

Summer Training

At

Public Health Foundation of India, New Delhi

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A project report on: -

Assessment of the utilisation services provided under ESIC scheme in India over the period of
2000-2018

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ACRONYMS

ESIC	Employees' State Insurance Corporation
ESIS	Employee's State Insurance Scheme
IP	Insured Persons
OOPE	Out-of-Pocket Expenditure
MOLE	Ministry of Labour and Employment
IMP	Insured Medical Practitioner
TDB	Temporary Disability Benefit
PDB	Permanent Disability Benefit

Keywords

- ESIC,
- ESI Scheme
- Social security
- Health insurance
- ESIS utilization

PART 1- WORK FROM HOME ASSIGNED BY THE ORGANISATION

SECTION 1- ABOUT THE ORGANISATION

Public health foundation of India (PHFI) is a public private initiative that emerged as a consultation in various constituencies including central and state governments, multi & bi-lateral agencies and civil society groups and also Indian and international academia. PHFI is an institution working towards strengthening, training and research and policy development in the area of public health.

PHFI was launched in **2006** by Honorable Prime Minister of India, **Dr. Manmohan Singh**. PHFI was born at the time when India's economic growth was souring but also out of great concern about the appallingly poor health indicators that were utterly incompatible with the image of rapidly developing country.

PHFI has built an impressive portfolio of research and implementation projects funded by both national and international agencies. The research at PHFI helps with India's health policy and programs in many areas of public health.

It is also providing technical assistance to both state and central government for strengthening of health system.

It covers various areas of public health concern such as:-

HIV prevention, routine immunization, health professional training, universal coverage, health accounts and budgeting, antibiotic resistance, tobacco control, environmental health, health workforce planning and public health cadre development.

The faculties and researchers at PHFI are actively contributing in many initiatives such as WHO commission on Ending child obesity, Lancet Commissions on health professional education, mental health, investing in health etc. various international conferences have been convened by PHFI on maternal health, antibiotic resistance endgame for tobacco, global youth meet on health, health in sustainable development and new directions for public health education.

PHFI has also developed affordable technologies for health care which are being evaluated in field studies.

Vision of PHFI is working towards a healthier India. A country with strong public health system.

SECTION 2 – SUMMER TRAINING REPORT

I. Background

Health is a basic human right of every individual irrespective of its socio-economic class, gender, ethnicity and demographical location. The idea of Health for all was conceived in 1978 during Alma Ata Declaration where the idea of health access for everyone was elaborately discussed.

Later in 2005, it was recognised that healthcare should be at reach for everyone and nobody should lag behind due to financial hardship. Equity in healthcare is one of the major challenges among the low-middle income countries (LMICs). All over the world, 150 million people suffer financial catastrophic expenditure annually and 100 million are pushed below the poverty line. The other grim side of financial impoverishment in developing countries is loss of wages which affects the utilization of healthcare. The core principles of Universal Health Coverage covers three areas to achieve healthcare for all individuals. First is to have equitable distribution of healthcare irrespective of ability to pay for services, second is having good quality of care at the point of services and third is to have financial protection in order to mitigate the risk of financial burden upon the individuals. To achieve these objectives, the healthcare system of the country should be equipped enough to deliver quality of care to its all people without incurring financial risks. UHC is indoctrinated in the Agenda 2030 of Sustainable developmental goals (SDGs). The third SDGs clearly talk about ensuring the well- being of people at all ages. Under its broad goal, it also discusses about achieving universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all (UNDP,2015). Many developing countries are progressing towards UHC as having good health indicators is one of the sign of the solid economic development. Health insurance is one of the approach towards health financing based upon risk pooling of resources by both employers and employees for social welfare privileges like healthcare. India is a developing country of 1.3 billion people which is going through an epidemiological shift in terms of disease pattern. There is a dual burden of communicable and non-communicable diseases at the same time.

Poor quality of healthcare in public healthcare system and higher expenditure on healthcare upon usage of private health services renders poor and low income groups into financial hardships and debts. With the government share of spending in healthcare to as low as 1.18 percent of GDP,

and burden of out of pocket expenditure (OOPE), to as big as 61 percent of total health expenditure, a large section of society is unable to utilize as per its needs (**National Health Accounts**, n.d.). Talking about health insurance, about 85.9 percent in rural and 80.9 percent in urban are not covered any health insurance scheme in India. (**NSSO, 2018**). The need for health financing becomes more imperative in scenarios where poorest of the poor have to spend more than their richer counterparts upon healthcare. In India, In order to cope up with it, a major stride is made towards it in 2018 with the launch of Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY) which aims at providing free at the point of service healthcare to most marginalized populations covering 500 million people in all government and private empanelled hospitals across country. The health insurance in India started with the Employee state insurance Act 1948 (ESI Act 1948) and implemented in 1952 as Employee State Insurance Scheme (ESIS) under statutory body of Employee State Corporation (ESIC) which functions under Ministry of Labour and Employment. It is considered both as first social security scheme and health insurance which started with 25000 employees in Delhi and Kanpur and now covers around 343.31 lakhs employees across the country (ESIS, 2018).

This government managed savings program gives insurance to formal sector workers and their families in the event of sickness, maternity, death and disability because of occupational mishap. The employer and his family are covered from the very first day of the employment. It also provides unemployment allowance under the Rajiv Gandhi Shramik Kalyan Yojana up to period of two years at the rate of 50 percent for first year and at the rate of 25% for the next year. The various medical benefits covered under ESIS are in patient and out-patient hospitalizations, free drugs and artificial aids, home check-ups, diagnostics, immunizations and other maternal and child (MCH) benefits. Till now there are around 343.31 lakh recipients under the plan and its coverage is increasing each year. Industries that use power and have at least 10 workers and 20 workers in case of non- power using factories attracting wages up to Rs.21000 a month are required to be enrolled under ESIC plot. The advantages given by the plan are supported by the contributions raised from secured workers and their managers at the fixed level of wages. The ESI Act is also applicable to the workers working in defined establishments like hotels, cinema halls, restaurants, road and transport. ESIS Act doesn't cover the workers in informal sectors and other state and central government employees who enjoy other benefits endowed upon them.

The vision 2022 of ESIC aims at covering whole India under its purview. Recently the ESIC has reduced its share of contribution for various benefits earlier from 6.5% to 4 %. Now share of contribution is 3.25 % by the employer and 0.75 % by the employee. The move was made to cover more establishments under the horizon of ESIC. However there are number of bottlenecks in the implementation of this massive scheme at ground levels. . The state governments also contribute 12.5% of the total expenditure (within the per capita ceiling of Rs.1000 per annum) reach beneficiaries as it intends to provide. In terms of healthcare, ESIS suffers from many issues from poor quality of healthcare to dissatisfaction for other benefits provided by ESIS. Many beneficiaries have claimed to be unaware about the scheme at first place itself (Garg, 2018).Awareness about the ESIS is very limited across different classes of workers as those belonging to rural areas and uneducated are least aware about the scheme. Except medical and incurred by the ESIC on medical care. Despite being the largest social security scheme, the benefits don't sickness benefits, they are unaware about the myriad benefits provided by ESIS (Gakhar and Kumar, 2012).

Problem Statement: By taking above mentioned problems into consideration we attempt to do this study to assess the utilization of different schemes provided by ESIC over the last decade so as to improve the uptake of healthcare services and other benefits across the beneficiaries.

II. Review of Literature:

An exhaustive research was done upon the annual reports, publications, and other websites. Grey literature was also researched to further research the unpublished literature done in context of ESI Scheme in the country.

- **Social Security and its need in developing countries:** Social security is consecrated as a part of universal declaration of human rights and many other conventions. According to International Labour Organisation (ILO), social health protection is a streak of mandates which protects individuals from social distress, and certain life risks. Lack of adequate resources, underfunded public health system, scarcity of manpower are considered main deterrents of the health sector growth which directly affect the utilization of healthcare services and in turn lead to poorer health outcomes in developing countries. Direct payments affect the poor and vulnerable people the most and pose threat to their economic status. Hence

to counter this social security in the form of health insurance becomes imperative. Risk pooling where both the government and different ventures like households, communities share the burden of expenses for healthcare is considered optimal resort in achieving the health equity and giant step towards the universal health coverage. Social security initiative automatically involves all the social groups under its umbrella which as a matter of course curtails the inequity. Many developed nations have made giant strides in this direction and have successfully mitigated the risk of economic burden for healthcare in their countries.

- **Health Insurance as a road to achieving health coverage:** The idea of healthcare financing isn't new and dates back to as old as 1940-50s when the two important health insurance schemes were introduced in the country as ESIS in 1952 and CGHS in 1954. Up till 2007-10, healthcare financing in India was focussed on supply side of healthcare under which it focussed on strengthening the healthcare infrastructure in the form of creating hospitals and various national programmes. Later on it was felt to establish the demand side by directing its focus upon health financing in the form of health insurance. A study conducted in Kerala showed the increased rate of in patient utilization of healthcare among insured people as compared to uninsured, however there was no effect on OOPe upon households as they continued to spend more resulting in distress financing (Philip et al., 2016). A study conducted upon 12,134 households in 8 Indian districts concluded that currently health insurance doesn't protect the households from incurring catastrophic expenditure, in fact this study yielded surprising result as people who were insured under the RSBY scheme had more CHE than other health insurances (Prinja et al., 2019). In a systematic review of impact of publicly financed health insurances, it was found that health insurance, though increase the utilization of hospitals but fail to diminish the risk of catastrophic expenditure as such (S et al., 2017).
- **Utilization of Employee State Insurance (ESI) Scheme in different Sectors:** Like other health insurances, ESIS also suffers from major drawbacks in terms of providing actual benefits. A study done in Tamil Nadu indicated that ESI has many flaws from poor quality of care to percolation of its benefits among rightful beneficiaries. Long waiting time, lack of remuneration of claims, lengthy paper work are many of the causes which deter people from using this insurance scheme (VR, 2011). Another study done in Kerala covering a period of 10 years from 1994- 2004 yielded similar findings. It inferred that ESI though keenly collects funds in its corporation but it doesn't care much about whether the beneficiaries are availing services from it or not (Hose, n.d.). A study done in Erode district, Tamil Nadu concluded

that lack of medicines in ESI dispensaries, misbehaviour of the staff are major concerns related to usage of ESI healthcare services. They suggested many reforms which can increase the uptake of utilization of ESI dispensaries and hospitals one of them being good co-ordination among the different stakeholders (**Parri and Renjithkumar, 2016**). However there are many studies which show that ESIS has an positive impact in terms of what it was intended for. An empirical study done for the state of Andhra Pradesh to evaluate the effectiveness to measure the ESI benefits and employers perception of both public and private sector. Based on the study inferred that majority of the respondents were aware about the ESI benefits under the ESI act 1948 and liability of the employer as per the provisions of the said act. Most of the workers are satisfied with the services of the ESI Corporation for effective implementation of the scheme benefits for all eligible labour working in their establishments and most of the workers are satisfied with the working mechanism of the ESI Corporation and effective delivery system of services. All the labourers know about the complaint redressal arrangement of ESIC and guarantee (**Chundi, 2015**). The study done in Rohtak, Haryana showed that majority of the beneficiaries (64 percent) were satisfied by the ESI scheme and were aware about the benefits entitled under the scheme. There was a significant effect on utilisation of healthcare services due to distances between workers residents and facility. Based on the understanding of factors important for better utilisation, it was concluded that there is still a need to increase OPD timings and 24 hours health facilities for complete care. Ultimately the ESI utilisation would increase if there is improvement in factors such as availability of physicians, medicines and good infrastructure (**Ramesh Kumar Verma, 2012**).

III. Methodology

The present study was designed to assess the Employees state insurance scheme in India. ESI annual reports have been used to know about the sources of income of the scheme and expenditure of the ESI scheme. Let us look into certain data provided by the annual reports of ESIC over the years and analyse the trends and patterns.

Sources of Data: - Annual Reports of ESIC from 2000-2018, journals and articles on ESIC, literary papers on the ESIC, was collected in tabular form for descriptive analysis.

Study period- The study covers a period of eighteen years from 2000 to 2018.

Data analysis- The collected data has been analysed by using Descriptive Statistics and CAGR

IV. Aim and Objectives:

Aim: This comprehensive review intends to know about the utilization of different social security schemes under ESIS in the past 20 years from 2000-2018. The overall aim is to assess the current utilization of ESIS in order to improve the uptake of its services by the beneficiaries at the receiving end in the future.

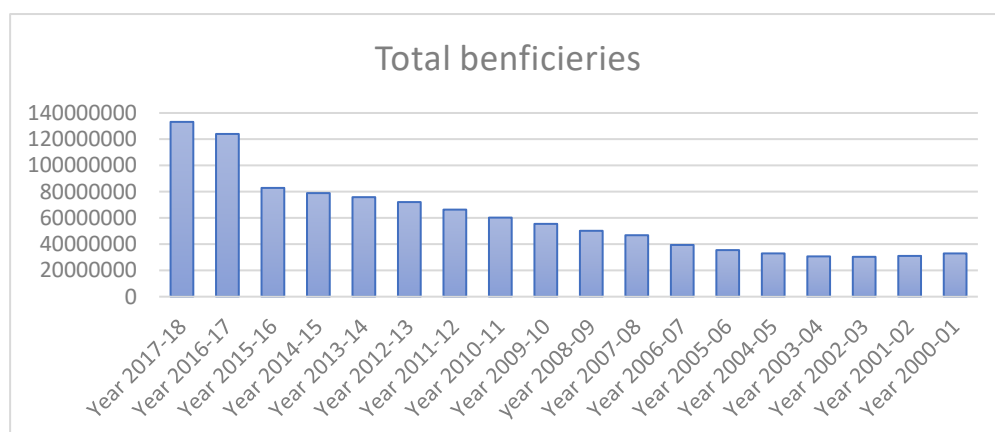
Objectives:

1. To assess the total beneficiaries and family units covered under ESIS over the last 20 years
2. To assess the utilization of medical services covered under ESIS.
3. To assess disease specific utilization of medical care over the 10 years period.
4. To study other benefits provided under the ESIS.
5. To assess the various gaps in the utilization of services provided under ESIC

V. Findings-

The present report showed that there is four times increase in total number beneficiaries since 2000 but over the time the number of IMPs and beds have gone down drastically, Though the coverage of beneficiaries is increasing each year due to inclusion of more establishments and workers but whether they are getting all the benefits as per the mandate remains questionable.

V(a) Coverage of ESI Scheme over the years: Over the years, the mandate of ESI scheme has increased significantly due to increase in the coverage of more formal establishments over the last 18 years. It has happened overtime in a phased manner which makes it one of the largest social protection scheme in India covering around 130 million beneficiaries under its umbrella in 2018 from 30 million in 2000, an increase of around 4 times. **(Figure 1)** Showing total number of beneficiaries from 2000-2018



V(b) Beds commissioned under ESIS: Total number of beds under different ESIC hospitals including empanelled hospitals and annexes have decreased from the years 2000-2018. The reason for it is not certain. The dip may be because of reduction in utilization of ESI services in the empanelled centres which led hospitals to reduce the number of ESI sanctioned beds.



Figure 2 shows the decrease in the total number of beds from 2000-2018..

V(c) Cash benefits : One of the major benefit apart from medical care is cash benefit payment during the time of economic distress in situations like sickness, disablement, confinement in insured women and dependent benefit (in case of death of employee).

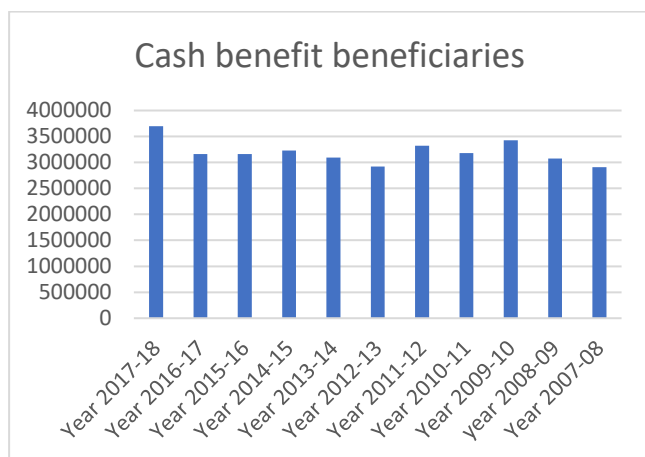


Figure 3 illustrates the cash benefit beneficiaries from 2008-18.

V(c).1 Sickness benefit beneficiaries: Over the years, the sickness benefit beneficiaries have also increased from 2008-2018.

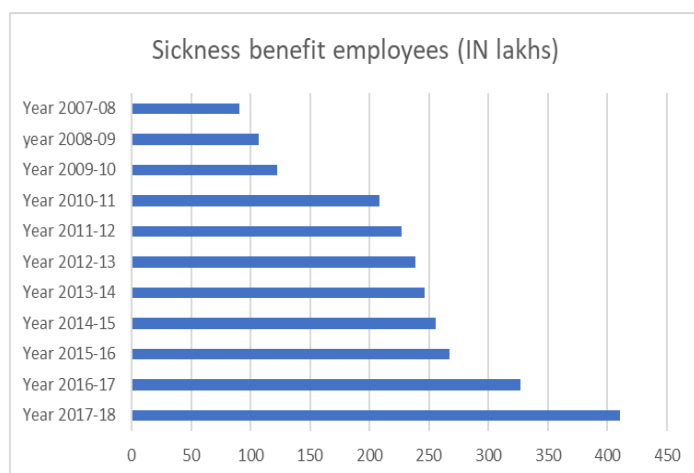


Figure 4 shows increase in the sickness beneficiaries from 2008-2018

V(c).2 Maternity claimants: All the insured females are entitled for maternity benefit during pregnancy and in cases of miscarriages. The average amount paid as average amount per women per claim for the year 2018 stands out as Rs.51946. It has been revised time to time over the years.

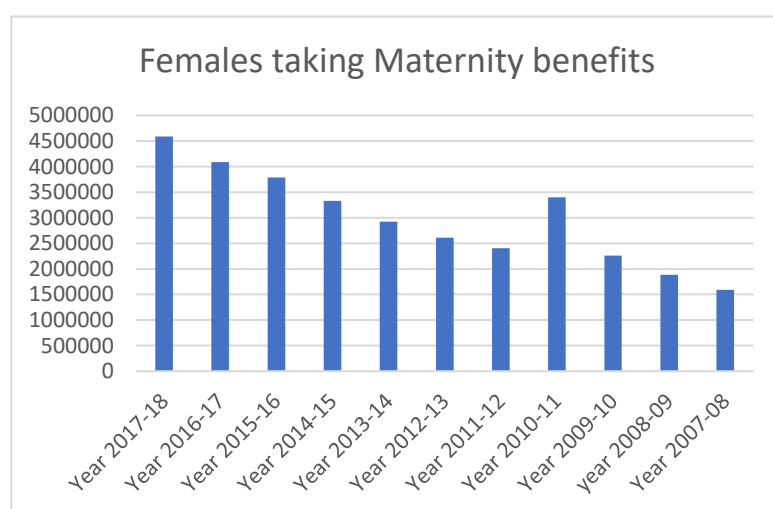


Figure 5 shows number of females availing maternity benefits

V(d).3 Temporary disablement beneficiaries: Around 90% of wages are paid to the employee in case of disablement as a part of occupational injury. The number of such beneficiaries have also increased over the period of time. (Figure 8). The rate of per day TDB has also increased over the period of time from Rs. 99.63 in 2008 to Rs. 307.36 in 2018. (Figure 9)

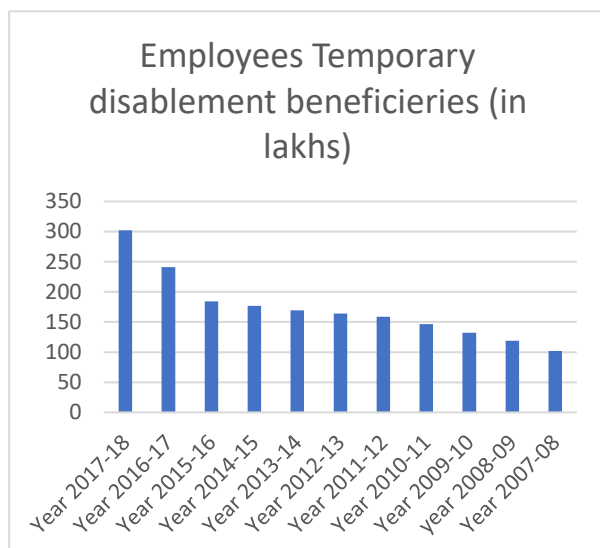


Figure 6. shows increment in number of temporary disablement beneficiaries.

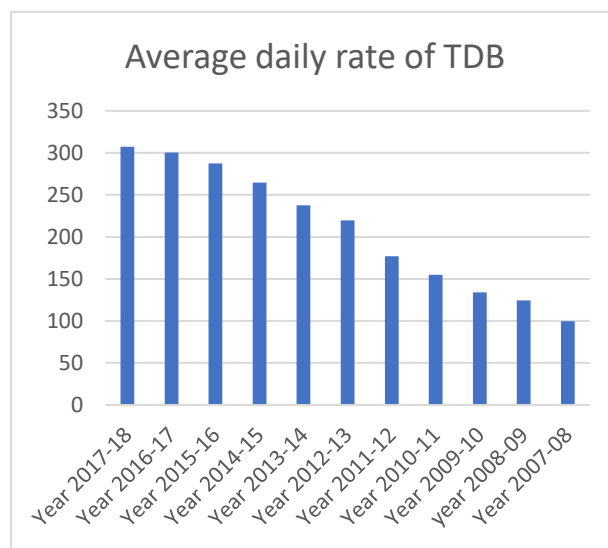


Figure 7. shows increment in average rate in TDB

V(c).4 Permanent payroll beneficiaries: Those sustaining permanent disablement are also entitled under ESIS benefit coverage. The number of claimants for PDB has also increased as the scheme has broadened its horizon.

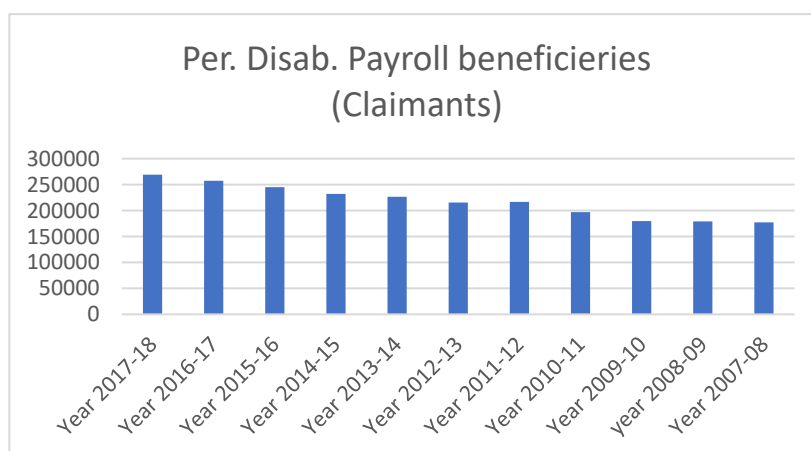


Figure 8 illustrates the increasing number of PDB (Claimants) from 2008-2018.

V(c).5 Dependent benefits:

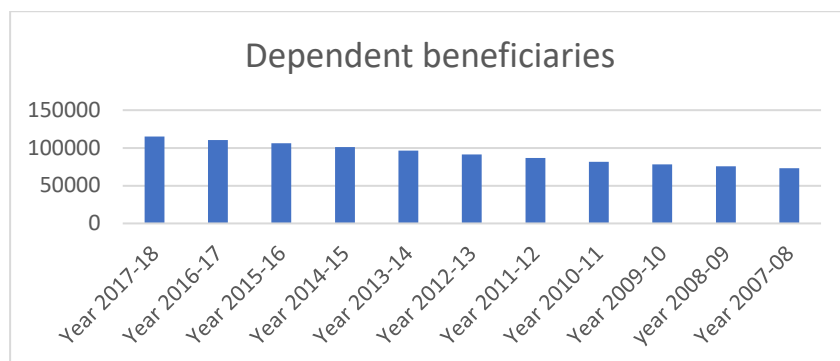


Figure 9 shows the number of dependent beneficiaries from 2008-2018.

V(c).6 Unemployment benefit: It is paid in the case if unemployment in case if any establishment closes or other.

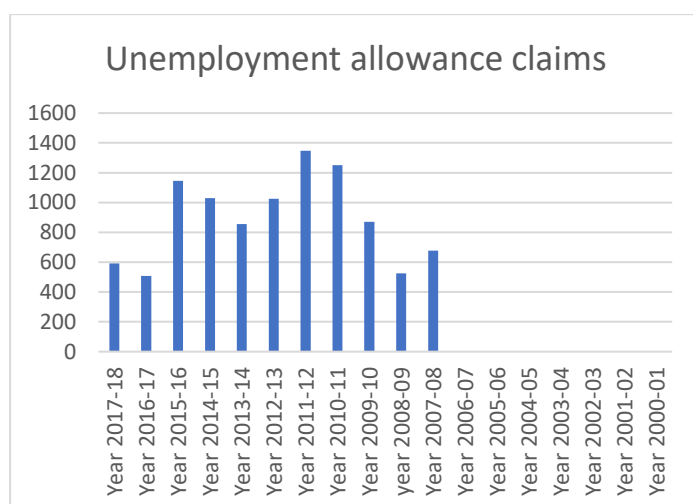


Figure 10 column chart shows the unemployment benefits from the year 2008-2018

V(d) Medical care utilization rate : In our report, we have calculated the medical utilization by dividing the number of insured persons exposed to the medical with the total number of insured persons. The medical utilization rate has remained almost consistent over the years. As on 2018, it stands at 0.96%.

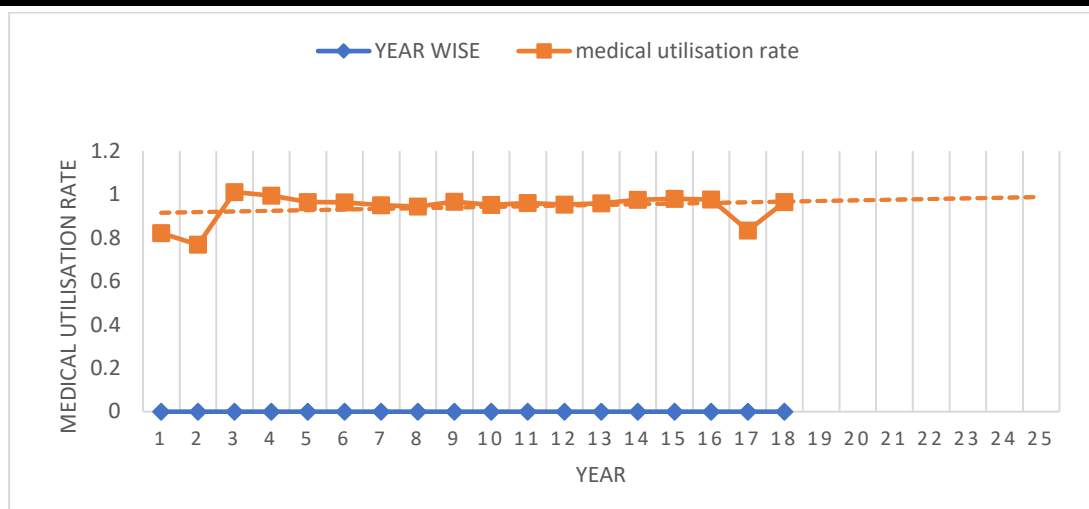


Figure 11 a line graph shows medical utilisation rate from the year 2000-2018.

V(e) Hospitalization utilization Rate : In present report, we have calculated the hospitalization rate by dividing the number of hospital admission cases with the the total number of insured persons. As shown in the figure,there has been sharp spile in the number of hospital admissions for the year 2016-17. For the year 2018, the hospital admission rate was 0.09%.

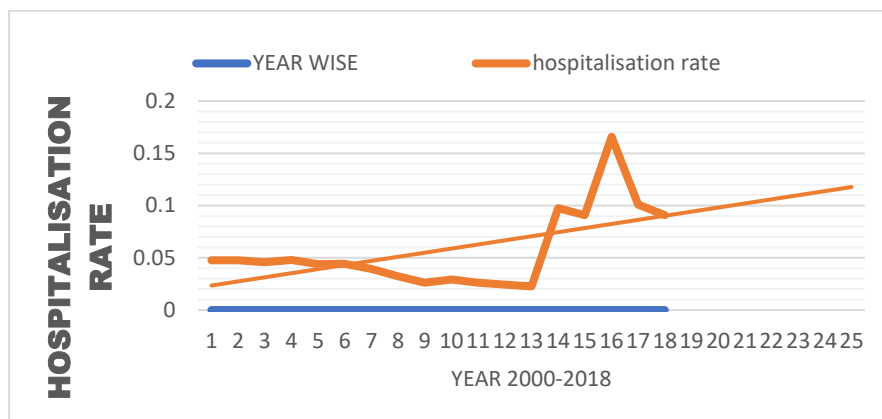


Figure 12 shows a line graph shows the hospitalisation rate from the year 2000-2018 with a linear trendline

V(g) Utilization in terms of specific diseases: Around 298 types of diseases are included for which ESI provides treatment under its purview. ESIS has broadened its disease coverage from 51 disease groups in 2008 to 298 disease groups. In the year 2018 and before that, highest burden of diseases for which care was availed was Acute Respiratory diseases followed by fever of unknown origin and then diabetes.

VI.Discussion

ESIC has been the largest social security scheme providing various benefits for the employees ensuring cash flow to household during sickness leave. Based on our study we have come to some observations

- It is observed that over the two decades there has been a growth in total number of beneficiaries from 30 million to 130 million indicating that employment is created in the organised sector and employers are giving benefits to their employees.
- Over the year there has been standard increase in dispensaries and diagnostic centres but there is a decline in IMPs and IMOs in ESIC hospitals.
- Total number of beds have been reduced from 26930 in the year 2000 to 21931. It may be due to decreased utilization of services which leads hospitals to reduce the number of ESI beds.
- The average amount per claim for maternity is revised every year from Rs. 13372 in the year 2000 to Rs. 51946 in 2018 which is a good sign for female beneficiaries.
- We have also calculated hospitalisation rate based on the number of admission every year and can observe a peak in hospitalisation in the year 2015-16 and 2016-17.
- Acute respiratory diseases leads in the disease specific medical care utilization.

VII.Recommendations:

- A rigorous imposition of the scheme is necessary. One of the major caveat is the lack of awareness about this scheme among its employees especially those who are uneducated.
- There are still exist gaps in ESIC administration, a social movement is required so that more and more employees and their families are benefited from this scheme.
- Since there are regular complaints about poor infrastructure of ESI dispensaries, an up gradation of all the facilities is need of an hour.
- Waiting queues in OPD, quality assurance of medicines and availability of medical doctors and staff should be looked upon by the corporation. Strengthening the liaisons between the public and private healthcare facilities for this scheme can help in increased utilization of medical benefits.
- Many studies revealed that various issues are faced by the insured person such as rude behaviour of the staff, poor availability of medicines, long waiting hours etc. There should be removal of cumbersome formalities at the centres and main focus should be on provision of quality care

VIII.Conclusion

As one of the largest social security scheme in India for organised sector, this scheme holds much potential for growth. As of now, under vision 2022, this scheme aims to cover whole country under its purview. However there have been many bottlenecks in terms of implementation of the scheme at the ground level. Poor quality of services, lack of awareness among many of its employees and lengthy procedure to procure other benefits deter people from utilizing this scheme effectively. Many ground breaking reforms are need of an hour. One satisfactory observation is it has covered more and more number of females over the years indicating that there is employment for the women in country and also encouragement of institutional deliveries by the family of insured female Due to availability of excess surplus funds, there can be a good scope to reform this scheme and also extend its benefit to unorganised sector which forms the major part of labour sector in India. Regular monitoring for quality check of hospitals can prove to help in up gradation of quality services in ESI hospitals. Awareness among the primary stakeholders for example beneficiaries will also increase the uptake of services.

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PART 2: Online Course Report

I. Name of the course:- Data analytics for lean six sigma

II. Course description :-

I chose this course because Lean six sigma provides analytic and process skills and I am very much inclined into analytical field. And these skills are relevant with leadership position in the organisation.

The background of this course is about data analytics techniques that are quitesentially useful within Lean Six Sigma refinement projects. It also teaches how to be able to analyse and Interpret data gathered within such a project. It emphasizes on use of data analytics tools and the interpretation of the outcome. The course consist of many real life problems to illustrate all tools. However data analytics tools are very widely applicable. The vast amounts of data a company collects can enhance Lean Six Sigma tools and techniques by allowing them to work faster. The ability to quickly analyse large data sets also improves the accuracy of outcomes. Data analytics can enhance Lean Six Sigma tools. Lean Six Sigma identifies areas where data analytics need to be used. Working together, the two can make organizations more competitive, effective and efficient. In this course the focus is less on theory and more on how to apply these influential tools to conduct projects in your business. Understanding proper Understanding proper data collection methods and using the proper analysis tool from the myriad of possibilities is emphasized.

- Website

<https://www.coursera.org/learn/data-analytics-for-lean-six-sigma>

III.Objectives

The objective of this course is to teach the importance of data, as required for process improvement in the organisation. It also emphasises on how the five phases about DMAIC process works- **define, measure, analyse, improve and control**. The goal of this process is to reduce errors, meet schedule deadlines and improve quality. It tells us about the importance of **CTQs**- CTQs is a property of a product or service that is relevant to our project objective, CTQ in lean six sigma is a metric that is needed to be changed for success of a project. For any analytical based research or problem solving selection of representative sample is very necessary. It enables us on how to use proper analysis tool for specific situation;-

Pareto charts, histograms, ANOVA, scatter plots, correlation and regression analysis.

To be able to differentiate between discrete and continuous data and how it affects our sample size calculations and analysis .Calculate confidence intervals based on process samples. To analyse 2 variables to know if they are related using various tools for data based testing of ideas and improvements.

IV.Course contents

Week 1 – Data and lean six sigma

- **Lean six sigma**- Introduction about Lean Six Sigma and the software Minitab which is used for data analytics. It is a methodology for process improvement, and it makes use of data and data analytics. Lean Six Sigma is a data-driven approach to process improvement.
- **DMAIC**- The acronym stands for:-
 1. Define 2. Measure 3. Analyse 4. Improve 5. ControlIt is a step wise procedure in Lean Six Sigma for process improvement. Someone leading the Lean Six Sigma project is called a Belt.
- **Selecting Critical to Quality Test (CTQ)**- in Lean Six Sigma, the CTQ is the metric which is used to change. It is often called Y-variable or dependent variable or outcome x variable.
- **Units and Measurement definition**- Units are things which we collect data on.Example - Objects, People. Units are always stored in the rows of the data set.
- **Sampling**- Collecting a representative sampling. Minitab software was used to make a random sample population.
- **Organizing data**- Data can be organized in a structured way using

Week 2- Understanding and visualising data

- **Numerical and categorical data**- Numerical data known as quantitative data has been divided into discrete and continuous. Categorical data known as qualitative has been divided into ordinal, nominal and binary data. Numerical data contains more information than categorical data.
- **Descriptive analysis**- Descriptive statistics are only available for numerical data. It summarizes features from a collection of information such as mean, median, range, standard deviation, variance, interquartile range etc.
- **Visualising numerical data**- The histogram and boxplot are the graphs for the numerical data. The histogram shows the variable and gives information about the data distribution. A box plot gives information about the spread in our data and outliers.
- **Visualising categorical data**- Pie chart, Bar chart and Tally table are used for visualizing categorical data. A pie chart shows us how often each category occurs. A bar chart also gives the same information, but it is easy to identify which category occurs most often. A Tally Table gives the exact numbers.
- **Pareto analysis**- It is a chart in which Pareto principle can be seen and it counts how often each cause on the x-axis occurs. It can be helpful to differentiate the major and minor causes of the problems.
- **Visualizing two variables**- The graph to visualize two variables depends on the type of data.

Week 3- using probability distribution

- **Population vs sampling**-The population is a collection of all units of interest, example; all customers of a company. The sample is a subset of population, example; all male customers of a company
- **Estimation and Confidence interval**- Estimates the unknown population parameters and uses confidence interval to quantify the uncertainty. Confidence Interval gives the boundaries where the population mean will lie in between with a certain level of confidence.
- **Probability distribution**- The normal distribution is the most often seen probability distribution while in Lean Six Sigma projects, both Weibull distribution and Lognormal distribution are also relevant.
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- **Probability plot**- It is a tool used to determine which distribution to be used for modelling the population. It can be used to spot data anomalies. Depends upon the data which lies on the straight line, it can be classified into good fit and poor fit.
- **Empirical CDF**- It is used in the analyse phase of the project and it is used to calculate percentages.
- **Properties of normal distribution**- It is symmetrical looks like a bell shaped. It is even called Gauss curve. The shape of the distribution is determined by the parameters location parameter (μ) and dispersion parameter (σ).

Week 4-Introduction to testing

- **Introduction to data analysis**- in the lean six sigma Sigma project, the main intention is to know whether CTQ is related to the influence factor or not. The suitable method depends on the type of data that is the CTQ and the influence factor is categorical or numerical variable.
- **Hypothesis testing**- This is done to find the effect between the variables. The null hypothesis and alternate hypothesis stated have to be checked in accordance with the If the P-value is smaller than 0.05, reject null hypothesis. If P-value is larger than
- **Causality**- It is about the cause & effect of relationships, example if x variable changes y variable also changes. So, the relationships should be interpreted judiciously in order to avoid mistakes.
- **Introduction to ANOVA**-- It stands for analysis of variance. It is used to study the relationships between numerical Y and categorical X variable. It consists of 2 steps, 1. Organize data, 2. ANOVA and 3. Residuals.
- **ANOVA analysis**— The hypothesis test using p-value is done to find the significant relationship between the variables. The R-square value assesses the relevancy of the influence factor.
- **ANOVA residual analysis**- This is done to validate the assumptions underlying ANOVA. To validate the assumptions, it must be checked that the residuals are normally distributed and there are any outliers or other irregularities present.
- **Kruskal-wallis test**- This is a non-parametric test used as an alternative to ANOVA when the assumptions are not met.
- **Two sample t-test**- This is used to analyse the difference between the means of two groups. The P-value obtained can be used to calculate whether the mean difference is coincidental or truly significant.

- **Test for equality of variance**- This is used to test the variability across groups as variation shows the consistency of the Variables. The hypothesis test shows the consistency of the variance.

Week 5- Testing; numerical X and numerical Y

- **Correlation**- It shows the strength of relationship between two numerical variables. It is always between the value - 1 and + 1 . A negative correlation shows that the variables are correlated in the opposite direction. Correlation of 0 means there is no relation between the variables.
- **Regression**- This is a statistical method to test whether two numerical variables are related or not by calculating the best fitting line. Regression analysis is about finding the values of a and b from the formula $y = a + BX$. Regression analysis consists of 4 steps which are, 1. Make a fitted line plot to visualize the data, 2. Perform main Regression analysis, 3. Perform residual analysis, 4. Calculating the prediction interval.
- **Regression analysis**- The hypothesis shows the significant relation and the R square shows the strength of the relationship.
- **Regression residual analysis**-- If the residuals are normally distributed and shows no outliers or irregularities then the assumptions can be proved. If not, then the quadratic regression model can be used.
- **Regression prediction interval**- This can be used to determine the level of influence factor, which ensures a certain CTQ performance.
- **Quadratic equation**- This is used when the linear regression analysis is not meeting the assumption. A curved line fits to the data instead of a straight line.
- **Chi-square analysis**-- It is used to find the relation between a categorical Y and categorical X variables. This has two steps, 1. Cross tabulation of data, 2. Chi-square analysis and p-value. The p-value shows the significance of relationship between the variables.
- **Logistic regression**- It is used to find the relation between a categorical Y and categorical X variables. This has two steps, 1. Cross tabulation of data, 2. Chi-square analysis and p-value. The p-value shows the significance of relationship between the variables.

III. Methodology

Recorded video lectures were used to teach the concepts of this course. Course instructor was Ms. Inez Zwetsloot, University of Amsterdam. After weekly module a graded quiz was arranged to evaluate our knowledge. A software named Minitab was introduced which was used throughout the videos for data analytics. It was not mandatory to use the package. It was a 5 week course explaining about various frameworks of lean six sigma. Since I opted for audit option hence I was not able to access the assignments and certificate.

IV. Key learnings

- The CTQ is the most important attribute for the customer satisfaction and requirements.
- It teaches us the importance of delivering what customer wants without fail
- It teaches us process capability as to what our process can deliver to the customer
- Variation:- what the customer sees and feels, customer satisfaction
- Stable operations ensuring consistent, predictable processes to improve what the customer sees and feels
- Design for six sigma:- designing to meet customer needs and process_capability

*My Biggest learning from this course:- Through this course now I can easily co-relate and understand my day to day problems. I can do justice to organisational problems through lean six sigma with a sound knowledge of data and its analysis.