between Q1 and Q3 is more often used to quantify dispersion, and is called the **interquartile range**. It is less susceptible to the influence of outliers. The mean and the median say something about the location of data and the standard deviation, variance, range and interquartile range say something about the dispersion in your data.

- **Visualizing two variables**

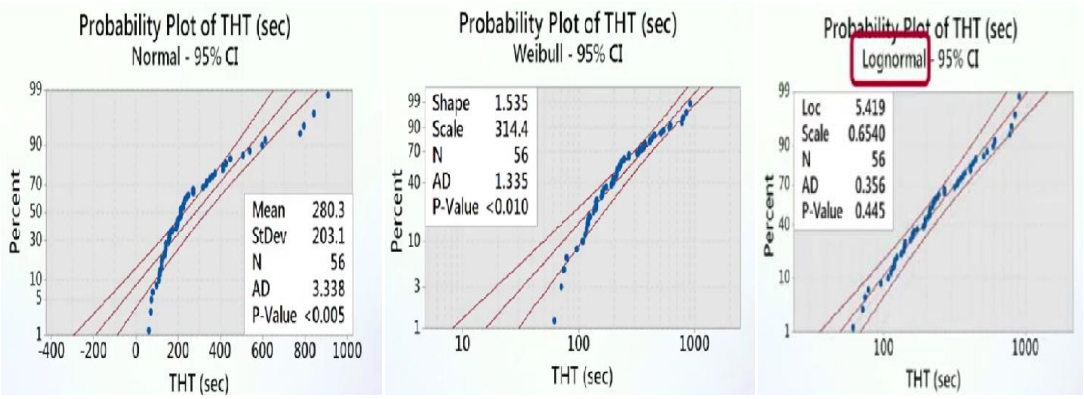


WEEK3- Using probability distributions

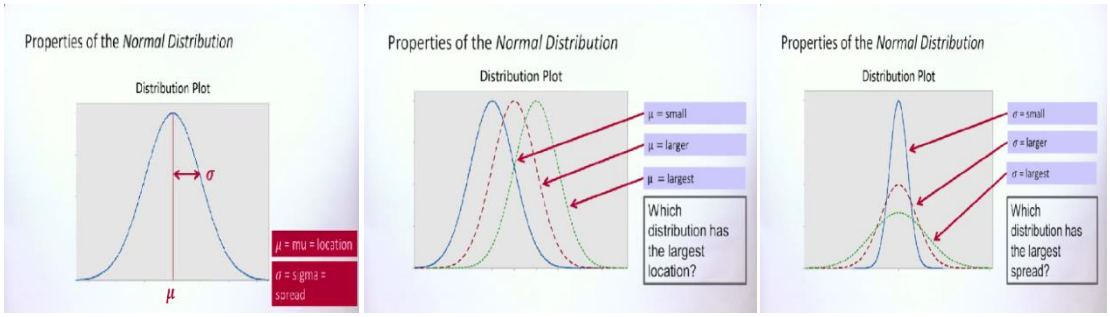
- **Population versus Sampling** A population is a collection of all units of interest whereas a sample is a subset of the entire population, used to say something about the population.

Normal, Lognormal and Weibull distribution

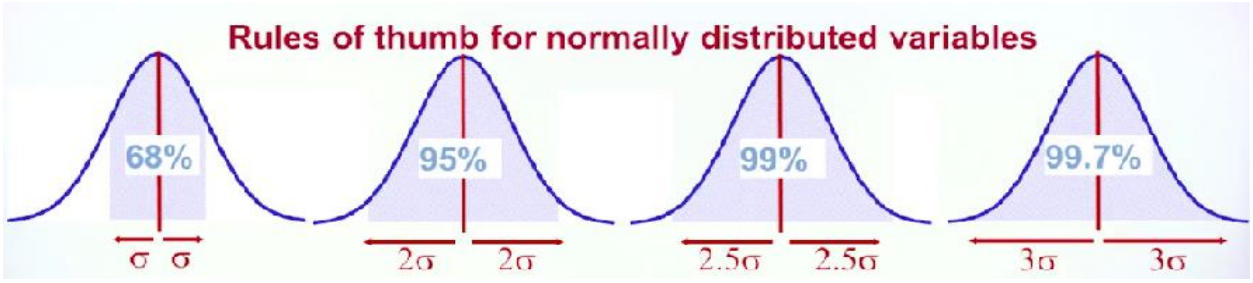
- **Probability plot** can be used to check if the distribution fits well if the measurements, the dots, are on a straight line, and as much as possible between the two outside lines. The middle line presents the normal distribution. If you compare all three graphs, you can conclude that a lognormal distribution fits best to your data of THT. As a second check, you can compare the AD (Anderson Darling) values. It measures the distance between your data and the theoretical distribution, such as the normal, Weibull, or lognormal distribution. The lower the value, the better the fit. So we select the distribution with the lowest AD value. In this case, the lognormal distribution has a lowest AD value and therefore fits the data best



- **Empirical CDF** is a useful tool in analyze phase of Lean Six Sigma project to calculate percentages by using crosshair function or percentile lines to find the exact percentages.
- **Properties of Normal Distribution** A Normal Distribution has two parameters that determine the shape of its distribution. The first parameter is the location parameter which determines the midpoint. This is denoted by mu, which is the location or mean. The second parameter describes the shape of the distribution and is known as the dispersion parameter, denoted by sigma and it determines the spread of the distribution.

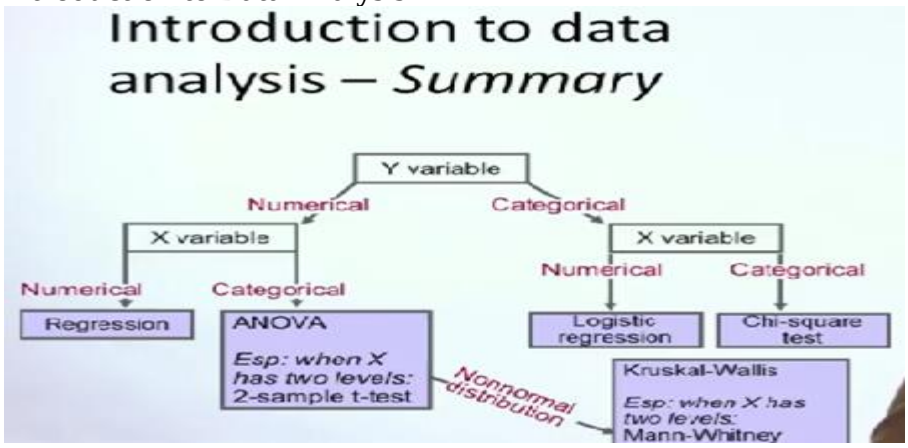


- Between these three normal distribution, it is the distribution that is situated most to the right, has the largest mu
- Between these three Normal Distributions, it is the distribution where the graph is flattened out the most shows the largest spread, the largest sigma

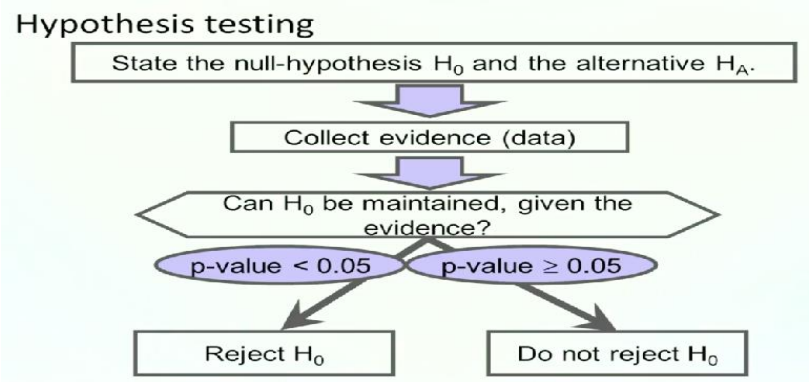


WEEK4- a) Introduction to testing

- **Introduction to Data Analysis**



- **Hypothesis Testing** is a procedure to arrive at a decision as objectively as possible, while dealing with uncertainty in a rational manner. Testing means that we claim something and we use data to test this claim. This claim is called a hypothesis. We start with constructing the hypothesis, then collecting the data and finally, drawing the conclusion



b) Testing: numerical Y and categorical X

- **ANOVA Analysis** ANOVA stands for Analysis of Variance and ANOVA is the appropriate statistical technique when the Y variable is numerical and the X variable is categorical. It is a suitable statistical method if you are comparing means across various groups. The analysis consists of three steps:
  - Organizing the data
  - ANOVA
  - Residual Analysis

The **p-value** tells us whether the difference between the means of the machines are significant, meaning, that are these differences real and not due to random fluctuations. The **R squared value** tells us how relevant the effect of the machines is. To make sure that the conclusions in your second step are valid, we will have to perform a residual analysis.

- **Kruskal -Wallis Test** should be performed when the underlying assumptions of the ANOVA analysis are not met. To interpret the output, you have to look at the medians for each group and of course, add the P-value to see if this difference is statistically significant.

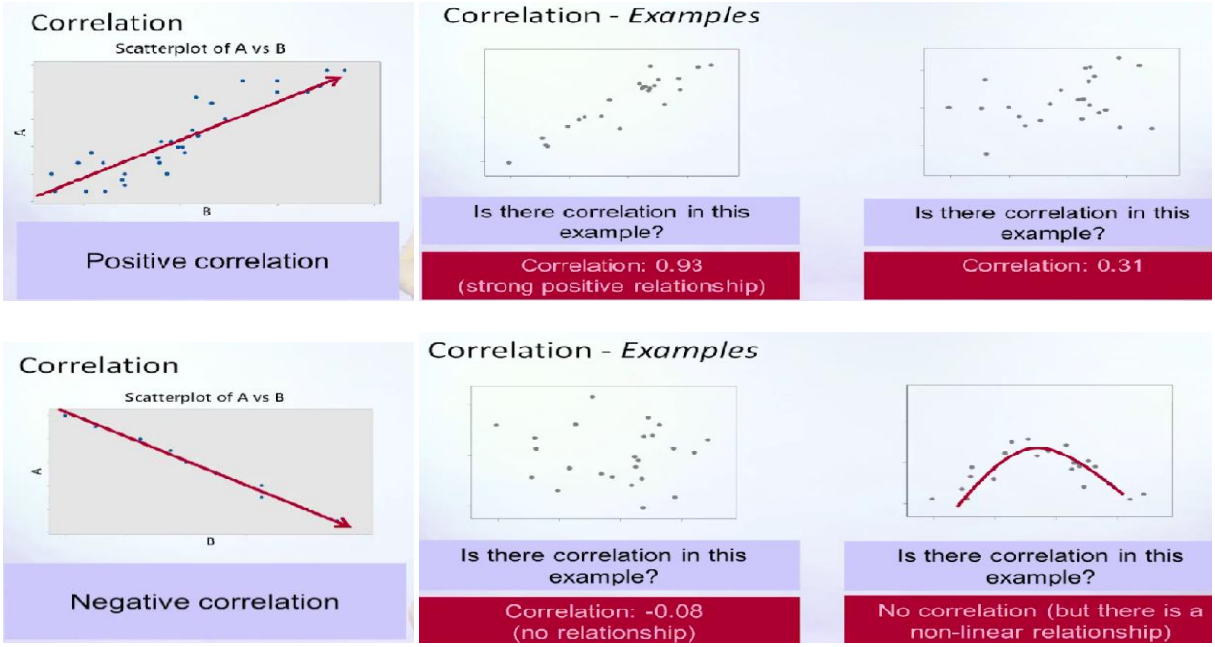
- **Two sample T-test** is also known as a student's t-test. It is a method to compare means of two groups. The p-value can be used to calculate whether the differences of the two mean is coincidental, or truly significant. Especially for small samples this is very useful.

- **Test for equal variances**: Increasing variability always decreases the performance of a production system. This is the law of variability. It shows that understanding variation is mandatory for the quality of a process. It helps to compare variances across groups and can be used to improve the p-value over and over.

WEEK5- a) Testing: numerical Y and numerical Y

Correlation is an index that expresses how strong a relationship between two numerical variables is. This index is always between minus 1 and plus 1.A correlation of 0 means that there is no linear relationship. For example A and B show a positive correlation. This means that higher values of one of the variables will generally correspond to higher values of the other variables

whereas a negative correlation means that the variables are correlated in the opposite direction. Thus, both variables are inversely proportional to each other.

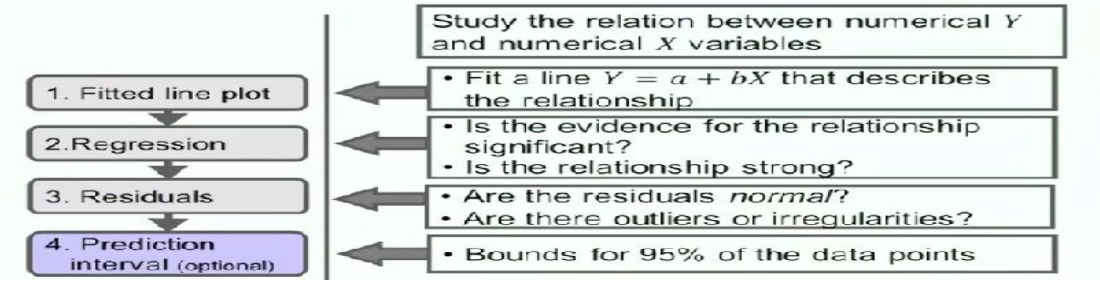


Correlation - *Overview*

Rule of thumb:

0 to 0.4	No or weak positive correlation
0.4 to 0.8	Moderate positive correlation
0.8 to 1	Strong positive correlation
0 to -0.4	No or weak negative correlation
-0.4 to -0.8	Moderate negative correlation
-0.8 to -1	Strong negative correlation

- **Regression analysis** is about finding the best fitting linear line for your data. It is a statistical method to test if two numerical variables are related by calculating the best fitting line. Regression analysis consists of four steps:



- Thus, the fitted line plot indicates the constant a and the slope b of your line. The formula for the fitted line is equal to the function Y = a + bX. The a represents the constant of the line, which is a value when X equals to 0.
- The p-value indicates whether the findings are due to chance or whether they are statistically significant and the R squared shows how strong the relationship is.

- If you have outliers, a possible way is to delete them and see if the results of your regression change a lot. If the residuals are normally distributed and show no outliers or irregularities, this means that your assumptions are met. If not met, you have to be careful to interpret your results.
- Prediction intervals are used to determine the level of influence factor, which ensures a certain CTQ performance. We can use crosshairs, or the formula, to determine the required value of the influence factor.
- **Quadratic Regression** If the linear regression analysis does not meet the assumption, we will have to apply the quadratic regression analysis. Quadratic regression makes it possible to study a curved line.

b) **Testing: Categorical Y**

- **Chi-Square Analysis** The two steps of the chi-square analysis are:
  - to make a cross tabulation
  - p-value shows you whether or not the effect you found is significant
- **Logistic regression** It consists of three steps:
  - In the first step, you may need to convert your data to the correct format.
  - In the second step, you make a fitted line plot and evaluate the quality of the fit.
  - In the final step, you analyze the p-value and see if you have found a significant relationship.

LEARNING METHODOLOGY

It is an online based learning course of 16 hours with flexible deadlines to refresh the statistical knowledge with the help of video lectures along with the reading material so that we won't miss out anything if we wish to review it again. There are weekly practice quiz and graded quiz to test our learning objectives and self assessment. There are weekly forums where course related problem solving take place. This course also introduces a software package Minitab which is used throughout the videos for data analytics. Many day to day process improvement examples are also use for a better understanding of the concept. There are some video exercises also which gives us hands on practice for solving the problems.

KEY LEARNINGS

WEEK 1: In this week we came to learn about the lean six sigma, Data and DMAIC framework, how to select CTQs, how to perform sampling, organizing the data, the units and operational definition along with installation of Minitab.

WEEK 2: In this week we learn to visualize numerical and categorical data, descriptive statistics, Pareto analysis, visualizing two variables along with video exercises on investigation time and coffee batch

WEEK 3: In this week we got to know the difference between population and sampling, we learn about estimation, empirical CDF and confidence intervals, normal, lognormal and weibull distribution curves, probability plot and a video exercise on the length of stay.

WEEK 4: In this week we got to learn about data analysis, hypothesis testing, causality, ANOVA analysis, ANOVA residual analysis, Kruskal-Wallis test, Two sample t-test, test for equality of variances and video exercises on productivity and department.

WEEK 5: In this week we learn about correlation, regression analysis, regression residual analysis, regression prediction interval, quadratic regression, chi-square analysis, logistic regression and video exercises on picking, printers and students.