Special Issue on
Health Analytics in Public Health

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Special Issue
on
Health Analytics in Public Health

Foreword

Administrative Staff College of India (ASCI) Hyderabad, India organized a workshop titled "Analytics in Public Health" in September 2018 under the aegis of a ASCI cell that is funded by the Bill and Melinda Gates Foundation. The ASCI cell works in tandem with the State Governments to track the progress of state vis-à-vis various critical indicators relevant to the state and also described in Sustainable Development Goals (SDGs).

Globally, there is currently more information generated in a single day than we could possible absorb in an entire lifetime. Data Analytics in Health Management as a part of Health Care System relies on data, to identify the needs for care, to measure the care provided and to help deliver the right care to the right people. Population Health Management Systems as a specific example deal with the inventory in terms of gathering of data from multiple sources, and transforming this data into a usable format. Then applying analytics to the data – metrics, reports, trends, graphs, work lists becomes crucial. Data Analytics in Population Health Population Health Management relies on data. Population Health Management (PHM) systems are the hottest item in health IT at the moment. Considering these factors the ASCI workshop stressed the importance of health analytics in facilitating better governance and service delivery. The workshop stressed presentations and discussion on the following general themes:

- Health Insurance
- Policy implications in health
- Technology intervention for health analytics

These general themes identify that the health care and health care policy are expected to provide wellness by promoting health, preventing disease, and addressing health inequities. The expected outcomes of the deliberations included advocacy to decrease health disparities, leadership strategies to impact safety, cost, and clinical outcomes and executing educational approaches to improve clinical decision making and evidence-based practice. Predictive analytics is identified here as the buzzword and will continue to rise. In other words, with the willpower for clinical intervention, the predictor benefit ican be fully utilized as the studies have demonstrated. The corresponding term prescriptive analytics, is considered to include evidence, recommendations and actions for each predicted category or outcome. After the workshop few authors submitted papers based on the

deliberations in the workshop. This special issue consist of these papers after peer review addressing specifically the following subthemes/topics:

- Health policies in India
- Health Insurance
- Health Surveillance and Recording system
- Health informatics
- Determinants of mortality rate
- IoT and cloud based analytics
- Women SHG and health care
- Air pollution and respiratory diseases
- Students stress
- Noise pollution

Considering the developments in Health sectors like insurance, health data recording, health informatics and envison mental management, the special issue present compilation and state of art review of the health policy in India.

With more electronic data available for analysis, and a growing need for the data to support population-based care, there is definite need to consider the state of the art of the technology for possible incorporation in the national health policy and prepare the public and the markets ready for a new generation of Health Management Systems. and managing the care for the population. This is the time to lay the data and analytics foundations and to make the appropriate national policies. Good health to all.

Dr Valli Manickam
Dr Nirmalya Bagchi
Dr Iyyanki V Muralikrishna

ASCI Journal of Management 47 (2) Spl: 1–25

Dr. K. Venkateswara Rao*

Health Policies in India - An Analytical Review

Abstract

Health Policies and the planning process for implementing them in the country so far have tended to be piecemeal, disjointed, expressed in different forms of rhetoric and formats. A little less than 100 committees were appointed to give shape to these, most of which at least in the initial stages tended to cater to the needs of communicable diseases like small pox, malaria, filariasis, trachoma, cholera etc. Unipurpose workers and the supervisory structure there for were created for considerably long time.. No conscious effort was made to lay a viable structure to cater to the basic primary health care needs. The unipurpose workers were so ingrained in the programme they were appointed for and failed not only to deliver comprehensive, cooperative community care but also played a spoil sport to the to multipurpose workers who joined later transmitting their legacy. Few voluntary organizations demonstrated the need for integrated approaches which were only copied recently of late. The various five year plans also toed the same line and made poor allocations for integrated health care.

INTRODUCTION

So far three National Health Policies were formulated in the years 1983, 2002 and in 2017. Almost all top level health planners have been obstetricians, orthopaedicians, general physicians and the like and not public health specialists with experience.

National Health policy 1983 stated:

Phased time bound programme of comprehensive primary health care services linked with extension and health education approach; Medical, physical and social rehabilitation of mentally retarded, deaf etc, Increased role for voluntary organizations; Reorienting existing health personnel; Phasing out of private practice by govt. doctors; Special programmes for improving MCH services; Organised school health services; Occupational health services to reduce morbidity, disability and

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mortality; Health education programmes backed by communication strategies; A nation wide set up for procuring health information ;Increased production of essential life saving drugs and equipment; Uniform health legislation; Fundamental and basic research for blindness, leprosy and TB; Inter sectoral coordination between heath, FW, medical education and research, drugs agriculture, food, water supply, drainage, housing education, social welfare, rural development etc

National Health Policy of 2002 while reiterating some of the policies laid down earlier made the following points:

- Achieve acceptable standard of good health; Improve the access to the decentralised public health system; Emphasis on prevention and primary health care importance to TB, Malaria, Blindness, HIV/AIDS; Promotion of rational use of drugs.

National Health Policy of 2017: The documents started by accepting that**: "the reality is straightforward. The power of existing interventions is not matched by the power of the health systems to deliver them to those in greatest need, in a comprehensive way and on an adequate scale"**

It has a preamble: 13 years after the last NHP the context has changed in four major ways:

1. Health priorities are changing with focus on MDGs : MMR, IMR and U5MR, burden of CDs and NCDs
2. Emergence of robust health care industry growing at 15% CAGR. It is twice the rate of growth in all services and thrice the rate in national economic growth rate
3. Rising health care costs which is becoming a cause for poverty
4. The economic growth has increased the fiscal capacity available

Apart from these the political will ensure health assurance by providing universal access to health care.

The primary aim of NHP is to inform, clarify a strengthen and prioritise the role of the government in shaping health systems in all dimensions.

Goals of 2017 policy:

The attainment of the highest possible level of good health and well being through a preventive and promotive health care orientation in all developmental policies and universal access to good quality health care services without anyone having to face financial hardship as a consequence.

1. Professionalism, integrity and ethics : Health care workers and managers to perform with highest level of professionalism, integrity and trust which is to be supported by the system and regulatory environment.

2. Equity: prioritising the needs of most vulnerable by greater investment in access and financial protection. Minimise disparity on account of gender, poverty, caste, disability and other forms of social exclusion and geographic barriers.

3. Affordability : Health care costs of households exceeding 10% of its total monthly consumption or 40% of its non food expenditure is designated as catastrophic health expenditures. Impoverishments due to health care is unacceptable.

4. Universality

5. Patient centered quality care

6. Accountability:Performance and financial accountability, transparency in decision making, elimination of corruption in health care both in public and private domain.

7. Inclusive partnerships:

   All activities cannot be carried out by government. Participations by communities, academic institutions, not for profit agencies and with commercial private sector and other partners in health care industry.

8. Access to AYUSH care when patients desire. These systems will have government support. Research in models of integrative practice, documentation and validation of traditional practices

9. Decentralisation

10. Dynamism and adaptiveness :

    - Constant improvements in the system which is knowledge and evidence based, learning from the communities they serve and from knowledge of national and international partners

    - Improve health status through concerted policy action in all sectors and expand preventive, promotive, curative, palliative and rehabilitative services by the public health sector

    - Achieve significant reduction in out of pocket expenditure on health and reduce proportion of households getting impoverished

    - Universal availability of free and comprehensive Primary Health Care for all aspects of reproductive, maternal, child and adolescent health and for most prevalent communicable and non communicable diseases

- Enable universal access to free essential drugs, diagnostics, emergency ambulance services, emergency medical and surgical care services in public health facilities
- Ensure improved access and affordability of secondary and tertiary care services through a combinational of public hospitals and strategic purchasing of services from the private health sector
- Influence the growth of the private health industry and medical technologies to ensure alignment with public health goals and enable contribution to making health care systems more effective, efficient, rational, safe, affordable and ethical

The policy gave the following directions:

A. Ensuring adequate investment:
   i. Public Health expenditure to be raised to 2.5% of the GDP. 36 to 40% to come from central government Works out to Rs.3800 / capita
   ii. Source of money: general tax; proposed health cess; CSR funding

B. Preventive and promotive health:
   i. Inter sectoral action for ' Health in All' as a complement to HFA.- Food and nutrition; educations, W.S and E.S, housing, employment, industry and occupational, welfare, social protections, communications, tribal affairs, and community services
   ii. Preventive and promotive approaches is also an economic gain.
   iii. Improvement of social and economic environment
   iv. Strengthening village Health, sanitation and nutrition committees
   v. Improve E.S through: Swach Bharat Abhiyan; balanced and healthy diet through anganwadis and school meals; addressing tobacco, alcohol and substance abuse (Nisha Mukthi Abhiyan); Yatri suraksha; Nirbhaya Nari; Reduction of stress at work place and promoting safety; reduction of indoor and outdoor air pollution
   vi. Swasth Nagri Abhiyan for promoting health in all
   vii. Evidence based advocacy in Media and govt. by developing suitable indicators
   viii. Promotion of school health and incorporating Health Education
   ix. Greater emphasis on occupational health by Yoga and proper linkages at work place

x. Strengthening comprehensive health care approaches by strengthening ASHA

xi. Involvement of panchayats, local bodies, professional bodies and CSR mechanisms

xii. Setting up of 7 task forces for formulation of detailed strategies and for setting up the indicators.

A policy shift:

Taken under financed interventions to on scale assured interventions to reach urban poor. 17% of our pop live in urban slums; Integration of national health programmes with health system;From standard care in AYUSH to three dimensional mainstreaming. Supporting and validating practices in AYUSH and self care.; Family Health Card to be linked to a Primary Health Care facility; Support of telemedicine; I ncentives to support achievements; Effective referral support

The following health programmes were suggested for improvements/ starting:

- Child and adolescent health
- Interventions to reduce malnutrition of mothers
- Universal immunisation
- Communicable disease control: TB, Lep; vector borne disease
- NCDs
- Mental health
- Population Stabilisation
- Health of Women
- Supportive supervision
- Emergency care and disaster management
- Mainstreaming AYUSH: Community based AYUSH interventions for preventive and promotive care
- Enable AYUSH doctors to perform National Program functions. Integration of AYUSH system with allopathic system
- Establishment of central drugs controller for AYUSH drugs
- Improve medical education
- Attract and retain doctors and specialists
- Improve middle level management

- Improve nursing educations
- Improve performance of ASHAs and PMWs
- Establish and strengthen public health management
- Leadership development
- Collaboration with NGOs and private sector
- Capacity building and skill development
- Improve mental health
- Improve HIS
- Food safety and drug requirements
- Improve vaccine quality and supply
- Attention to Legal parameters

For secondary health care services the following were suggested:

Strengthening of district Hospitals by linkages with CHC and sub divisional hospitals; Purchasing private care; Strengthening private sector by collaborative and financial and man power arrangements; Development of skilled specialists in both sectors; Reorient public Hospitals to provide universal access to free drugs and diagnostics; Close the HR and Skill gap; Add beds and staff in secondary hospitals

For improvement of tertiary care: Establishment of Medical colleges in each district; Those established to be strengthened; Establishing six more AIIMS in addition to existing Nine; Find and train faculties by involving the private sector were suggested

For improvement of human resources the actions suggested were:

Planned and systematic increase of HR; Find right person for right job; Attraction and retention of specialists; Strengthen nurses through good governance; Preferential selection in ANM course for ASHAs; Establish a nursing school in each district hospital; Expansion of allied health professionals; Creation of a public health management cadre like in TN.

For raising financial resources the document suggested:

- Tax based funding as of now to cover 70% population
- Raising resources through health cess and CSR funding
- Expenditure monitoring

A regulatory frame work was suggested to facilitate implementation of policies:

- Strengthening Clinical establishment Act of 2011
- Accreditation of clinical establishments
- Regulatory frame work for Medical Education
- Strengthen public health lab for food safety
- Quality control of drugs
- Promotion of quality clinical drugs for validations. Ensuring vaccine safety by quality control
- Improving access to life saving drugs and devices
- Improve quality of public procurement and distribution on TN and Rajasthan model
- Regulate pricing of drugs and devices

For efficient decision making the document suggested strengthening of ICT

- E-health
- Integrate Health Information System (H.I.S.)
- Increase access to information
- Provide tools to public health providers
- Support the providers
- IT enabled supply chain management
- Monitoring , Planning and governance

For improving knowledge of health providers and administrators:

- Research on country specific health problems
- Strengthen 32 public funded health research institutes under dept. of Health Research
- Strengthen 15 apex public health institutes
- To generate data for evidence based decision making
- Medical product innovation through innovations
- Grant in aid to extra mural funding
- Build data base of researches and researchers

For improving governance and stewardship the following were suggested:

- 36% of all health expenditure is central
- Equity sensitive resource allocation
- Strengthening institutional mechanisms for decision making
- Better co ordination between technical and bureaucratic wings
- Strengthening and streamlining state health societies
- Increase the role of panchayat raj institutions
- Improve accountability by involving local bodies and local communities for monitoring
- Professionalise management practices

Finally the document suggested a better enforcements on the legal front by:

- Mental health bill
- M.T. P. Act
- Food Safety Act
- Drugs, cosmetics and magic remedies Act
- Clinical establishments Act
- Consumer protection Act
- Public Health Act
- Formulation of a national health rights Act to ensure health as a fundamental right

For improving health care the following targets were set:

- Life expectancy : 70
- TFR : down to 2.1
- U5MR : down to 23
- MMR : 100
- IMR : 28
- NMR : 16
- SBR : single digit
- HIV : reduce by 90%
- Eliminate leprosy, kala azar and lymphatic filariasis

- Cure rate of new sp +ve cases: more than 85%
- Reduce deaths due to CVDs, cancer, diabetes, COPD by 25%
- Increase utilisation of PH facilities by 50%
- AN coverage above 90%
- Skilled attention at delivery: 97%
- Immunisations: 90%
- Hypertension and diabetes : 80%
- Reduce prevalence of stunting
- Increase access to safe water to all
- Reduce deaths due to occupational and accident injuries
- Health expenditure to 2.5% of total expenditure
- State spending to increase more than 8% of their budgets
- ReduEnsure availability of Medical and paramedical personnel
- Increase CHVs
- Establish SHCs, PHCs and secondary care centres
- Establish registries for diseases
- Establish national wide health information network
- Ensure 2 beds per 1000 pop
- reduce catastrophic expenditure on health
- Ensure availability of Medical and paramedical personnel
- Increase CHVs
- Establish SHCs, PHCs and secondary care centres
- Establish registries for diseases
- Establish national wide health information network
- Ensure 2 beds per 1000 pop

Urban health care:

- Check air pollution
- Improve solid waste management
- Improve water quality
- Ensure occupational safety and prevent road accidents

- Improve housing
- Vector control
- Reduction in deaths due to violence and stress

SITUATIONAL ANALYSIS

Let us now examine the current status of health care services in the country

- MMR - 178 expected to touch 141
- U5MR – 52
- IMR - 40
- Rate of decline of still births and NMR are lower than the child mortality
- There are urban – rural inequalities
- Sex ratio: 933 F/1000 M
- Age: 27% below 14 yrs; 64% between 15 and 59; and 5% above 60
- BR: 20.4; DR: 6.4: GR: 14/1000
- Life expectancy : 65.3
- IMR : 34/1000 LBs
- TFR : 2.7
- Rabies : 97
- JE : 2180
- Acute encephalitis : 13030
- Meningococcal meningitis : 3251
- Influenza : 38811
- Neonatal tetanus : 295
- Diphtheria : 5290
- Non neo natal tetanus : 4702
- Viral meningitis : 7559; New infective leprosy cases and cases with deformities are being reported; Some blocks have greater incidence of Kala Azar and lymphatic filariasis;21 Lakh people are living with HIV.

Non Communicable diseases:

- Diabetes : 8.41%
- Hypertension : 10.22%
- CVS disorders : 0.37%

- Cancers : 0.11%
- Accidents : 4.1%
- Disability : 26814994
- Snake bite deaths : 1,42366
- 68.7% received three AN check ups
- 31% of women took the full course of IFA tabs.
- 61% of children fully immunized

On the nutritional front the following summarises the scenario:

Condition	Prevalence %
Low birth weight	22
Kwashiorkor/Marasmus	<1
Bitot's sports	0.8-1.0
Iron deficiency anaemia (6-59 months)	70.0
Underweight (weight for age) (<5 years)	42.6
Stunting (height for age) (<5 years)	48.0
Wasting (weight for height)	20.0
Overweight / obesity	6.3

56.1% ever married women aged 15-49 are anaemic.

- Infant Mortality Rate is 50/1000 live births for the country with a low of 12 for Kerala and a high of 67 for Madhya Pradesh.
- Maternal Mortality Rate is 212 for the country with a low of 81 for Kerala and a high of 359 for UP and Uttaranchal
- A national AYUSH mission has been launched. Integrated care expected
- Two thirds of the population lack access to essential drugs.
- 80% health care expenditure born by patients and their families as out-of - pocket payment (fee for service and drugs)- Courtesy: Christy Solomon
- There is Poor attention to social determinants of health
- Communicable diseases contribute to 24.4% of disease burden.
- NCDs and injuries contribute to 50% of disease burden

- Urban health care is still neglected
- 18% of all households are facing impoverishment due to health expenditures
- The insurance schemes have resulted in fragmentation of funds available
- Private health care industry has reached 280 Billion $. Private sector provides 80% of OP and 60% of IP care

INDIA'S SHARE IN GLOBAL HEALTH PROBLEMS:

- India has 2.5% of world's land and 17% of world population. But it accounts for:
- 17% of total deaths in the world
- 23% of all child deaths
- 26% of vaccine preventable diseases among children
- 20% of maternal deaths
- 68% of leprosy cases
- Harbors 30% of all TB cases
- 10% of HIV positives of the world
- Is becoming the diabetic capital of the world

The following are some of the determining factors for the current scenario:

- Demographic profile of population
- Geographic and climatic and environmental influences
- Political
- Socio – cultural
- Economic
- Organizational
- Administrative
- Technical
- Manpower
- Community
- Availability, accessibility, approachability, affordability and accountability of health services
- Specialist vis a vis medical managers at the middle level

Health infrastructure required as per current norms laid down

- SHCs : 314547
- PHCs : 50591
- CHCs : 12648
- SDHs : 4561
- Dt. HQ hospitals : 642
- MCHs : 502

Human resources for health as per current norms laid down

- Physicians : 816629
- Dentists : 104603
- General nurse midwives : 1073638
- ANMs and & H.W : 190919
- LHV : 52375
- Pharmacists : 656101
- V.H.Gs : 3.23 lakhs

SHORTFALL IN RURAL PERSON POWER

	Required	Current levels	Short fall	Percent Increase required
MPW's (F)	244716	190919	53797	28.2
Health Workers (M)	244716	57439	187277	326.0
Health Supervisor (F)	40786	18168	22618	124.0
Health Assistants (M)	40786	16083	24703	153.5
Doctors PHC	81572	23982	57590	240.0
Specialists at CHC	61000	5789	55211	953.7
Radiographers	12235	3910	8325	213.0
Pharmacists - PHC's and CHC's	65000	26579	38421	144.5
Lab Technicians - PHC's and CHC's	65000	26579	38421	144.5

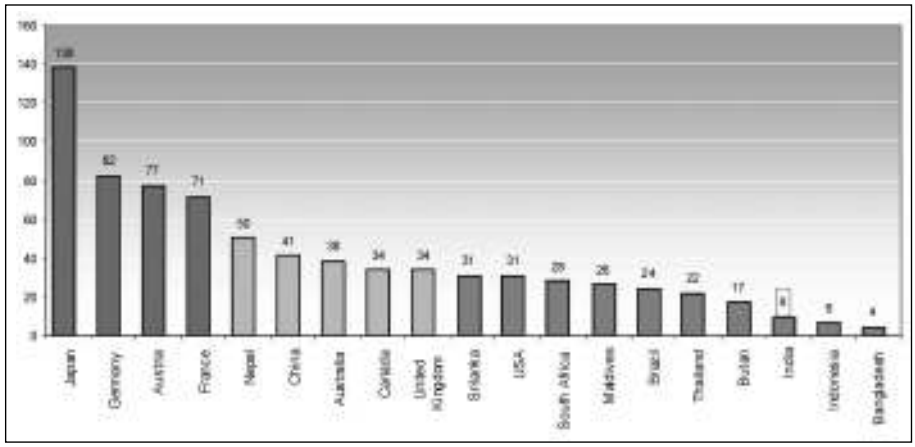
- At present there is no clear policy for human resource development and deployment in the public health system
- No policy on promotional opportunities
- Disconnected education and training to suit public health needs
- There is an all round shortage of work force
- All countries faced or are facing health work force shortages
- The overall shortages are aggravated by skewed distribution
- Rural / urban
- Public / Private: within private: Profit/non profit
- Migration to non health sectors
- Inability to attract and retain good work force
- Competition from the private sector which has raised expectations for governments to respond
- To day there is no clear system of projecting the future supply of human resources in the absence of established norms in the country
- Health is a State subject but the medical education is in the Union list
- Medical and paramedical education not commensurate with our societal requirements
- Lack of good quality teachers with social orientation
- State governments are unable to invest in the infrastructure required for a good medical college
- "The private public partnerships improve access of public to private services without necessarily strengthening public health services"
- Poor quality of work force due to organisational and personal constraints

Reasons for poor quality in work force:

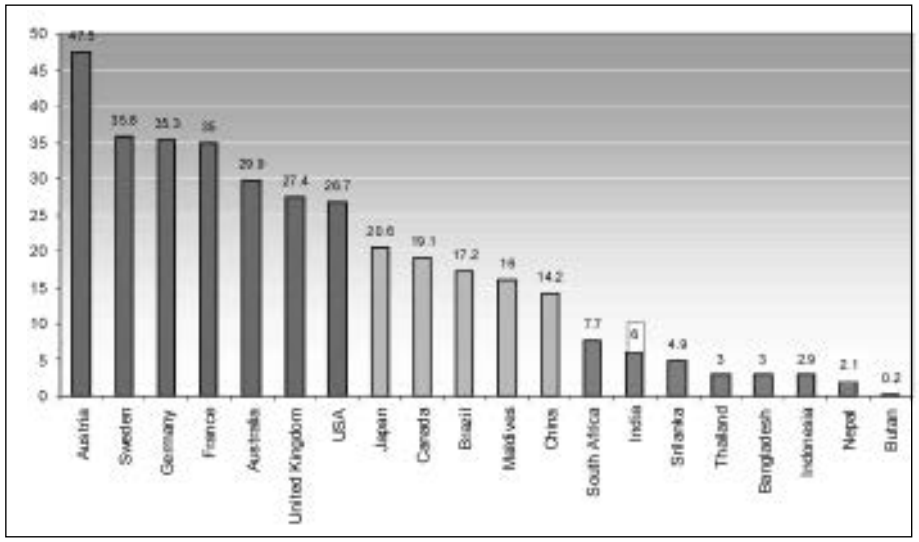
Insufficient money; Inadequate pre and in-service training; Work overload; Lack of growth opportunities; Poor work environment; Lack of safety; Unionisation; Household pressures.

INTERNATIONAL COMPARISONS: let us now draw comparisons in some areas with the rest of the world.

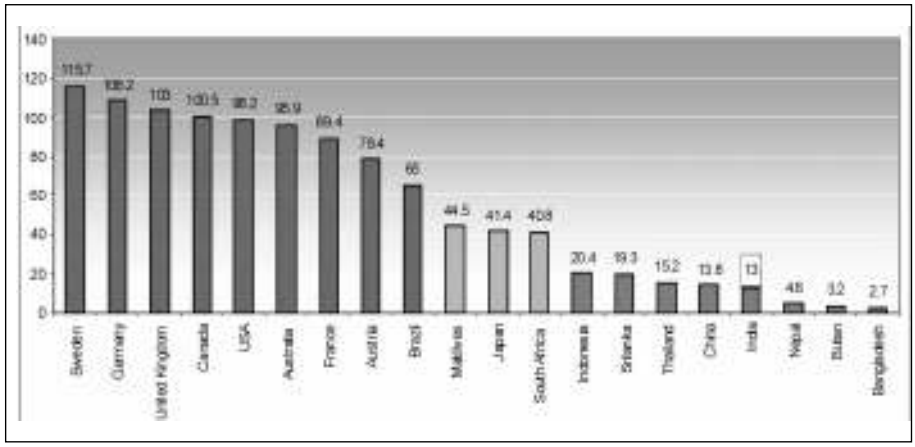
Hospital Beds / 10,000 Population



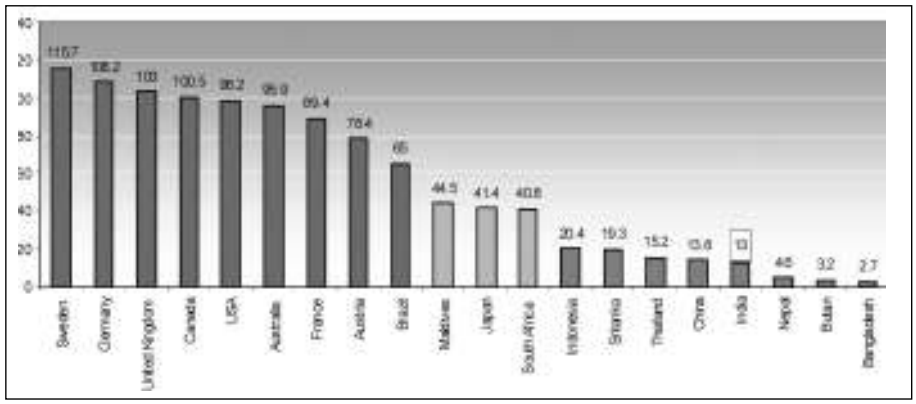
Physicians / 10,000 Population



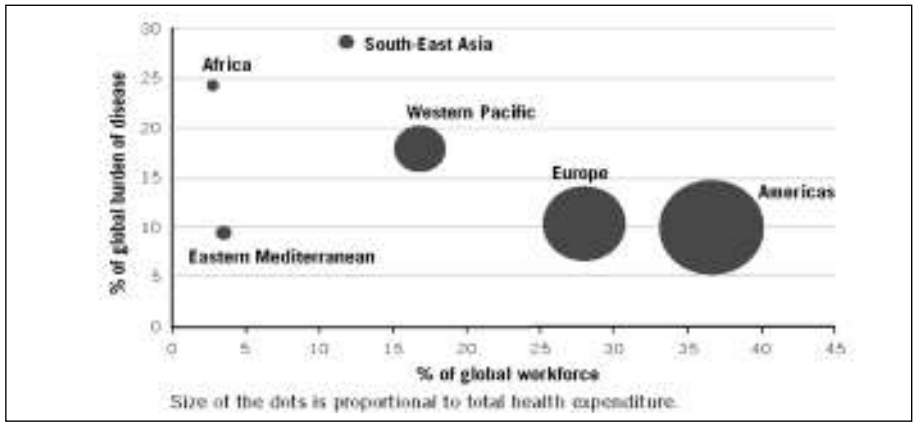
Nursing and Midwifery Personnel / 10,000 POP



Nursing and Midwifery Personnel / 10,000 POP



Distribution of health workers by level of health expenditure and burden of disease, WHO regions



- "There is still a long way to go before we attain the ideal norm of one doctor per minimum of 1,000 population (though times of India report of 2nd September says 6 states have achieved it), and 3 nurses/ANMs per doctor. Existing institutions in the country are inadequate to meet the present needs as per the norms advocated by various expert committees, as well as WHO global norms"- High Level Expert Group Report on Universal Health Coverage for India
- Medical colleges are not responsible to the health system though they are caused by it – there is no social accountability of the medical education
- Bureaucratic environment
- Existing standards and curricula have inadequate community and rural orientation
- The syllabus is skewed towards teaching rare diseases to the relative exclusion of diseases prevalent in our country
- The posting in community health department during the study as well as during internship is not uniform. The position is worse in private medical colleges with no earmarked and permanent field practice area. Team work and management concepts are absent
- Postings are given in specialties and super specialties during the SPMs quota of three months during internship to the exclusion of hands on community health experience

The subject of SPM as a career preference is poor due to several reasons such as:

- Detail of Public Health Engineering topics like water supply, sanitation and entomology etc in the syllabus;
- Lack of teachers who have fair knowledge of social sciences
- Poor teacher motivation resulting in poor motivation of students
- Without the benefit of strong motivation and aptitude in the formative years, doctors are not favourably disposed to work in rural areas
- Jobs in community health by and large are non lucrative
- There is no political patronage when compared to clinical disciplines
- While Primary and secondary care in the system is weak, publicly funded tertiary care is even more scarce and ill equipped
- The growth of medical colleges has been predominantly in the private sector and confined to a few states
- Present medical education does not prepare the graduate to function effectively in areas of need

- Educational institutions for health care are expanding
- Most have little orientation to rural service
- Teaching standards are varied
- Less than1% of P.H. expenditure for research

Issues in Nursing and Paramedical education:

- Issues are by and large same
- Non adherence to student teacher norms
- Poor Quality of education
- Inadequate infrastructure
- Insufficient budget
- Lack of commitment and accountability of educators
- Lack of adequate exposure to practical training is the current policy change in rural medical education – doctors for rural areas the answer? Has their use effectiveness been scientifically and socially studied? What if they raise revolt to get regularized as MBBS later especially in the light of what happened to GCIM?
- Can a mere increase in the financial allocations for the health sector result in tangible benefits to the community and consequently result in better health status?
- Is the current scenario due to financial dependency, (even though roughly 27% of the resources only come from the centre) on the grants or aid from the centre?

SOME ISSUES NEEDING DELIBERATIONS:

- "Currently there is a mix of central regulation and financial support with a small local self regulation", though health is a state subject
- 'Like any other country India tries to adjust to the economic, political and social demands of the moment'
- Rising costs of care and public outcry for better services are the motivations for reforms
- Lack of wisdom and foresight in the planning process
- Planning tends to be a fire fighting exercise than a problem solving one
- The planning processes in our country visualise one solution for the whole country although requirements of each state may be different

- Poor resources for health
- Inherited legacy to visualise every health activity as a water tight compartment and dealt with vertically
- Lack of standardised protocols to promote quality care
- Lack of Accountability

WHAT DO WE MEAN BY UNIVERSALISATION ?

Now a days the catch word spoken often is "Universalisation of health care"

- Services available to each citizen at times of need?
- Services accessible?
- Services approachable?
- Services affordable?
- Services made accountable?
- All or some of the above?
- Ensuring an agreed level of health status to one and all? If yes what is that level – how to define it – based on episodes of illness –felt needs or identified needs? Who will define it? Are those levels going to be constant?
- Ensure that with improved health status every one contributes to human capital formation?

How much time will it take to Universalise?

- It has taken 71 years since planning process began to attain between 40 to 50% levels of coverage
- At this rate it may take an equal number of years to cover the rest
- May be consequent to the technological boom there will be much rapid progress than hitherto
- By which time population would probably have doubled and there is likely be an unmet gap probably of the same order
- Universalisation is not a one time the all and end all process. It is a continuous process as there are not many constants eg., health status which is variable
- If health is a state subject then why no single state government is having a state health policy in which planning for manpower requirements and resource deployment can be state specific
- Are the doctors at fault for not serving in the rural areas or is it the system which is taking them away from those areas

- Why only doctors alone are made accountable while the system which produced them is at fault – wrong value orientation
- Can more of the same approach solve the problems identified in man power planning and deployment of resources
- Will attrition of the old timers who have been recruited from individual disease programmes into multi purpose work result in a new era of committed workers for integrated work?
- Use effectiveness of professional managers at different levels both in urban and rural areas has to be studied
- Should there be a single uniform model for health care delivery in the entire country?
- Lack of standardised protocols to promote quality care
- To day the management of health care system and the reforms there for are rather poor at various levels. There is an all round lack of accountability.

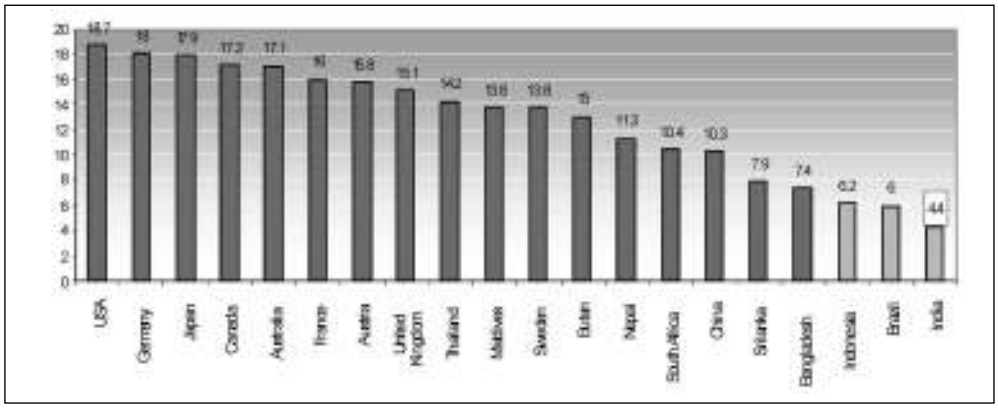
EQUITY – RURAL / URBAN

- In Location of Secondary and tertiary care institutions
- Distribution of medical man power
- In allocation of resources: e.g.,
- Health expenditure in Maharashtra State: 80% of per capita expenditure in three cities: 61.74; 12.17; 6.09-Mumbai; Pune; Nagpur respectively; District towns 6.2% Other Misc. centres 9.3%; Villages: 0.13 Rs. : 4.5%

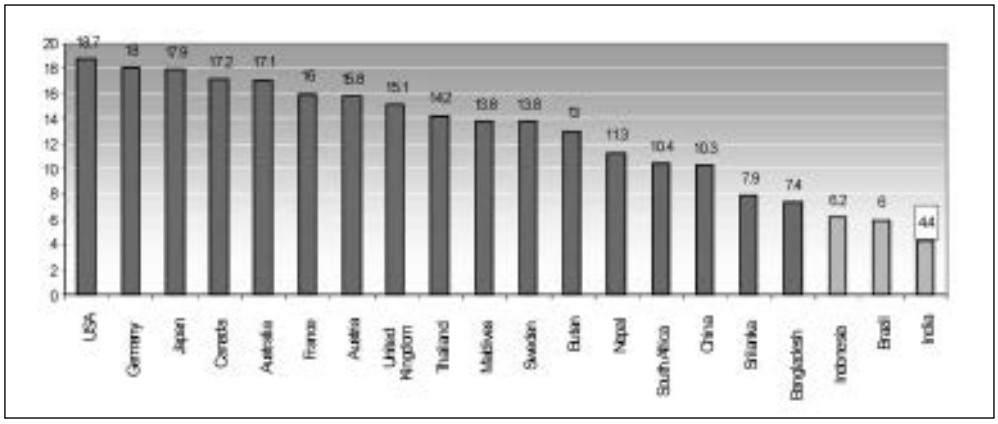
HEALTH FINANCING AND ITS INTERNATIONAL COMPARISON

- As one of the fastest growing economies in the world, we cannot afford to rank 171 out of 175 amongst countries surveyed by the WHO in terms of percentage of GDP spent in public sector on healthcare.
- In the same survey, India ranks 17th in terms of private sector spending on health which now contributes 4.3 per cent of the GDP spent on healthcare in the country.
- Amongst the BRIC countries India ranks the lowest with a 5.2 per cent of the GDP spent on healthcare while Brazil spends 7.6 per cent, Russia 6.1 per cent and China 5.4 per cent.
- Health, far from being accepted as a basic right of the people, is now being shaped into a saleable commodity - **courtesy: Christy Solomon**

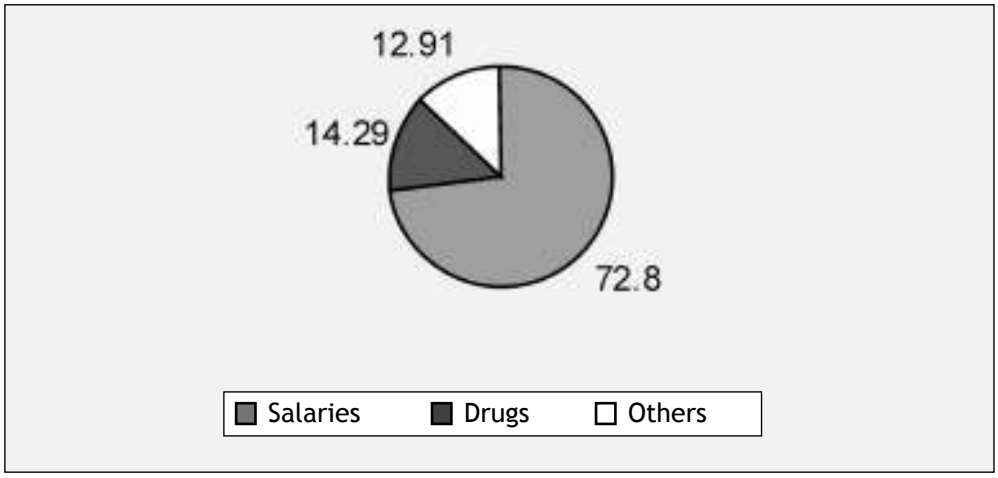
General Government Expenditure on Health as a % of Total Government Expenditure



Per Capita Government Expenditure on Health in US $



Break-up of Health Rupee in Tamil Nadu



Sharing of Public Spending on Health in Tamil Nadu

STEWARDSHIP AND MANAGEMENT:

THERE IS AN URGENT NEED TO ADDRESS THE HEALTH CULTURE which is a curious mix of:

- Health seeking behaviour
- Health providing behaviour
- Health administering behaviour

OTHER ISSUES:

- Health care on an area concept not on occupational concept
- No need for the Major referral hospital to manage minor ailments which constitute about 94% of morbidity – to avoid wastage of time of man power and resources
- Building up of a referral system
- To simultaneously build up awareness levels in the community and strengthen the empowerment processes
- We need innovations that address the issue of cost and appropriateness
- Methods of incorporating and up scaling the innovations already made into the public system will have to be an immediate priority
- We have to pay attention to all round improvements in the health culture which is a curious mix of health seeking; health providing and health administering behaviours. This has singularly been missing in the planning process

IMMEDIATE ACTIONS ARE REQUIRED FOR:

- Public health specialists to be at the helm for health planning and administration in the country. They must be highly paid to compensate for the loss of private practice and the thankless, monotonous, lustreless jobs
- Strengthening the managerial capacity at different levels
- Management reforms to improve efficiency, effectiveness and accountability
- State specific human resource management policy e.g, The Tamil Nadu model of a separate public health cadre
- Establishment or more managerial institutions for giving hands on experience in management
- Utilisation of the professional managers in various levels to enable medically qualified personnel to concentrate on the patient care and education

There is an urgent need

- To produce more work force of all descriptions
- To improve quality of current and future training
- To rationally deploy the staff
- To reorient the existing massive establishment to bring them on par with new workforce charged and ingrained in social responsibilities by the time the new cohort takes over
- To further redeploy after every one comes on board
- Develop man power through appropriate policies with a futuristic perspective
- Integration of medical colleges with the health system will require a reorientation of medical training to suit the requirements of our communities
- Curriculum planning process and faculty development need to emphasise the principle of building this social accountability matrix into medical education
- Convergence of all national health programmes under the umbrella of NRHM is being attempted and is to be speeded up
- Promoting awareness and empowerment among people is to be a top priority
- An accountability matrix is being thought of in the current plan, even though a state like Tamil Nadu has shown the way. It should be taken up in right earnest
  - Responsibility for MCH; water – sanitation at block and habitation levels
  - Monitoring and evaluation by civil society organisations
  - Real time data collection

- Community based validation of data
- Maternal death audit
- Medical audit
- Audit of health care service delivery

FOOD FOR THOUGHT

- Can promotive, preventive, curative, and rehabilitative health be declared as a fundamental right especially in a milieu where complete health is vaguely defined and understood and whatever is understood is ever changing on a sliding scale?
- How much the improvements in health standards are really due to increase in man power and physical infrastructure and the planning process there for?
- What percentage of improvements are due to rise in living standards in a time dimension?
- Ravi Duggal says: "The solution for satisfying the health needs of the people does not lie in the health policies and plans but it is a question of structural changes in the political economy that can facilitate implementation of progressive health policies".

"Any expectation of a significant improvement in the quality of health services, and the consequential improved health status of the citizenry, would depend not only on increased financial and material inputs, but also on a more empathetic and committed attitude in the service providers, whether in the private or public sectors" – Ministry of health and family welfare – health policy 2002

"Successive administrative and political reforms have conveniently bypassed training citizens and local bodies to actively participate in healthcare. In a situation where people are not enabled to identify poor quality, speak up and debate. There is dire need for the health system to fill that role on behalf of the people and can be easily done by decentralisation of healthcare governance"- public domain material from Library of Cross Country Studies

Before I end let me reiterate the famous "cycle of negative cumulative causation" of Gunnar Myrdal propounded in his book "The Asian Drama", where each of the components in the negative cycle adds its own weight and problems and passes the "baton" down to the next one. There is an urgent need to convert this cycle into a "virtuous" one where every component contributes to lessen the burden of the one coming next. Let us hope that this will happen sooner than later.

CYCLE OF NEGATIVE CUMULATIVE CAUSATION
(Gunnar Myrdal-The Asian Drama)

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Enrico M. Staderini*

Health Surveillance and Recording System (HSARS)

Abstract

Telemedicine concept started as soon as wireless communications were in- vented, so it has been around since one century or so. Nevertheless, the doctors as well as the medical informatics community are still arguing and discussing about the possible benefits, uses, implementations and deploying of telemedicine systems. In this short paper a brief history of medicine is presented along with motivations for its very late, if any, adoption. A revolution in health care providing is required for it taking benefits from telemedicine services. After doctor and patient needs identification, the HSARS concept is described[1].

INTRODUCTION

Telemedicine has a long history. The April 1924 issue of the magazine "Radio News" is credited to propose the very first intuition of the telemedicine concept the article "The Radio Doctor – Maybe?". One year later, in 1925 Hugo Gernsback's magazine "Science and Invention" published the proposal for the "Teledactyl" as a future instrument by which it would have been possible for the doctors to "feel at a distance" thus enabling for a physician to remotely visit a patient. Interesting enough to note that at the time the system was presumed to be commercialized within 50 years (by the way Mr. Gernsback died in 1967).

As of today the old and pioneering "Radio Doctor" has been realized as any PACS system in our radiology departments at the hospital and the "Teledactyl" has been now developed as the well known "Da Vinci" surgical robot.

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[1] A full presentation of this work has been given to "uHealthcare2017 New Vision for Bi-omedical Engineering" https://www.uhealth2017.com", Seoul National University Hospital, Seoul, Korea Dec. 5 to 7, 2017, under the title: "A User-friendly Turnkey Infrastructure for Setting up World-wide, Personalized, Peer-to-peer Telemedicine Services".

According to WHO (World Health Organization) telemedicine is "The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities".

Nice and comprehensive definition but why is telemedicine still a fascinating promise and not a common tool?

Fig. 1 The visionary "Radio Doctor" on April 1924 Radio News magazine compared to a modern PACS (Picture Archiving and Communication System) telemedicine system.

Fig. 2 The visionary "Teledactyl" on 1925 Gernsback's Science and Inventions magazine compared to the modern "Da Vinci" surgical robot.

So telemedicine has been around since many decades now, but why is telemedicine still a fascinating promise with only a few sound implementations and not a common everyday tool for the doctors? How much time does telemedicine need to be world-wide adopted? Indeed, the speed of adoption of new technologies has been dramatically increasing in the last decades.

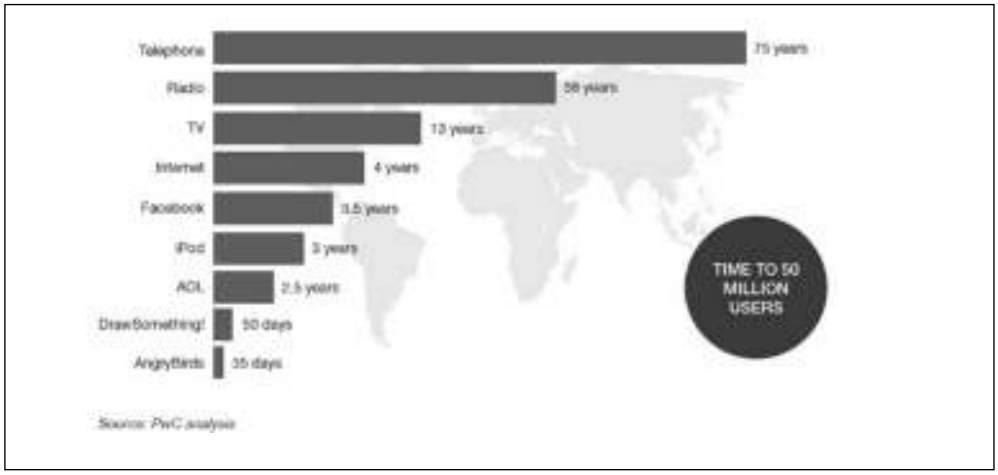

Fig. 3 Approximate time for technologies reaching 50 million users.

2 Lot of research in the telemedicine field ended-up Skypeing

As a former employee at the NST (the Norwegian National Center for Telemedicine in the far northern city of Tromsø, now Norwegian Centre for E-health Research) I was quite touched by an article appeared on Computerworld magazine (Norwegian edition) in September 2012.

The article considered four factors affecting the spread of large-scale use of telemedicine.

Degree of complexity (levels and parties collaborating), Organization, Technology Maturity and, more importantly. A strategic and structural context: in that health-care systems stakeholders should put telemedicine into their strategic plans

As a matter of fact, many questions are put forward when proposing a telemedicine service: Has telemedicine yet to prove its value? Is telemedicine really reducing health-care costs? Has a robust business model been developed for telemedicine medical practice? Is telemedicine really ameliorating health-care outcomes? Is telemedicine really necessary on a Health Technology Assessment basis? Are privacy issues cleared? Is telemedicine compatible with current medical practice so to be practiced concurrently? Is telemedicine maybe a sort of "complementary" medicine? Do doctors need a particular new skill to use telemedicine? Are patients comfortable in being remotely cared for?

Maybe all the previous factors are still hampering the use of telemedicine practice, but while I was balancing all these points, I was struck by the July 17, 2017 first page of the London "Daily Mail" newspaper. The full page title read "CALL 999… GET SKYPE INSTEAD".

INSIDE: £15 HOLIDAYS PULLOUT

Daily Mail

Whistleblower reveals how NHS avoids sending ambulances

CALL 999... GET SKYPE INSTEAD

EXCLUSIVE

By Sophie Borland Health Editor

PATIENTS who dial 999 are being assessed over Skype instead of being sent an ambulance, it has emerged.

Trials are under way across England to see if video consultations on smartphone apps could replace ambulances for thousands of 'lower priority' calls.

They are being used on patients whose conditions aren't deemed immediately life-threatening, such as back pain, abdominal pain, falls or heavy bleeding.

Details of the Skype and FaceTime trials were revealed by former South Central Ambulance Service emergency call handler Karen Frederick, who says patients are being failed because the service is so overwhelmed.

The whistleblower revealed a string of controversial practices being used to cope with rising number of 999 calls. They include:

- A 'no send' policy whereby patients are refused ambulances if their lives aren't thought to be in immediate danger;
- Operators being allowed to take high-priority calls while drunk or high on drugs;
- Call handlers being banned from giving out medical advice to heart attack patients because they don't have time;
- Taxis being used to ferry patients to hospital if ambulance crews are too busy;
- Elderly patients who have fallen being made to wait nine hours for an ambulance as they are repeatedly bumped down the queue.

Just last week the NHS said heart attack

Turn to Page 4

Fig. 4 This was really shocking! So, what about privacy, quality of service, human computer interface, doctor and patient friendliness, telemedicine outcomes, and other issues we have been studying and discussing for years?

After many years of research, lot of money, prototypes, pilot centres, test projects... when in need… eventually… of a reliable telemedicine system… wasn't there anything better than Skype to be used? Really? By the way in most Countries Skype emergency calling is forbidden but in a few Countries like Australia, Denmark, Finland and UK (as of December 2012).

Thus telemedicine ended up using Skype! What it is shocking is: UK NHS (United Kingdom National Health System) operators (end users) were clearly struggling in urgent need of a better organization of their service and they were looking for an IT solution. NHS operators had no support from the telemedicine guys and were somewhat obliged to choose a "do-it-yourself" solution as Skype© (by the way I do not personally endorse Skype©). Where did we telemedicine guys go wrong?

3. The main problem is a methodological one

Bioengineers and medical informatics people often operate in one of two ways: they get from doctors the specifications for their inventions or they are looking at doctors for creating new inventions. Both methods have important drawbacks:

doctors don't know how technology might be exploited at best and engineers don't know what is really important for doctors.

We have not evolved so much from Mr. Gernsback's concept. Mr. Gernsback noted the manoeuvres of the doctor on the patient and he thought that a virtual replica would have had the same effect. Many telemedicine colleagues and bioengineers think the same as of today. Wrong!

For telemedicine being a revolution in medicine, we need to revolutionize medicine. Well, medicine IS a science, nevertheless: Most medical concepts are well defined only in descriptive terms

- problems arise with differences in various medical schools and medical approaches most medical concepts are not correctly measurable because of
- lack of proper instrumentation
- too high uncertainty/error in the measure
- too high inter-sample and inter-subject variability
- no units of measure available
- impossible numerical comparisons a complete philosophical formulation of medicine is still missing or what has been provided so far is not used a "theory of medicine" and a "theory of the practice of medicine" have not yet gained widespread acceptance
- Dr. Kazem Sadegh-Zadeh's work "Handbook of analytic philosophy of medicine" is a largely ignored, very important milestone
- theory of diagnosis
- what is the meaning of care

So, what about telemedicine?

Telemedicine is all about automatic transfer of information which implies information structuring for preserving meaning and for avoiding errors. Without a robust "theory of medicine" and a robust "theory of the practice of medicine" medical information structuring is impossible and telemedicine losses its very basic foundations.

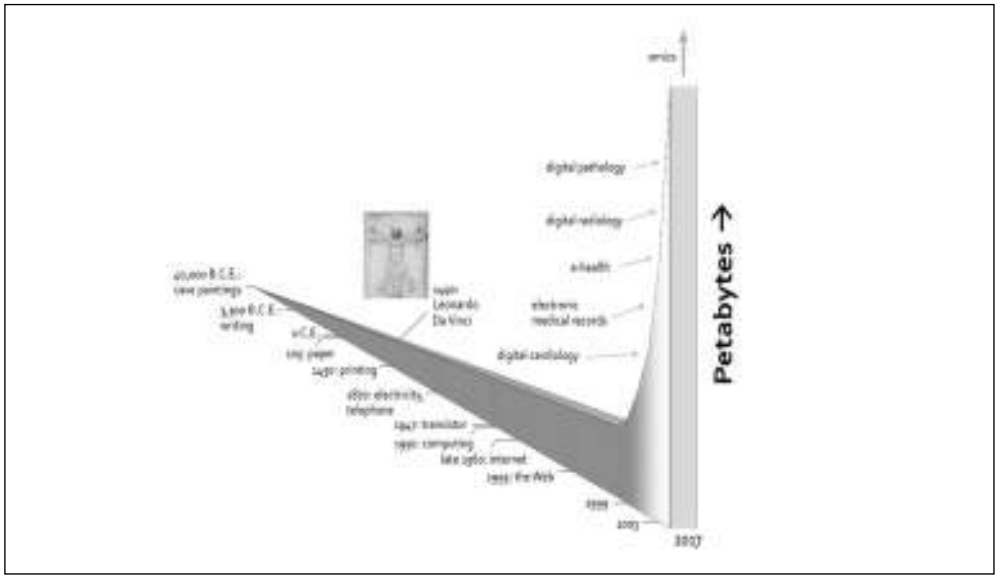

Fig. 5 Information as- sociated to every single human being is skyrocketing.

We got more data over the past 3 years than previous 40,000 years combined.

So why telemedicine is still at port? A few motivations may be that the structuring of medicine and of the remote practice of medicine is (unfortunately) not yet the most important issue in the medical schools. Indeed, any structuring of medicine is very difficult from the philosophical point of view and the structuring of the practice of medicine is often frowned upon by doctors who are not keen to see their work surveyed by pears.

What should we learn from the 999-Skype case? The first point is that users are more prone to adopt "off-the-shelf" solutions (even not directly created for telemedicine application), low-cost or free solutions, simple to use and simple to install and further more they are comfortable with very widespread applications. We should learn from this.

4. The Health Surveillance and Recording System (HSARS)

HSARS is a system intended for the continuous recording of health data, automatically or manually, from subjects and/or their local caregivers and to store in real time this information into a repository from which the data can subsequently be shared, on demand or on predefined warning thresholds levels, with registered nurses and doctors, remotely located, to help determine the best course of care for a given subject.

Its concept comes from civil aviation where the ACARS (Aircraft Communication Addressing and Reporting System) continuously transmits aircraft and flight data to ground stations implementing a sort of remote black box.

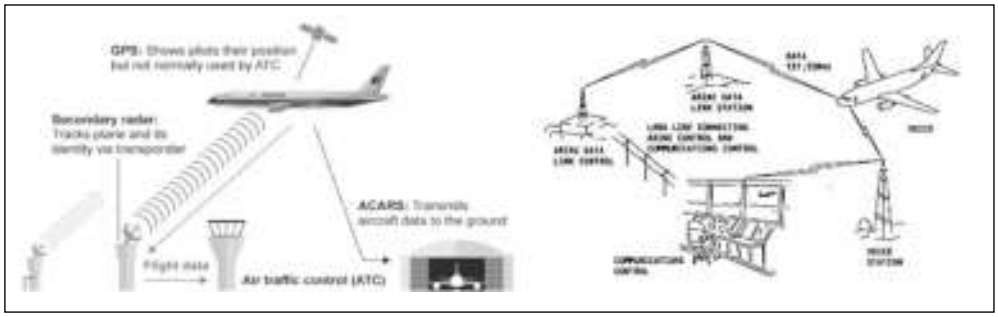

Fig. 6 Civil Aviation ACARS operation.

ACARS was unfortunately very much known to the general public because of the so called "AF447 tragedy". The Airbus A330 Air France flight AF447 from Rio de Janeiro to Paris crashed into the Atlantic Ocean on July 1st, 2009. Before the various flight recorders had been recovered months after the tragedy, explaining the origin of the disaster, the only possible clues about the cause of it were the ACARS messages automatically transmitted by the troubled aircraft, to the Paris based airline headquarters, up to seconds before the crash.

Likely, the HSARS system is a medical IoT application resembling the ACARS applied to a human being instead to an aircraft. According to a popular definition, the Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

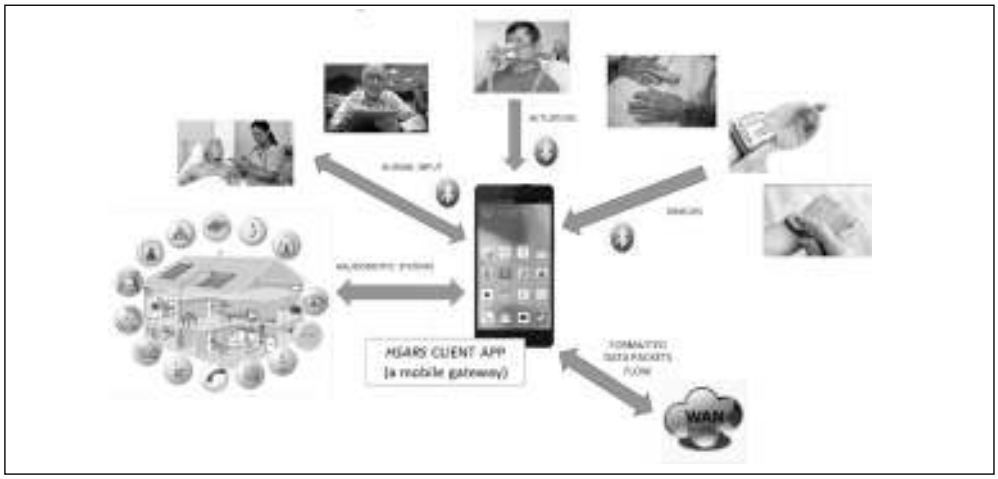

Fig. 7 HSARS is an ACARS for humans using IoT.

In a preliminary application of HSARS a constellation of wearable sensors is continuously sending biomedical data to a mobile phone using low power Bluetooth connection. Subsequently the mobile phone, with a proper App, sends data to the doctor server computer in the doctor premises.

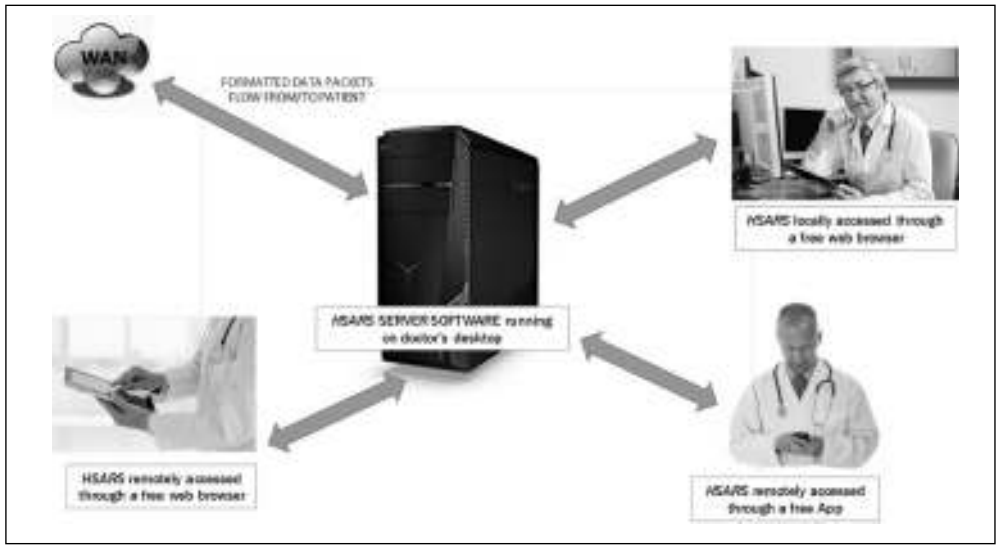

Fig. 8 HSARS data stored at doctor's server and retrieved at his will.

HSARS is implementing a sort of virtual black-box for recording subject's data along with data coming from the environment and, as such, it also creates a new Active Assisted Living (AAL) infrastructure. HSARS is essentially a diagnostic aid system: the medical data from the subject are continuously recorded through IoT for being analysed off line or remotely.

The main idea at the base of HSARS is that through a better history recording of patient data, a more precise diagnosis can be done and, more importantly, a better prognosis and care can be given.

HSARS features and applications:

- early detection of signs, findings and symptoms of high diagnostic value
- predictive maintenance of human beings, predictive health care
- no missing of any potentially useful diagnostic data
- remote follow-up of post-surgery people
- remote and continuous follow-up of people with chronic diseases conditions (most likely candidates for high costs medical care)
- increase the efficiency of the work of doctors and caregivers
- optimize the needs for medical consumables and drug delivery
- decrease the number of working hours lost by family members
- assuring more QALYs (Quality Adjusted Life Years) to the elderly and other critically ill subjects

HSARS has the potentialities for becoming a global telemedicine service. Unlike the totality of telemedicine systems developed worldwide so far, HSARS is not targeting any specific medical issue or disease. HSARS will stand as a global telemedicine framework through which many different applications and telemedicine services will be delivered even by third parties. In a few words, at the lowest level, HSARS system will only worldwide manage the communities of patients gravitating around each doctor or medical personnel or health care premise. Each particular telemedicine application might be easily customized by the end user via an intuitive user-interface. Until now telemedicine applications were delivered as very specialized, closed, proprietary and expensive software programs: this business model highly hampered diffusion of telemedicine services to the point that telemedicine is still at the starting blocks of future health care. HSARS will be an open system which will be delivered free of charge via a simple downloading from the HSARS company website. Both the doctor software and the patient smartphone App will be distributed free of charge. Implementing a telemedicine service will become as simple as in- stalling Skype© on one's own computer.

The impact of such a service on India health care is better understood with the words of Dr. Mahboob Khan now a freelancer healthcare consultant and former General manager quality and operations at Virinchi Hospitals, Hyderabad Area, India:

> "*The Internet of Things (loT) is set to revolutionize the health care industry. With loT it is possible to connecting smart gadgets and wearable devices to the technology infrastructure of hospitals or doctor's offices, which would enable a kind of predictive maintenance for humans, or predictive health care. Devices strapped onto or even embedded in patients can feed a continuous stream of data that can alert healthcare professionals to an impending heart attack, stroke or other potential incident. This ability to monitor a patient 24/7/365 provides an unprecedented quantity and quality of data that improves diagnoses and care.*"

6. Conclusions

In conclusion the HSARS strategic choices for an effective successful global tele- medicine service are summarised as follows: easy to install, freely available software both on the patient and on the doc- tor side, free test and immediate operation easy customizable and scalable for the real needs of the doctor compatible with existent hardware and seamless interaction with other software not interfering with standard medical practice: adaptable to various kinds of medical practice innovative business model put the doctor at the center the patient is empowered and stimulated not to give up company delivering the service is paid back by advertising scalability creates further options of reward for the company.

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Allam Appa Rao*, Alok Srivastava**

Big Data in Health Informatics

Abstract

Big data has changed the way to manage, analyze and interpret data in the field of health informatics. This domain has the potential to reduce the cost of treatment, predict outbreak for epidemics, avoid preventable diseases and improve the quality of life in general. This study provides an overview and recent developments in the key components of health informatics in context of big data. We have focused on how integrated approach on different aspects of health care sector helps in better decision making and providing most effective diagnosis for prevention and to personalize treatments. We have also discussed some of the existing activities, challenges and future opportunities related to big data in health care sector, that needs to be tackled carefully..

INTRODUCTION

With the evolution of technology amount of data generated is exponentially increasing regardless of the disciplines, without exception in the domain of health care sector also. The datasets present in health care sector are too complex and huge such that it is categorized into Big Data category. Initially, Meta Group, Inc (now Gartner, Inc) has defined *Volume, Velocity* and *Variety* are the three key characteristics of the big data [1]. Later, it's definition has been extended to add other factors as well, including *Variability* (consistency of data over time), *Veracity* (trustworthiness of the data obtained), and *Value*. Fig 1 describes six V's of big data in health informatics. Altogether, these six V's of the big data also applied to the health sector data. This data is concerned with meaningful complex datasets that are too big, too fast and too complex to process and interpret with existing tools and technology.

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Fig. 1. Six V's of big data applied to health informatics.

Above mentioned six V's are the important components of big data health care data. Data collection process involves acquisition and storage of such complex structured, unstructured and semi structured data. Information retrieval from such data needs data from different source to integrate, followed by cleaning and processing. Handling of such data needs specialized domain knowledge for data modeling and predictive analytics. It also requires intelligence system for inference through analysis and actionable insights to communicate to the doctors, patients and other stake holders. Fig 2 describes the structure of big data component and process involved corresponding to each of them.

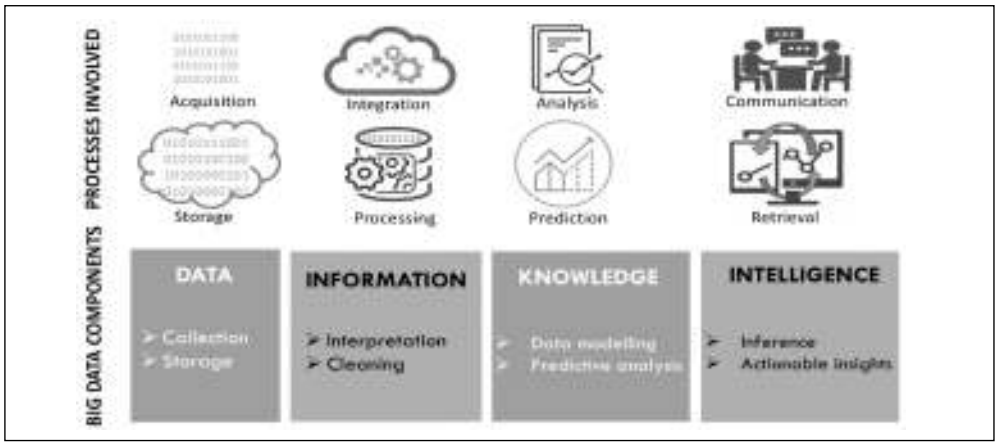

Fig. 2. Big data component in health care sector and process involved in each segment.

Overall, big data components in health sector describes acquisition, storage, processing, mining, analysis, integration, retrieval, interpretation and presentation of the patient's health data in order to deliver better health services towards prevention, early intervention, and optimal management. Each of these components leads to its specific characteristics with six V's.

Clearly *volume* of the data is an important factor for defining big data. It is expected that countries with emerging economy like India and China are producing enormous amount of data of quantum zettabyte (10^{21}) and yottabyte (10^{24}) [2]. This enormous amount of data is being generated due to fact that multiscale data generation from individuals is continuously increasing, particularly with next generation sequencing technology, real time imaging, wearable computing devices and mobile health technologies. Altogether these technologies provide genomics, proteomics, metabolomics, as well as long-term continuous physiological features of an individual. In addition to these environmental factors present another set of variables that can be captured by continuous sensing that are important in health informatics.

Velocity is another factor to determine big data for health informatics. With the speed, versatility, diversity, heterogeneity and connectivity of data capturing devices, data is generated at increasingly high speed. The complexity that arise in such a case is to provide analytics and decision support in real time situation.

In health care, *variety* of data such as structured, unstructured or semi-structured data arise as a result of linking diverse range of bio-medical devices. Sources can be either quantitative (e.g., sensor data, images, gene arrays, laboratory tests) or qualitative (e.g., free text, demographics). The objective of this challenge is to support the basis for observational evidence to answer clinical questions, which would not be possible otherwise. In addition, the issue of generalizing results based on limited number of participants may be solved by taking advantage of big data for deploying longitudinal studies.

Veracity belongs to the trust worthiness of the data and is an important challenge in big data. As personal health records may contain typographical errors, abbreviations, and cryptic notes. This type of data can lead to wrong predictions.

Variability refers to the consistency of data over time. It helps in reporting seasonal health effects and disease evolution, which in general are non-deterministic models of illness and health.

Last, *value* to both health care and patients can only be realized if challenges to analyze big data can be addressed in a coherent fashion. New protocols and algorithms are required to gain insight from the underlying health data. It can be a valuable resource that can provide significant insights toward improving contemporary health services and reducing health care costs.

Further, in this paper we will discuss health informatics and its components in the context of big data. More specifically, we will discuss the overview of each of the components and recent developments in each of them.

HEALTH INFORMATICS

In order to address the solution to analyze large amount of structured, unstructured and semi-structure data from different source, big data analytics tools and technology hold the promise to study outcome of large scale population based longitudinal studies, and also helps to build predictive models to capture trends from the data generated from various health records. This technology helps to improve quality of health care, reduce medical errors, reduce health care costs, increase administrative efficiency, and expand access to affordable health care. The integration of data from various sources, such that mobile platform, social media, environmental, geospatial, previous patient history, social habits, which affects health care analytics provide a unique opportunity to get meaningful detailed insight from these sources, to provide early diagnosis of the disease, better health care facilities, helps to improve quality of life as well as life expectancy of each individual. Fig 3 explains the major components of health informatics that has major impact on its positive outcomes. In the next section we will discuss each of these components in details.

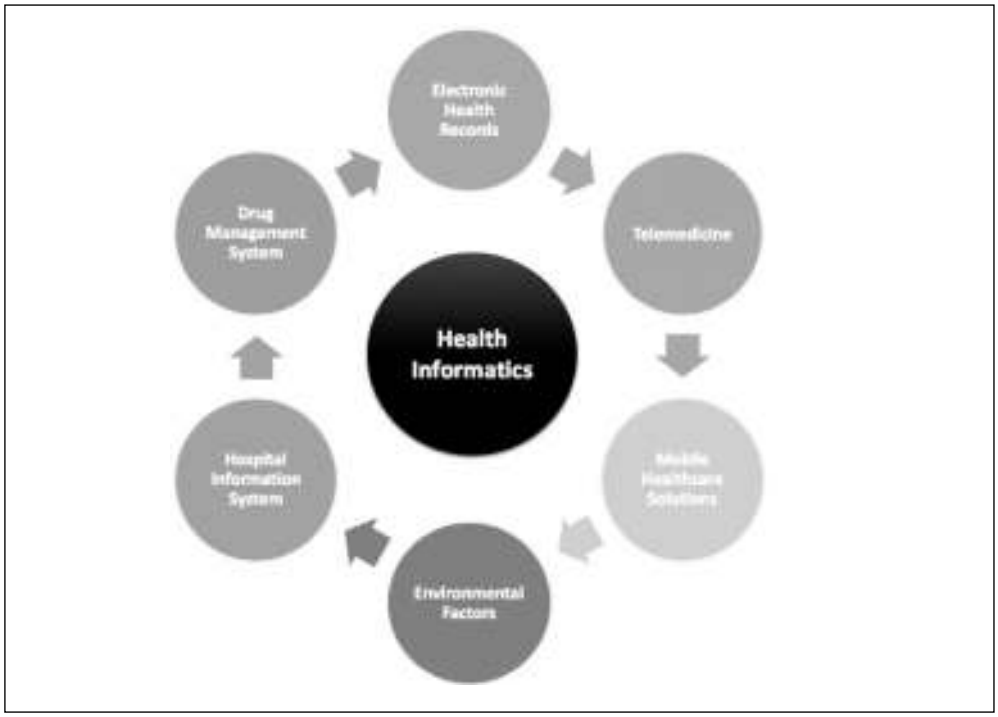

Fig. 3. Major components of Health informatics.

A. Electronic Health Records (EHR)

EHR also known as Electronic Medical Records (EMR) is the systematized collection of patient and population health data and electronically store these information in a digital format [3]. EHRs may include a wide range of data, including demographics, medical history, medication and allergies, immunization status, laboratory test results, radiology images, vital signs, personal statistics like age and weight, and billing information [4]. For processing such patient reports, the use of natural language processing plays an essential role for systematic analysis and indexing of the underlying semantic contents.

Mining EHRs is an important and valuable tool to support clinical research to improve clinical knowledge, for example, in discovering phenotype information [5]. Data mining using EHR data has already been proven to be effective for a wide range of healthcare challenges, such as disease management support [6], [7], pharmacovigilance [8], building models for predicting health risk assessment [9], [10], enhancing knowledge about survival rates [11], [12], therapeutic recommendation [11], [13], discovering comorbidities, and building support systems for the recruitment of patients for new clinical trials [14].

Earlier, most clinical databases provided low temporal resolution information due to the difficulty in collecting rich long-term time-series data. However, EHR systems are designed to store large multidimensional longitudinal patient data collected across time. The quality of the data can be enhanced by connecting with mobile health platforms, community centres, or elderly homes such that other information can be incorporated into the system to facilitate clinical decision-making and addressing unanswered clinical questions.

One of the advanced applications would be to build patient-specific models using data already available in existing clinical databases, and, then, update the model with data that can be collected outside the hospitals.

B. Telemedicine

Owing to the shortage of doctors and hospitals in rural areas of the country, telemedicine solutions have become an attractive option to reach quality health care everywhere. These solutions enable patients in the remote area to engage in live consultation with doctors situated elsewhere, sharing medical records and test reports online. However, with the increasing awareness of social networks, communications has been started among patient to patient beyond the traditional doctor to patient paradigm. One fourth of patients with chronic diseases, such as diabetes, cancer, and heart conditions, are now using social network to share experiences with other patients with similar conditions, thereby providing another potential source of big data [15]. In addition to biological information, social apps and geographical location provide an additional feature to understand the behaviors and social demographics of patients, which has

already been explored by several epidemiological studies, such as influenza outbreaks [16], [17], collective dynamics of smoking [18], and the misuse of antibiotics [19].

Compared to traditional approach, such as surveys, reading behavior from document records, thoughts and behavior analysis over social network platforms, such as Facebook, Twitter, offer new opportunities for the real-time analysis of expressed mood and its context [20]. For example, Larsen *et al*. collected 2.73×10^9 tweets over a period of 12 weeks to study correlation between emotion tweets and global health estimates from the World Health Organization on anxiety and suicide rates [20]. Therefore, these text messages and posts on social platform are also a valuable source of health information, e.g., for the better management of health care system. Similar models are anticipated to help other areas of public health surveillance.

C. Mobile Health Care Solutions

This section extend the concept of Telemedicine to the mobile technologies through embedded devices. Nowadays, there is a significant growing market of small sensors embedded in clothing, jewellery, watches, shoes, phones, and other mobile devices like the Chair-type Interface [21] that elderly can use daily. This system uses the mobile communications services to develop generic Body Area Network and a generic health care service platform for monitoring the following parameters: ECG, EMG, Pulse rate, Respiration Rate, Skin Temperature, Blood Flow, and Saturated Percentage of Oxygen. These systems allows a better quality of life and reduces costs for the health insurance system.

Embedded health sensors are very important as they collect the data on the fly and are connected with wearable computing technology that enable mobility and flexibility in situations of continuous health monitoring. These technologies plays a significant role to have free and active life style, specially in the elderly surveillance.

The mentioned mobile health care environment enables the identification of possible hazard situations or diseases. Furthermore, whenever possible, it makes a readjustment of long-term medical treatment based on the analysis of previous stored data., to avoid the risky situations. Thus reducing the intervention time of health care professionals.

D. Environmental Factors

Climate data, such as heat stress and cold related mortality, present another dimension to predict personal health [22], [23]. Recent geographic information systems and remote sensing technologies allow climate data for global land areas to be interpolated at a spatial resolution of 500 m to 1 km [24], [25]. This technology helps to capture the spatio-temporal data to record toxic air

pollutants in the atmosphere [26]. These technologies are very important to connect epidemic intelligence with infectious disease surveillance, to launch effective climate response plans [27–29].

E. Hospital Information System

Hospital Information System (HIS) is an integral part of health informatics that focuses mainly on the administration needs of the hospitals. In many implementations, an HIS is a comprehensive, integrated information system designed to manage all the aspects of a hospital's operation, such as medical, administrative, financial, and legal issues and the corresponding processing of services. It provides a common source of information about a patient's health history. The system has to keep data in a secure place and controls who can reach the data in certain circumstances. These systems enhance the ability of health care professionals to coordinate care by providing a patient's health information and visit history at the place and time that it is needed.

Potential benefits of hospital information systems include:

- Efficient and accurate administration of finance, diet of patient, and distribution of medical aid. It helps to view a broad picture of hospital growth.
- Improved monitoring of drug usage, and study its effectiveness. This leads to the reduction of adverse drug effects, while promoting more appropriate pharmaceutical utilization.
- Enhances information integrity, reduces transcription errors, and reduces duplication of information entries [30].
- Hospital software is easy to use and eliminates error caused by handwriting. New technology computer systems give perfect performance to pull up information from server or cloud servers.

  While designing the HIS it should be noted carefully that system should be safe and secure from data management point of view, since highly sensitive data is handled by such systems and hence the comfort level related to privacy and safety should be addressed aggressively.

F. Drug Management System

In health care sector one of the common problem is the periodic shortage, storage, loss due to expiry medicine, lack of good distribution system and inadequate amounts of necessary drugs. Proper functioning of DMS require up to date management policy and guidelines, drug inventory databases across all levels of the health system, and trained capacity of health professionals through training, supervision, and technical assistance. Based on the annual requirement

and shelf life of the drugs central DMS should generate the requirement list. It should also be capable to generate specific requirements in case of emergency situation like epidemic. At any point of time DMS can provide the details of all the drugs included in the system. It records the drugs reaction agent combination, their generic details of allergies, their corresponding anti-allergic medicines, their usage conditions, and special instructions associated with the use of any drug. DMS should also contain drug trial information as well as individual who are participating in trial information and drug trial history information. An effective DMS is require to manage these critical challenges and to provide better health care services.

3. CONCLUSION

In real world where population is heterogeneous and various factors including previous history of the patient and family, patient habits, his social behaviour, climate data, geographical conditions, affects the disease treatment process, big data plays a crucial role and the major challenge is to acquisition of such seamless health data. Big data technology enables us to integrate such type of data to get meaningful insight to get better diagnosis and early health treatment for precision treatment by performing patient stratification. Big data applications in health informatics is indeed the key achievement towards personalized health care management. A better use of these resources can lead to well managed health service to provide better quality of life and also address the challenge of the aging problem. Thus, advancement in big data tools and technology for health informatics will have a great impact on future of clinical research.

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Determinants of Infant Moratality Rate: A panel data analysis of BIMARU State of India

Abstract

Big India has achieved high rates of economic growth post after economic liberalization in 1991. A sustained level of high growth was achieved resulting in a large GDP for the country. India is today the 6th largest economy (in terms of nominal GDP) of the world with a GDP of 2.597 trillion USD (Ranking of countries on gross domestic product as on 2017 by World Bank). However this GDP growth has not led to much improvement in social development indicators. One of the key social development indicators pertaining to health is infant mortality rate (IMR). Although, the initiatives of Government of India to bring down the infant mortality rate (IMR) have earned its kudos, they are not enough. Moreover, this improvement in IMR is not uniform across the country. In India, BIMARU (acronym of four Indian states Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh) states are economically poor and having serious deficit in health awareness. Therefore, any improvement in the overall IMR of the country cannot happen without improving the indicator significantly in these BIMARU states. This paper attempts to identify the determinants of IMR for the BIMARU states. A basic regression model (pooled OLS) of IMR has been developed on the basis of data collected from the Annual Health Survey (AHS) for 184 districts of BIMARU states for 3 consecutive years (2011, 2012 and 2013). The analysis presented in this paper lays out the determinants of IMR in BIMARU states in India and argues in favor of developing targeted initiatives to improve IMR.

INTRODUCTION

India has achieved high rates of economic growth post 1991 when the country liberalized its economic policies. Sustained levels of high growth of 7% plus was achieved in different time periods from 1991 onwards resulting in a large GDP for

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the country. India is today the 6th largest economy (in terms of nominal GDP) of the world with a GDP of 2.579 trillion USD[1]. However this GDP growth has not led to similar improvement in social development indicators. Much of this GDP growth was concentrated on the service sector which has benefited the urban elites more than the people in the hinterlands. Various factors have affected a similar improvement in social development indicators. One of the key social development indicators pertaining to health is infant mortality rate (IMR)[2]. The Millennium Development Goals (MDG) and recently launched Sustainable Development Goals (SDG)[3] of the United Nation (UN) both highlight the importance attached to infant mortality rate (IMR) as a health indicator of social development. In line with MDG and SDG, Government of India has initiated several programmes to improve the infant mortality rate like universal immunization programme, Reproductive and Child Health (RCH) etc. Besides providing health services, health facilities were established in every corner of the country in the form of Sub-Health Center (village level), Primary Health Center (block level) and Community Health Centers. These initiatives helped in bringing down IMR to 34 in 2016 (SRS bulletin, 2017) which was previously at 130 in 1970s (Annexure, Figure-1).

Although, the initiatives of Government of India to bring down the infant mortality rate (IMR) have earned it kudos, much more can be achieved as India is far behind of European countries, USA, Australia, Japan etc. Even the neighboring countries like Nepal, Bhutan, Bangladesh, China, Maldives and Sri Lanka are ahead of India in controlling infant mortality[4]. Moreover, this improvement is not uniform across the states of India (Annexure, Figure-2). In progressive states like Kerala, IMR is 10 (as good as European countries), while in backward state like Madhya Pradesh it stands at 47 (comparable with backward African nations).

Some Indian states have consistently shown higher infant mortality rate than Indian average (figure-2). Aiming to monitor the performance of the government's various health interventions at relatively more frequent intervals in these backward states, Annual Health Survey (AHS)[5] was carried out Government of India. This survey was

[1] Source: World bank statistics

[2] Infant mortality rate (IMR) is the number of deaths per 1,000 live births of children under one year of age

[3] United Nations Development Programme (UNDP) has developed Sustainable Development Goals (SDGs) which came into effect in January 2016. Child death has been identified as a focus area of Goal-3 (Good health & Well-being) among 17 goals of SDGs

[4] Source: Estimates developed by the UN Inter-agency Group (UNICEF, WHO, World Bank, UN DESA Population Division) for Child Mortality Estimation

[5] AHS was initiated by National Commission on Population, PMO (Prime Minister Office) and Planning Commission. RGI (Registrar General, India) was entrusted to conduct the district level survey on behalf of MoHFW (Ministry of Health & Family Welfare).

conducted in 9 states namely Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh and Uttarakhand to capture the health scenario of these backward states in terms of mortality and health infrastructure. These AHS states accommodate 50 percent of the total population of India, whereas 71 percent of infant deaths are recorded by these states.

Among these AHS states, Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh have shown worse performance in child health. The worst 10 performing districts published in AHS report in terms of Child Health Deprivation Index (CHD)[6] are from these four states. These four states are popularly known as BIMARU[7]. BIMARU states are economically poor and having serious deficit in health awareness. These Hindi heartland states cover a huge geographical area and counts nearly 40% (Source: Census 2011) of the total population of the country. Beside IMR, these states have consistently reported poor performance in other socio-demographic indicators and reported high fertility, low literacy and poor socio-economic development for year after years. Table-1 shows the values of different social indicators of BIMARU states and corresponding Indian average.

Table 1: Demographic indicators of BIMARU states and Indian average (Source: NITI Aayog)

Indicators? / States/India?	Maternal Mortality Rate (2011-13)		Literacy rate (total) as on 2011		Literacy rate (female) as on 2011		Total Fertility Rate (TFR) as on 2013		Poverty estimate@2013 (% of people under BPL)	
Bihar	208		63.82		53.33		3.4		33.74	
MP	221	India	70.63	India	60.02	India	2.9	India	31.65	India
Rajasthan	244	167	67.06	74.04	52.66	65.46	2.8	2.3	14.71	21.92
UP	285		69.72		59.26		3.1		29.43	

Therefore, any improvement in the overall IMR of the country cannot happen without improving the indicator significantly in these BIMARU states which are at the bottom. Moreover, there are huge variations in IMR among the districts of BIMARU states for example IMR of Shrawasti is 103 whereas in Kanpur Nagar it is 36 (both the districts are from Madhya Pradesh).

Due to wide intra-state variations, working with state level data is not sufficient to efficiently identify the factors which affect infant mortality rate in BIMARU states. Thus, this paper attempts to identify factors of IMR on the basis of data collected from the Annual Health Survey (AHS) for 184 districts of BIMARU states (BIMARU

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[6] CHD is the summary of health deprivation of the child which was introduced in AHS report and was computed for AHS 2010-11 and 2012-13 district level information

[7] In India, BIMARU (which in Hindi stands for 'sick') is the acronym of four Indian states Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh

stands for Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh) for 3 years (2011, 2012 and 2013)[8].

2. Literature Review: Determinants of Infant Mortality Rate

Infant mortality rate has been considered as a health care and socio-economic indicator of any region/nation for a long time (Mosley & Chen (1984), Caldwell (1986), Tanaka (2015), Kapoor (2010) etc.). Different government, public and private bodies, researchers have focused on finding the determinants of infant mortality rate across the globe. In India, several factors play major role in determining the survival of the infant and mother during the pregnancy and ante-natal period of child birth.

Gonzalez and Tseng (2009) worked on social determinants on mortality in Taiwan combining aggregate mortality data with individual level data on socio-economic characteristics. Mother's education has often used as a determinant of mortality. Caldwell (1979) showed the significant impact of mother's education to improve infant mortality.

Traditionally, correlation between the socio-economic characteristic and mortality were used for inferring the mortality determinants. Mosley and Chen (1984) and later Caldwell (1986) identified intermediate variables that influence the risk of morbidity and infant mortality. Torre and Myrskyla (2011) have propounded a causal relationship health and income distribution.

Hanmer, Lensink, White (2003) showed that the relationship between income and infant mortality is 'an imperfect one'. In addition to this, they brought forth the significance of female literacy rate and its impact on IMR. They opined that, increase in literacy gap (difference between literacy rate of male and female) badly affects the child healthcare and increases infant death.

National Institute of Public Cooperation and Child Development (2014) analyzed the trends of infant and child mortality in India. The study depicted the state wise trend of infant mortality in India and found evidence of child health inequality along several dimensions. This study identified huge differentials across states and among socio-economic group as well in terms of access to health service, health outcome and utilization of health services. The disparities of health outcome could be explained by differential pace of social and economic development, uneven distribution of benefits of development and inadequate public health care system.

Basic female education was considered as one of the most powerful factors that influence infant mortality and fertility. Kapoor (2010) opined that an

[8] The AHS has begun in 2010-11 and had two more rounds of updations in 2011-12 and 2012-13.

educated mother is more knowledgeable about nutrition, hygiene and health care of the infant. Shetty & Shetty (2014) stated that female literacy empowers women and showed an inverse relationship between infant mortality and female literacy rate in context of Indian states. Saurabh et al (2013) showed that female literacy is a better predictor of infant mortality than male literacy. They also contended that infant mortality is inversely related to female literacy whereas male literacy is not a significant predictor to explain infant mortality. They opined that a high gap in male and female literacy results in a poor show of health indicators despite high overall literacy rates.

According to the Census 2011, Schedule Tribes (STs)[9] comprises 8.6% of India's population. Acute poverty is evident among the scheduled tribes. Kapoor (2010) found that percentage of scheduled tribe population in a district is directly related to infant mortality.

Socio-economic variables can also add more lights in explaining infant mortality. Ijaz (2012) included number of employed persons as a proxy variable of income and poverty. Flegg (1982) opined that under-developed economies should put impetus on reducing income inequalities to achieve a rapid decline in infant mortality rate. Denise et al (2016) noted that in Brazil, health services like average number of pre-natal visits and place of birth (i.e. institutional delivery or home delivery) have significant effect on infant mortality.

3. Research methodology

The review of literature helped to identify factors that play significant role in variation of infant mortality rate. Further, these factors are divided in 4 categories namely demographic, economic, health service and health infrastructure. Table-2 shows the variables undertaken for this research and their definition.

[9] The Scheduled Tribe (ST) is officially designated group of historically disadvantaged and backward communities in India. The term is recognized in the Constitution of India and separate reservation is allotted for this group to uplift their social and economical status.

Table 2: Description of variables undertaken for this research

Variable type	Variable name	Description
Dependent	**IMR**	Infant mortality rate
Demographic	**ST_per**	Percentage of Schedule Tribe population
	LR_M	Literacy rate of male
	LR_F	Literacy rate of female
	Gap_lit	Literacy gap (male-female)
Economic	**PCI**	Per capita income at 2011-12 constant price
Health service	**Reg_first_tri**	Registered within first trimester (in % wrt no. of reported delivery)
	3_ANC	Availed 3 ANC (ante-natal care) checkup (in % wrt no. of reported delivery)
	Inst_del	Institutional delivery (in % wrt no. of reported delivery)
	Inf_immun	Percentage of infant availed full immunization
Health infrastructure	**SC**	No. of Sub-Health Center
	PHC	No. of Primary Health Center

This research was initiated with the above mentioned variables for BIMARU states. The data collected for this paper is secondary in nature and collected at the district level for all the variables mentioned above from several government and other authentic sources (Tablel-5). Availability of data restricts us to work with 184 districts (out of total 197 districts) of BIMARU states. Table-3 shows the source and methodology of the data collection.

Table 3: Source of the data for all the variables under this study

Variable name	Source	Methodology
IMR	AHS (Annual Health Survey)	Direct data from government sites like NRHM, Niti Aayog and data.gov.in
ST_per **LR_M** **LR_F** **Gap_lit**	Census 2011	Data is collected from census 2001 and 2011. Using these two data points, data for 2012 and 2013 is calculated using linear growth of the data.
PCI	Statistical Abstract & Economic survey of corresponding states	Per capita income is converted to 2012-13 constant scale. Most of the data is found in current year or 2004-05 base patterns. Unavailable data points are estimated using least square method
Reg_first_tri **3_ANC** **Inst_del** **Inf_immun**	AHS- 2010-11, 2011-12, 2012-13	Data is collected from the AHS report from the NRHM/ HMIS sites
SC **PHC**	RHS (Rural Health Statistics) bulletin 2010 & 2013	Data is collected from RHS-HMIS and NRHM sites

Collected data is used to prepare a panel for 184 districts of BIMARU states.

The final balanced panel contains 184*3= 552 data points (184 districts, 3 years). Pooled OLS regression is used to identify the determinants of IMR and determine the regression line. Following is the general regression equation which estimates IMR (Y) as the linear combination of independent variables (Z_i) where ßs are coefficients of Zs and C is the intercept.

$$Y_{i,t} = C + ß_1 Z_{1it} + ß_2 Z_{2it} + ß_3 Z_{3it} + \ldots\ldots\ldots\ldots + ß_n Z_{nit} \text{ where } i=1(1)184 \text{ and } t= 1(1)3$$

Pooled OLS was adopted after taking the logarithmic transformation of all the dependent and explanatory variables to find an improved R^2 and adjusted R^2 of the model. Later, VIF (variance inflation factor) was introduced to efficiently handle the issue of multicollinearity as the correlation matrix of the variables clearly shows the evidence of high correlation among some of the independent variables.

4 Result and discussion

The descriptive statistics of the dependent and independent variables under this research are given below

Table 4: Descriptive Statistics

Descriptive Variables	Number of datapoint	Minimum	Maximum	Mean	Std. Deviation
IMR	552	31	103	62.32	12.55
ST_per	552	0.00	87.00	8.59	15.89
PCI	552	8118	105830	32811.64	19573.93
LR_M	552	50.00	97.00	79.20	7.14
LR_F	552	32.00	86.00	57.84	8.59
Gap_lit	552	4.00	35.00	21.36	4.90
3_ANC	552	13.0000	226.00	72.03	16.61
Inst_del	552	19.0000	100.00	77.046	17.04
SC	552	29	854	274.76	131.29
PHC	552	6	121	44.56	22.45

Table-4 shows the descriptive statistics of data under this research. There is huge variability which can be understood through Minimum and Maximum column of table-4. The highest IMR reported during this period is 103 and 31 is the lowest. All the other variables show similar kind of variability.

Table 5: Correlation matrix

		IMR	ST_per	PCI	LR_M	LR_F	Gap_lit	3_ANC	Inst_del	SC	PHC
IMR	Correlation	1									
	Sig 2 tailed										
ST_per	Correlation	.095	1								
	Sig 2 tailed	.026									
PCI	Correlation	-.258	.225	1							
	Sig 2 tailed	.000	.000								
LR_M	Correlation	-.148	-.078	.192	1						
	Sig 2 tailed	.000	.068	.000							
LR_F	Correlation	-.187	-.145	.016	.823	1					
	Sig 2 tailed	.000	.001	.700	.000						
Gap_lit	Correlation	.114	.138	.255	.019	-.551	1				
	Sig 2 tailed	.007	.001	.000	.664	.000					
3_ANC	Correlation	.225	.165	.178	.177	.132	.025	1			
	Sig 2 tailed	.000	.000	.000	.000	.002	.557				
Inst_del	Correlation	-.297	.257	.430	.125	-.066	.303	-.056	1		
	Sig 2 tailed	.000	.000	.000	.003	.121	.000	.192			
SC	Correlation	-.030	-.067	.125	.026	-.110	.227	-.009	-.052	1	
	Sig 2 tailed	.484	.114	.003	.543	.010	.000	.833	.221		
PHC	Correlation	-.033	-.238	-.06	.002	-.074	.128	-.113	-.188	.866	1
	Sig 2 tailed	.438	.000	.161	.960	.081	.003	.008	.000	.000	

Correlation matrix (Table-5) shows that, there is high correlation between male and female literacy and so is also true for gap literacy with male and female literacy. Same behavior is observed in the case of SHC and PHC. Rests of the variables are moderately correlated with IMR and no indication of high correlation among the independent variables.

Table 6: Summary of OLS model for 184 districts of BIMARU states

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.572[a]	.327	**.320**	.0729295

a. Predictors: (Constant), L_PHC, L_Gap_lit, L_ Inst_del, L_PCI, L_ST_per

Table 7: Coefficients of the OLS Estimation of IMR of 184 Districts of BIMARU states

Model		Unstandardized Coefficients		Standardized Coefficients	t	Signifi -cance	Collinearity Statistics	
		B	Std. Error	Beta			Tole-rance	VIF
1	(Constant)	2.259	.101		22.448	.000		
	L_ST_per	.043	.007	.290	6.429	.000	.608	1.646
	L_PCI	-.139	.016	-.371	-8.641	.000	.670	1.494
	L_Gap_lit	.217	.031	.268	7.065	.000	.860	1.162
	L_Inst_del	-.268	.033	-.340	-8.169	.000	.715	1.399
	L_PHC	-.039	.014	-.106	-2.713	.007	.810	1.235

a. Dependent Variable: L_IMR

Table-7 shows that, L_ST_per (log of percentage of schedule tribes), L_PCI (log of per capita income of the district), L_Gap_Lit (log of gap literacy between male and female), L_Inst_del (log of percentage of institutional delivery with respect to actual number of deliveries) and L_PHC (log of number of public health center) are significant at 1% level[10]. Table-7 also shows the values of VIF which help us to infer that there is no issue of multicollinearity in this model. The value of adjusted R^2 (Table-6) is 0.32 indicating that, 32% of the variability of the independent variable has been explained by the model.

Hence the primary model using pooled OLS can be mathematically expressed as-

$$Y'_{i,t} = 2.259 + .043\ Z'_{1it} - 0.139\ Z'_{2it} + 0.217\ Z'_{3it} - 0.268\ Z'_{4it} - 0.039\ Z'_{5it}$$

Where $Y'_{i,t} = \log(Y)$ and $Z_{jit}{}' = \log(Z_{jit})$

The role of different variables as determinants of infant mortality rate is discussed below and diagrammatically represented in Figure-1.

- Coefficient of ST percentage is positive and statistically significant at 1% level. It appears that, 1 unit increase in ST percentage increases IMR by 0.04 units.
- Coefficient of Literacy gap is positive and statistically significant at 1% level. It appears that, 1 unit increase in Literacy gap increases IMR by 0.22 units.

[10] only significant variables are included in Table-8 & 9

- Coefficient of Per Capita Income (PCI) is negative and statistically significant at 1% level. It appears that, 1 unit increase in Per Capita Income (PCI) decreases IMR by 0.14 units.
- Coefficient of Institutional delivery is negative and statistically significant at 1% level. It appears that, 1 unit increase in Institutional delivery decreases IMR by 0.27 units.
- Coefficient of number of PHC is negative and statistically significant at 1% level. It appears that, 1 unit increase in number of PHC decreases IMR by 0.04 units.

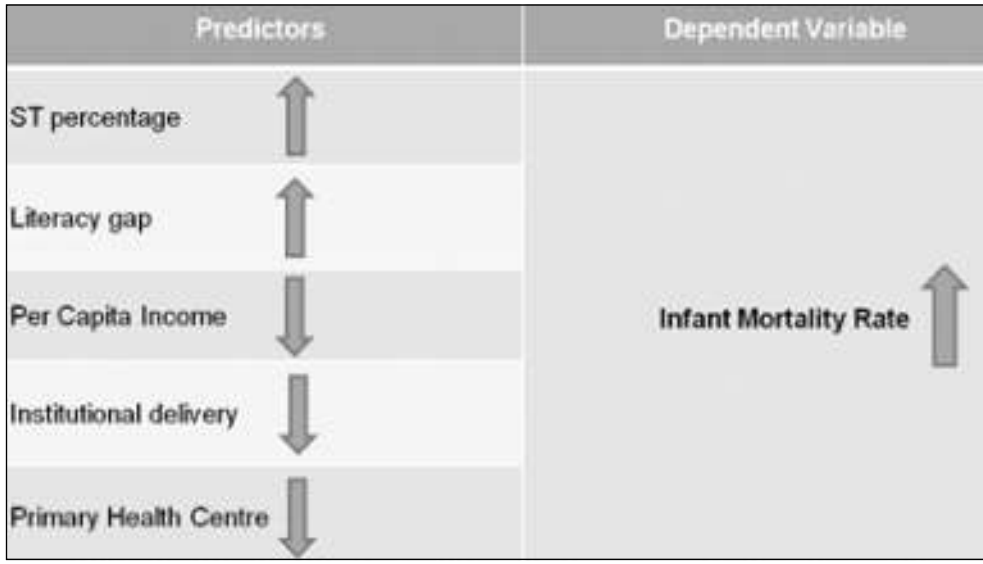

Figure 1: Role of the determinants of Infant Mortality Rate

5 Conclusion:

The BIMARU states represent the soft underbelly of India in terms of social development and hence if India has to progress on any of the key social development indicators the state of affairs of that indicator in BIMARU states has to significantly improve. This analysis presented earlier lays out the determinants of IMR in BIMARU states in India. Clearly, per capita income, literacy gap and number of PHC in districts under this study are significant and contribute to IMR. For the policy maker it is interesting to note that, apart from the usual variables like per capita income, number of PHC, gap in literacy also is significant variable with high co-efficient. Hence, for the policymakers it will be extremely important to focus on reducing the gap between male and female literacy to have a positive long-term impact of reducing IMR in BIMARU states. Hence, there must be focus on an aggressive program to increase female literacy in

BIMARU states in order to tackle the issue of IMR. Per capita income (PCI) also has an impact on IMR. With increasing growth and its trickle-down effect to the BIMARU states, we can hope that the per capita income in these states will improve. More so given that, the government is planning to double agricultural income in the next 5 years which will have a salutary effect on per capita income and consequently on IMR. Mean and maximum IMR being 63.32 and 103 (which is much higher than average IMR of India i.e. 39) in these BIMARU states is a cause for great concern and we hope that this pooled OLS model developed on the basis of openly accessible data will be able to provide policy insights so that intervention can be revised to reduce IMR in the BIMARU states.

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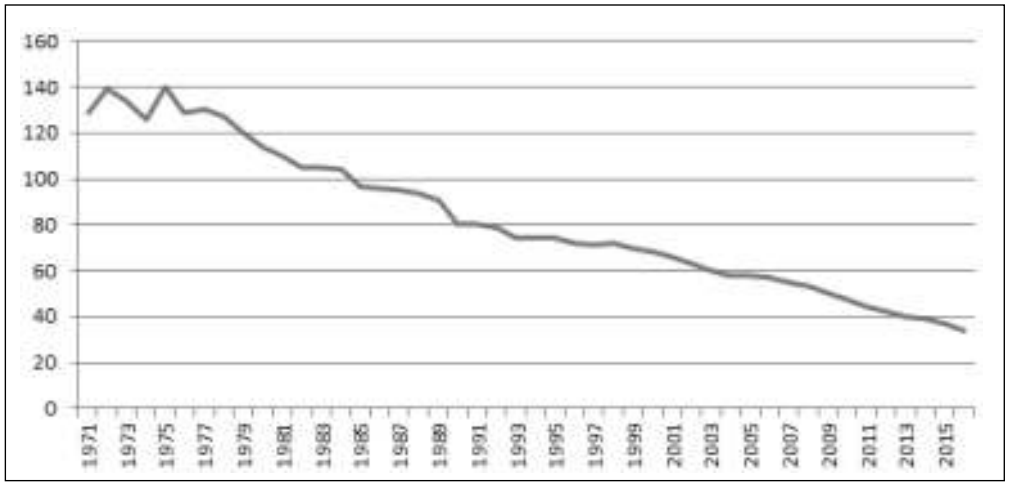
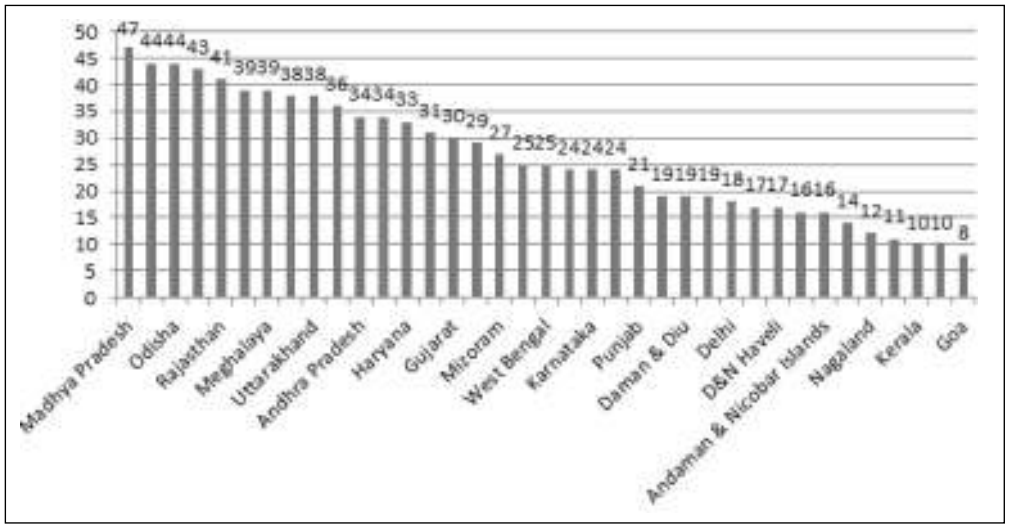
Annexure

Figure 2: Graphical presentation of Infant Mortality Rate of India from 1971 to 2016



(Source: Sample Registration System (SRS))

Figure 3: Infant mortality rates of states of India (2016)



Source: Niti Aayog

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Pervasive Health Care driven by IoT and Cloud based Analytics

Abstract

Internet of Things (IoT) has been a new paragon of connecting devices and providing services to various applications, e.g., healthcare, smart city, energy, transportation. Modern healthcare systems depend on advanced technologies and compu ting methods, like Internet of Things (IoT) devices and cloud, to collect and analyze personal health data at an unrivaled depth and scale. Patients, doctors, health care providers depend on analytic models to monitor patients, early-diagnosis of diseases and find personalized medications. The vision of e-health system has been evolving past a decade constituting Health Care Devices connected over cloud. Data Mining and predictive modeling algorithms gather patient's data from various sensors and propagate timely alert to the caretaker as well as doctor through textual messages. It monitors the patient's vital parameters remotely and diagnose the diseases at its earliest. This can be implemented in the wearable alert system through Wireless Body Area Network (WBAN). Different wireless interfaces are integrated via a cloud service. This survey aims to expose pervasive health care, existing models and health care systems.

INTRODUCTION

Health is not everything but everything else is nothing without health. Every individual has the right towards healthcare, due to lack of quality infrastructure, lack of qualified medical functionaries, and lack of basic medicines and medical facilities thwarts its reach to 60% of the population in India. In rural India, 31% of the population travels more than 30km to pursue healthcare and 66% of the population do not have access to the critical medicines. Despite government, running a lot of programs and policies, the success and impact of these programs are questionable due to the implementation gaps. In rural India, the number of Primary health care centers (PHCs) are limited. 8% of these centers do not have doctors or

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medical attenders, 18% of PHCs do not even have a pharmacist and 39% do not have lab technicians [1]. The technologies which have key roles in enhancing the health care include Internet of Things, Artificial Intelligence and Data mining. These technologies help in identifying the right medication to the patients, improving the medication efficiency and help in providing preventive medicines.

Internet of Things (IoT) is a developing technology which connects human and information processing media anywhere and anytime. Its scope is not only limited to connected things, but also allow devices to interact and exchange the data associated with the users. With the help of IoT, medical information can be exchanged from one location to another to diagnose the diseases and arrange proper medications to improve patient's health conditions even at remote locations.

A Wireless Body Area Network (WBAN) can be interpreted as a Wireless Sensor Network (WSN)in which the sensors are coupled with wearable computing devices. The WBAN devices may interface with the human body either internally or externally. These devices get connected to the internet through the WPAN gateway devices. This helps in providing pervasive access to the patient data [2].

Health care analytics is one of the industries in the world which is constantly evolving. Health care analytics is used to describe the analysis of data collected from various areas in healthcare. The data collected can be claims and cost data, pharmaceutical and research and development (R&D) data, clinical data, or patient behavior and sentiment data. Health care analytics allows the examination of patterns in healthcare data in order to determine how clinical care can be improved to limit excessive spending [3]. Cloud computing is changing the way healthcare providers, doctors, clinics and hospitals deliver quality, affordable services to their patients. Healthcare providers are increasingly turning towards cloud based solutions to meet the business and patient needs by modernizing their IT infrastructure and legacy applications [4].

The health care services distribution around the world is highly uneven as the remote rural areas do not get their fair share of resources and attempts to attract healthcare professionals to render their services in rural areas have been only partially successful. So, an alternative approach is required. Drones are likely a solution to this problem. Drones make it possible to deliver medicines and have the ability to reach the victims who require immediate medication within minutes, which in some cases could be a matter of life and death.

All the healthcare applications that are being developed using these disruptive technologies have to abide to a number of compliances. One of the key compliance is HIPAA (Health Insurance Portability and Accountability Act) and HIPAA sets the decisive levels related to the patient's sensitive data protection. It directs the developers and the researchers to develop a more viable healthcare application through the HIPAA Executive, Physical and Technical specifications.

This survey is further organized as follows. In Section II, the disruptive technologies contributing to the pervasive healthcare and its related applications are presented. In Section III, some of the case studies utilizing these disruptive technologies are reviewed. The survey concludes in Section IV.

2. Pervasive Health Care

Pervasive healthcare can be defined as *"healthcare to anyone, anytime, and anywhere by removing locational, time and other restraints while increasing both the coverage and the quality of healthcare"* [5]. This pervasive healthcare includes prevention, healthcare maintenance, health checkups, short-term monitoring, long-term monitoring and personalized healthcare monitoring. Pervasive healthcare can be achieved by implementing the pervasive computing technologies in the assistive care facilities. The predominant pervasive computing technologies include cellular networks, wireless LANs, sensor networks, satellites, Bluetooth and RFID. The challenges in providing a pervasive healthcare includes –

i. Periodic collection of the healthcare data

The advent of miniaturized medical devices and huge interest in use of wearable de- vices has led to rapid increase in the volume of different kinds of electronic health information. The different kinds of Electronic Medical Record (EMR) alone comprises huge amount of data. In order to create actionable insights from the data arriving at such a high velocity, the processing of data has to be geared up.

ii. Pervasive access to the healthcare data

Pervasive healthcare access aims at allowing users to efficiently access the healthcare data at any place at any time. This unrestricted mode of access through a wide variety of devices is still improving and a tremendous research effort has been put forth to support these kinds of access.

iii. High level of data privacy

Privacy is one of the major issues for the pervasive computing applications. Privacy in these applications is entitlement of users over the collection and the utilization of any form of information related to them. The users may not be completely aware of the health data collection due to the embedded nature of pervasive applications leading to a lot of safety issues.

iv. Highly reliable service

The pervasive healthcare has to ensure reliability. This reliability has to get fortified both at the software and hardware layers of the healthcare application. The hardware layer reliability mainly deals with the proper functioning of the sensors and the software layer is with the actual service.

v. Support for prioritization

The pervasive healthcare application should be capable of adding prioritization to its intelligence and data collection. This kind of prioritization based on the context, self-learning and results associated with the rules can introduce context awareness which greatly helps in patient monitoring and alerting applications.

vi. Support for diverse environments

The pervasive healthcare can be deployed on different healthcare environments such as ICUs, health centres, home and so on. Each of these environments poses different challenges to the pervasive healthcare like adopting a suitable communication channel between the sensors and the gateway node.

2.1 Internet of Things

Internet of Things (IoT) is an emerging technology which connects human beings and things anytime and anywhere.

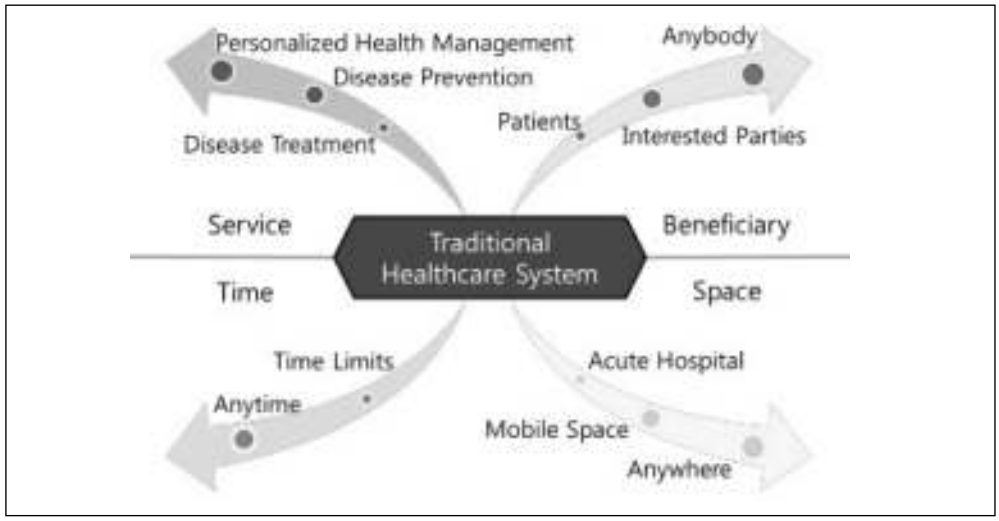

Fig. 1 Traditional HealthCare System

A health management organization should create an ideal healthcare system that serves anybody at anytime and anywhere using personalized health management system. In order to accomplish this service, it is necessary to identify the suitable technologies that have been developed for healthcare systems. Sensor technology, networks and data processing can be primary technologies for better healthcare systems than the traditional ones as shown in Fig. 1. Some of the existing medical applications of IoT has been shown in Fig. 3.

The expansion of healthcare systems can be achieved by applying IoT into this system. The key characteristics of the components of IoT are:

i. *Stability:* Continuous real-time monitoring using the sensor requires stability for data collection which is trustworthy.

ii. *Continuity:* Interoperability for intelligent network requires continuity to communicate with users, internet, and among each other.

iii. *Confidentiality:* A powerful storage for computing resource in cloud computing requires confidentiality to save dynamic data.

iv. *Reliability:* Big-data analysis demands reliability to transform dynamic data into valuable information.

v. *Efficiency:* Smart hospital requires efficiency for proper diagnosis and treatment. IoT can be divided into different segments so that the system is scalable and able to support the environment with high reliability and flexibility.

Devices - The action and perception layers comprises low-level devices like actuators and sensors. They perform only primary tasks such as collecting information, changing system parameters and monitoring environmental conditions.

Communications and Networking - This layer provides data communications and net- working infrastructure to transfer data in a significant manner. Wireless networks have been used to connect the devices to the gateways, which can be fixed or mobile. The data is then transferred to cloud from the gateway via backbone networks such as mesh networks.

Platform and Data Storage - This layer provides data access and storage. It can be a platform in local data centers and hardware or services in the cloud such as Platform- as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS).

Data Management and Processing - This software layer provides services to access functions of IoT services for users. It is composed of front-end user, backend data processing, i.e. decision unit and database and Business-to-Business (B2B) interfaces.

Different layers involve different resources such as spectrum and bandwidth for both wireless and wired networks to transfer data, energy used for the devices to operate, data processing services for IoT applications and computing and data storage for the infrastructure and the platform. For example, in IoT-based home surveillance applications, motion sensors and video cameras are positioned at different locations in a house. The sensors and cameras transfer the data back to the gateway via a wireless connection. The sensor data and video are stored in the cloud. That data are processed to detect if there is any intrusion. If there is an intrusion, it will stream video data to the end user's device and inform the security officers for further action. Cloud data storage

and computation services like virtual machine hosting, have to be allocated for image processing and signal detection.

The information generated by the human services IOT is of unstructured assortment, making a noteworthy part of Hadoop and progressed enormous information working within the Hadoop system. More intelligent gadgets speaking with other patient gadgets could reduce the requirements for direct doctor medication. Gadgets include sensors with their hardware installed, programming and system availability.

2.2 Healthcare Data Analytics

Data forms an integral part of healthcare. With advancements in the data sensing and acquisition techniques, the amount of healthcare data collected from the patients through the healthcare institutions has been on an exponential rise. The different healthcare data sources shown in Fig. 2 include Electronic Health Records (EHR), images, sensors, biomedical signals, genomic data, prescriptions, biomedical literatures and social media. Of these, the data accumulated from the sensors are receiving a lot of attention in the recent days. Sensor data is ubiquitous and supports both real time analysis and analysis of the past events. Most of the medical data collection instruments such as Electrocardiogram (ECG), Electromyogram (EMG), and Electro-encephalogram (EEG) are sensors that gather signals from the human body.

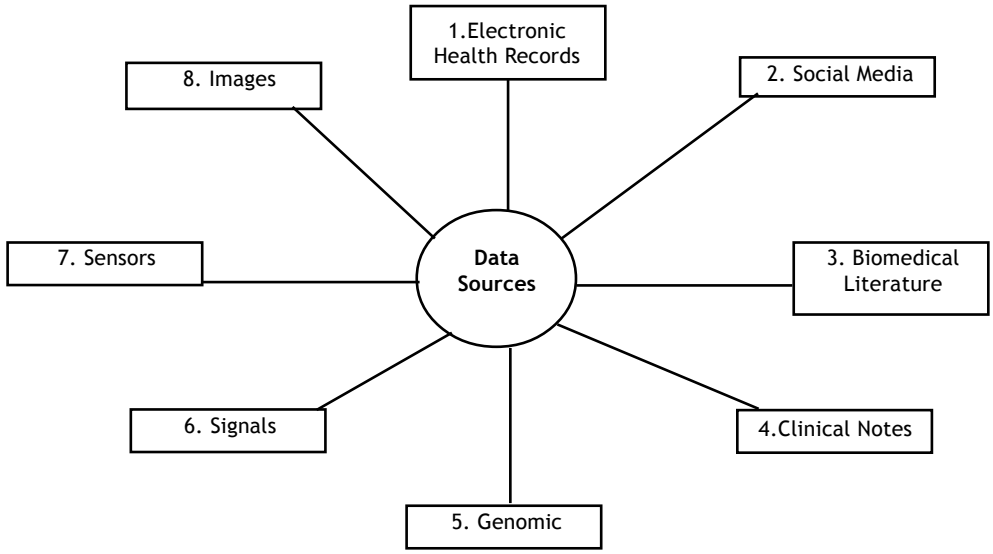

Fig. 2 Different data sources for Analytics

The analysis of the sensor data can be achieved through different paradigms of analytics as explained below.

i. ***Descriptive Analytics***

Descriptive analytics help in identifying what has happened. In healthcare, this kind of analytics provides various insights like analyzing the number of patients hospitalized during a time period, the vital parameters of the patients etc. [6].

ii. ***Diagnostic Analytics***

Diagnostic analytics help in arriving at the reason behind an event. This greatly helps in recognizing the pattern in the historical data [2].

iii. ***Predictive Analytics***

Predictive analytics is the widely adopted analytic technique. It helps in predicting the likelihood of an event in the future. It has many applications in the healthcare like forecasting the abnormality based on the vital parameters [6].

iv. ***Prescriptive Analytics***

Prescriptive analytics help in deriving an action plan to eliminate a problem in the future. An example of prescriptive analytics is suggesting a prescription to reduce the possibility of the occurrence of an abnormality [6].

Prediction analytics on the big data is the most active challenge in the healthcare industry. It requires a lot of expertise to develop a successful prediction model. In order to develop this kind of model, the prediction and the resulting intervention has to be both content-driven and clinician-driven. So the prediction should also lead to interpretation and recommended actions for each outcome which is prescriptive analytics. So the combined utilization of the predictive and the prescriptive analytics can result into a competent application for the people.

Accessing Technology	Development Method	Merits	Demerits	Usage
PAN,LAN-IF	Continua Health Alliance	More Efficient, Cost effective	Low data rate while compare with other network, Short range (10M)	Primary Prevention, General well Begin.
RHHC[Remote Home Healthcare]	Continua Reference Architecture	Reduce device cost, save time; improve communication, Simplifies complex Task.	Decision making problem, Interrupted information	Chronic diseases Management
Body Area Network	Mobile phone based architecture	Large scale implementation,256 device per network, Timely medical care	Range (2-5meter),Network density (2-4 m)	Care elderly, Disable person, Diabetics.
Wireless Body Area Network	Windowing and learning based technique	Geographical large area Location monitoring.	Low security, complicated and complex task, High Cost.	Cardiac, Rehabilitation, Diabetics, Home care chronic
M-IOT	Heterogeneous,3-Tier Structure	Tele treatment services	Easily deployable, Easily prone to hacking	Neurology, Obstetric trauma care, pulmonary medicine

2.3 Applications of Health Care Data Analytics

Most of the clinical applications utilizing data mining and analytics fall into the gen- eral class of Clinical Decision Support Systems (CDSS). These CDSSs provides the physicians with required knowledge and information about each individual patient, intelligently filtered and presented, to enhance their healthcare service. CDSSs can either be completely knowledge-driven or completely data-driven or hybrid. But the data-driven CDSS is the one that is prominent in the industry. The data-driven CDSS rely of the data mining and machine learning technologies to build inferencing models providing decision supports.

i. Analysis of physiological streams of the patients

BioStream[7] is a system that executesstream processing and analysis on the physiological streams of the patients collected using a general purpose streaming infrastructure. The system utilizes the ECG, temperature, oxygen saturations, glucose levels, and blood pressure as inputs. The BioStream helps in discovering new patterns and hypothesis from the data of every patient to provide better therapy.

ii. Intensive Care Unit (ICU) Monitoring

SIMON (Signal Interpretation and MONitoring)[8] is a system developed by the team at Vanderbilt. This system periodically collects bedside patient monitoring data. The data collected by the SIMON includepulse rate, blood pressure, pulse oximetry measurement, intracranial and cerebral perfusion pressures and ECG/ EKG waveforms. The system has also been designed to generate alerts when there seems to be an abnormality using the event notification mechanisms through a web interface.

iii. Predicting the onset of Complications in ICU

Artemis, an *Online Healthcare Analytics (OHA)*[9] infrastructure is a system de- signed for real-time analytics of ICU patients using the data collected from sensors. The system utilizes IBM InfoSphere stream analytics engine. This system interfaces with systems like the *BedMasterEX*[10], the *CapsuleTech*[11] and the *Excel Medical Electronics*[12] to perform data collection. It executes different machine learning algorithms on the data for the prediction of the inception of any hindrance of the patients in the ICU.

iv. Similarity learning of patients

MITRA[13] is a system developed as an extension to the existing OHAs. This system exploits the patient similarity concepts to assist the physicians in making decisions by leveraging the past experiences gathered from similar patients. The physicians can query the system to get records of similar patients in the past to make predictions about the patient's health.

v. Improving the patient experience and operational efficiency

Data analysis and mining applications have been developed to enhance the functioning of the operating rooms. These applications analyze the Electronic Medical Record data to improve the effectiveness of operating rooms with reference to scheduling and utilization.

The *AeroScout Patient Flow Solution* [14] for Clinics is a solution deployed in Stanley Healthcare, US, to automatically monitor the current location and the status of the patients, physicians, operating rooms and other resources using visual driven analytics. This way, the patient's wait time and patient movement between different departments of the clinical institution can be optimized leading to improved patient experience.

vi. Chronic Events Management

The *Holter Monitor*[15] is one of the widely used class of sensors by the people suspected with cardiovascular complications. The patients are advised to wear this for a period of time by the medical practitioners. The analysis is done on the recorded ECG data to detect any abnormal cardiac events. The *Personal Care Connect (PCC)*[15] is a remote monitoring system with advanced analytics capabilities. This system analyses the data with the rules constructed on the data hub when there is a change in the context of the user. It adjusts the thresholds of the vital signs based on the context of the user. For example, the threshold for the heart rate of the patients are adjusted based on the conjecture of the patient's activity.

The *MyHeart*[16] system is an intelligent system aimed at preventing abnormal cardiovascular conditions using smart electronic and textile systems based wearable sensors. The system embeds the body area network sensors with functional clothes to acquire and process the physiological data. The clothing monitors the patients and establishes communication with the patient and doctors wirelessly through different devices. It has been designed to be more comfortable to wear and is highly cost-effective compared to other sensors.

The *MOLEC*[17] is a system designed for the hospitable to raise an automated alarm in case of high-risk arrhythmias for a patient by analyzing the ECG locally on the PDA.

vii. Wellness Management

One of the major reasons for the occurrence of various clinical conditions among the human race is the physical inactivity. There are systems like *myHealthAssistant*[18] which utilizes the motion sensors data in addition to the general body sensors data to provide wellness and preventive healthcare services. The system captures a person's activity throughout the day and suggests

new workout plans based on the historical data. It combines the heart rate measure from the sensor to identify the activity of the person and to calculate the expenditure of energy in calories.

viii. Automated Telemedicine

The *Alert Portable Telemedical Monitor (AMON)*[19] is a system that establishes direct communication with a telemedicine center through a cellular network based on the detection of any abnormalities. It consists of a device encasing many sensors. It measures the blood pressure, ECG, body temperature, accelerometer and pulse oximetry.

ix. Cohort Discovery

The cohort discovery is a technique which gives the researchers and medical practitioners, the ability to query different sources of patient data to derive meaningful insights. This technique greatly helps in the better understanding of patients' disease history, and epidemiology, in the study of selected populations of people and in assessing the profitability of a treatment. The *IBM Explorys*[20] is one of the popular cohort discovery tools utilized in real time. It works on top of the *IBM Watson*[21]. The IBM Watson on cloud allows a user to exploit its intelligence, storage and management capabilities into an application in a secure way. The IBM Watson uses the *IBM DeepQA* [22] Software and the Apache UMA (Unstructured Information Management Architecture) framework implementation.

2.4 Cloud-based Data Storage

There has been a constant rise in the popularity of the cloud computing paradigm over the recent years. Cloud computing can be defined in simple terms as one of the plat- forms for providing distributed computing resources. The computing resources as shown in Fig. 4 may include storage, bandwidth, memory space, processing elements and so on. These resources are rented to the users employing the pay-per-use model. The demand for the resources may not be static, but they can be requested on-demand due to the growing internet facility. There are a number of factors which are essential for the success of a cloud system that includes availability, reliability and flexibility. These metric differ based on the perspectives.

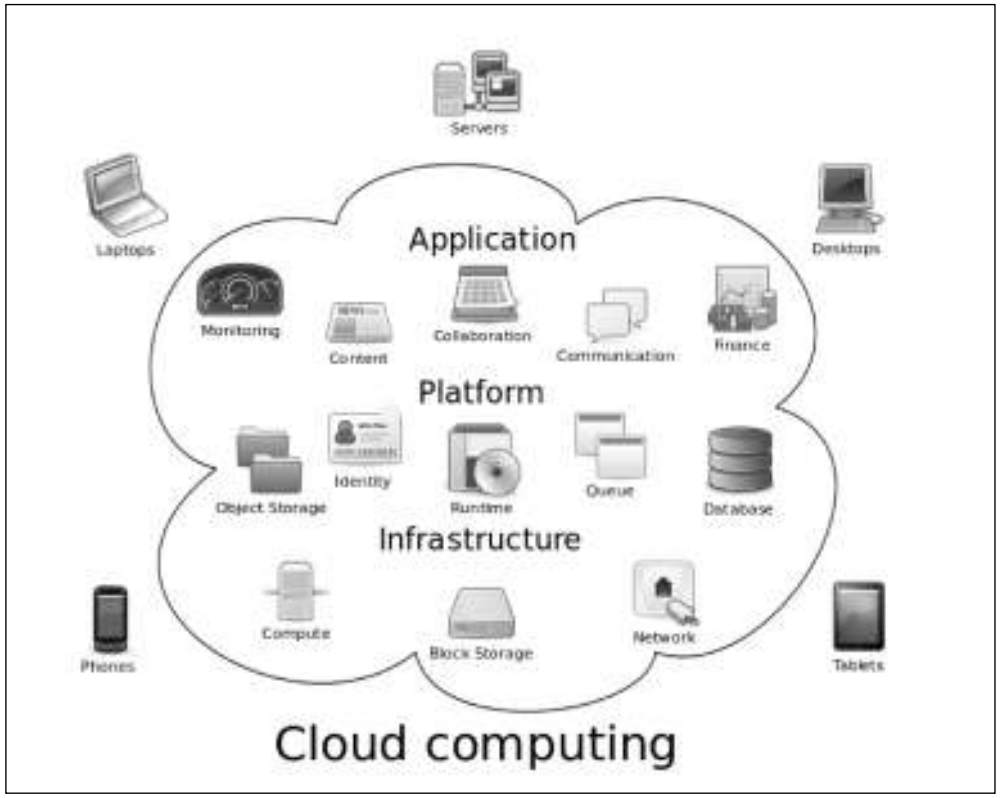

Fig. 4 Cloud Computing Architecture

The users of the cloud desire to have a minimized response time and cost, but on the other hand, the cloud provider focuses on achieving efficient cloud resources allocation and minimizing the maintenance costs. The Cloud Service Provider offers different plans of services to the users based on their requirements.

Most of the applications developed in the field of healthcare deploy sensors to collect data. The volume of data being collected, the velocity of data ingestion and the variety of data formats generated by the sensors makes it challenging to manage in the real time. In addition to real time processing of these sensor data, it is also exploited by different analytical processes. The data have to be stored in some persistent storage locations. The solution provided by the cloud is the SaaS. The data collected from the sensors are stored in the storage provided by any Cloud Storage Provider (CSP). The cloud storage facilitates the healthcare applications by managing data storage, data ingestion and data retrieval operations.

i. Data Storage

The cloud storage usually adopts a distributed database architecture. The distributed data storage can be basically defined as a network of computers

where the data is distributed on multiple computers. This distributed data stores have an increased availability of data. It also ensures consistency and high-speed read/write access to the data.

ii. Data Ingestion

Data Ingestion is an operation of collecting the data from the sources and importing it into a data store in real time. The data ingestion can be done as one record at a time or a batch of records from the source (sensors). This data ingestion has to be performed efficiently while storing huge amount of data with different data formats. This greatly helps in data retrieval and analysis.

iii. Data Retrieval

Data Retrieval is the process of extracting the essential data from the data store through searching to perform analysis. It is usually done with the help of some queries of REST API calls to the endpoint. The amount of time spend on data retrieval has to be optimal. This is usually difficult, particularly with different data formats from the data sources. Generally, to speed up the retrieval process, parallel computers are employed by the CSP to fetch the results of a request.

There are a number of choices that can be made when it comes to cloud storage. These choices can be made based on the amount of storage, type of storage system, storage cost and so on. In addition to the raw cloud storage options that are available in the market, there are some dedicated cloud-based PHR storage systems to assist the healthcare application developers. Some of these kind of systems are –

1. Google Health

Google Health [23] is a cloud-based system to store, share, analyze and retrieve personal health records. This system demands the user to create an account for authentication and then allows to store the health information through an API. The Google Health is also partnering with a number of healthcare providers to create a single point of access for a user's personal health records. In addition to the storage, consolidation and retrieval options, it also provides the user with an option to query for doctors and hospitals in a selected location and also other health related information.

2. Microsoft HealthVault

Microsoft HealthVault [24] serves the same purpose. It helps the users to store their health-related statistics. Besides storing the information, it also offers the users with the privilege to provide the data to different institutions such as hospitals, pharmacies, insurance companies, laboratories, and application developers on their will to provide different services.

Data lakes in the cloud are one of the important topics in the current research trend. A data lake is a storage repository that helps in holding huge amounts of data in its native format until the data is needed for analysis and processing. The advantage of deploying data lakes in the cloud for the data generated by the sensors is that it provides the ability to model complex forecasting systems and simulate scenarios. But implementing a data lake requires a careful preparation to generate meaningful insights.

3. Case Study

3.1 Intelligent Remote Health Monitoring System (IRHMS)

A. Description

IRHMS is a cloud-based application, with a motive to develop a healthcare system that utilizes intelligent soft computing based learning to classify the vital parameters measurement of the patients and to determine the severity level of the patients to provide suitable health services.

B. Environment Setup

1. Body Area Network (BAN) sensors with Bluetooth module,
2. Android mobile phones,
3. Java IDE
4. Cloud-based data store

C. Architecture

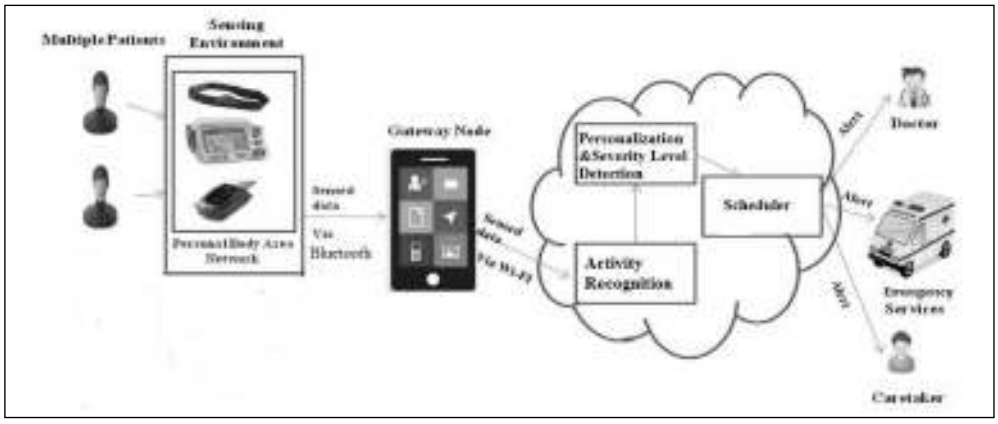

Fig. 5 IRHMS Overall Process

The overall process of IRHMS has been shown in Fig. 5. The first step of IRHMS is to effectively collect data from various biosensors connected to

the patients and persist it in the cloud in geospatial context through mobile nodes. The second step involves the learning, classification and the determination of the severity level using the vital parameters measured from the patients and the historical data. This task is performed with the help of trained probabilistic and the classification models. The third step is to generate alerts to the people connected with the patient and to cache the results back in the cloud storage.

D. Results

The results obtained after executing the model has been depicted in the Fig. 6. The IRHMS consists of a web portal for the doctors and the patients, a mobile app each for the doctor and patient. The data were collected using the sensors and through the mobile app, were persisted in the cloud. The collected vital parameter data is initially trained using supervised training methods like Naïve Bayesian Classification and Bayesian Belief networks to classify the five vital health parameters. Heart rate, Breathing rate, Electro Cardio Graph (ECG), and Blood Pressure are classified into one of the five abnormality classes viz. Very low, Low, Normal, High and Very high. Dissolved oxygen i.e., SPO2 which can be classified only into very low, low and nor- mal to give a generalized, universally optimal thresholds for each abnormality class. In real time, the system uses a sensor network to continuously collect values of the five vital health parameters and clusters them individually by applying an unsupervised clustering algorithm (modified K-means). The health care system is made adaptive by replacing the most outlier data with the trained data of patient.

Fig. 6 IRHMS Results

The algorithms were executed on the data collected from the patients and the results were ported onto the cloud. Alerts were generated to the concerned doctors and care-givers on the detection of any abnormality in a patient with the help of details collected from the doctors and patients during registration. The validation of the IRHMS was carried out in real time with the patients in the MIT Health Centre for a period of 1 week and it was certified to be a useful remote patient health monitoring system. The level of correlation between Classification and K Means for Breath Rate, Heart rate and BP have been depicted in Fig. 7a, Fig. 7b and Fig. 7c respectively. The accuracies are given in the following table I.

Table 1 Prediction Accuracies for the Abnormalities

Abnormalities	Accuracy
Breath Rate	80.27%
Heart Rate	87.8%
BP	95%

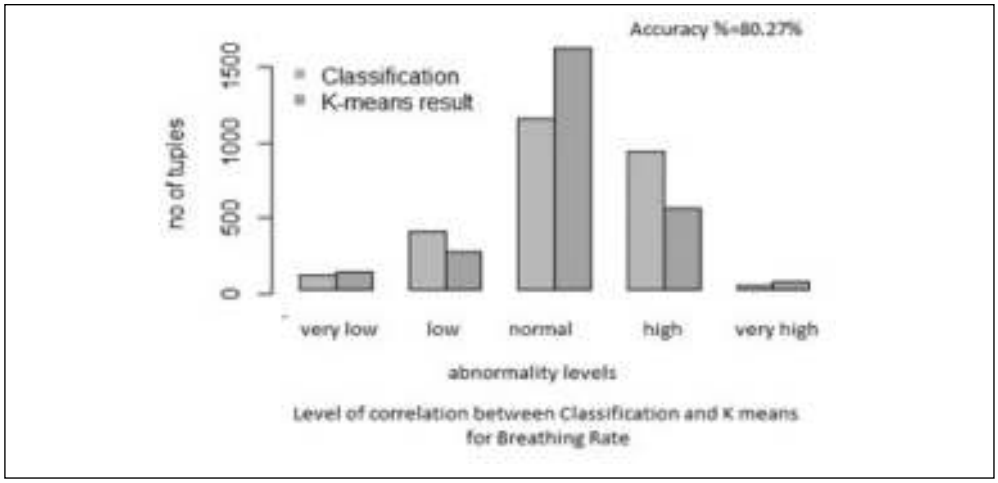

Fig. 7a Level of correlation between Classification and K means for Breathing Rate

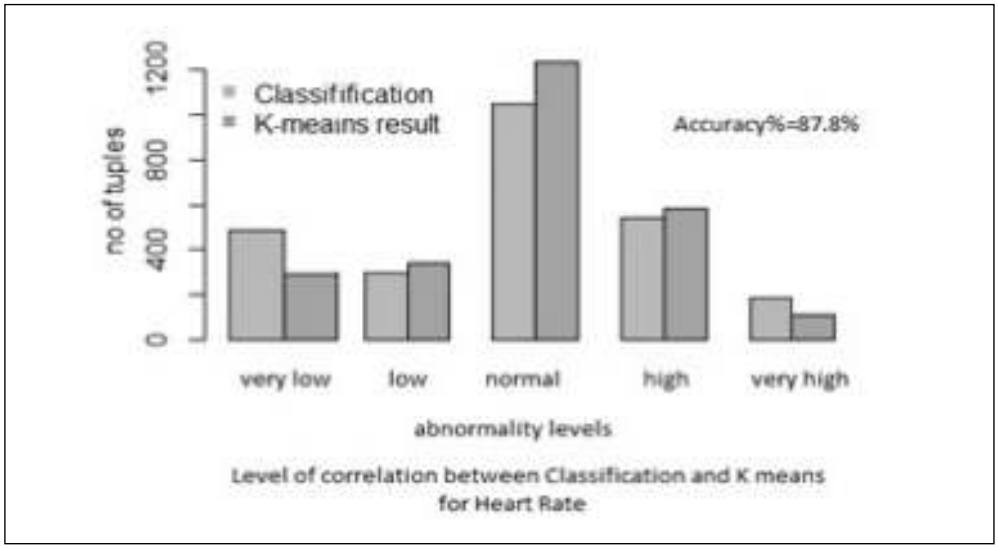

Fig. 7b Level of correlation between Classification and K means for Heart Rate

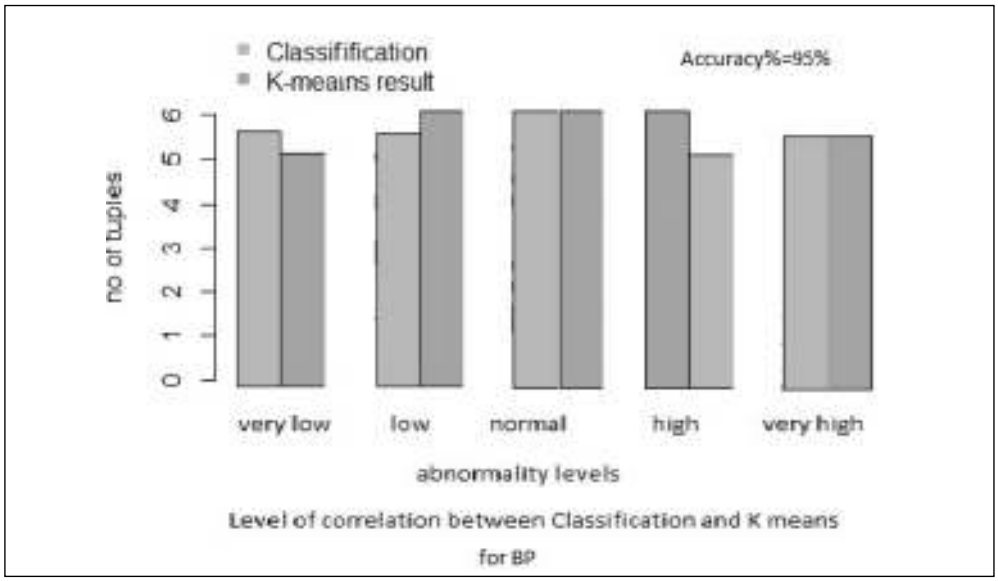

Fig. 7c Level of correlation between Classification and K means for Blood Pressure

3.2 Chronic Kidney Disease Prediction using IBM SPSS Statistics

A. Description

The case study was carried to out identify patients with chronic kidney diseases from the data collected. The data were collected from Indian hospitals for a period of 2 months. The final dataset consists of 25 features. A model was trained to identify patients with chronic kidney disease.

B. Environment Setup

1. IBM SPSS Statistics

C. Architecture

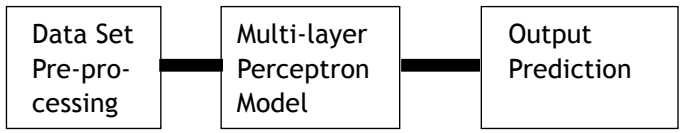

Fig. 8 Chronic Kidney Disease Prediction Architecture

The architecture adopted for Chronic Kidney Disease Prediction has been shown in Fig. 8. The dataset used for the prediction consisted of some missing fields. As a first step of the case study, the missing values were replaced with the mean of that attribute values. A multilayer perceptron model with required parameters and architecture was constructed using the IBM SPSS Statistics tool. The dataset was split using 3:1 ratio for the train and test set. The output of the model is the classification of each dataset instances as ckd or notckd.

D. Results

The results obtained after executing the model has been depicted in the Fig. 9. The model predicted the possibility of chronic kidney diseases in the patients with a very high accuracy.

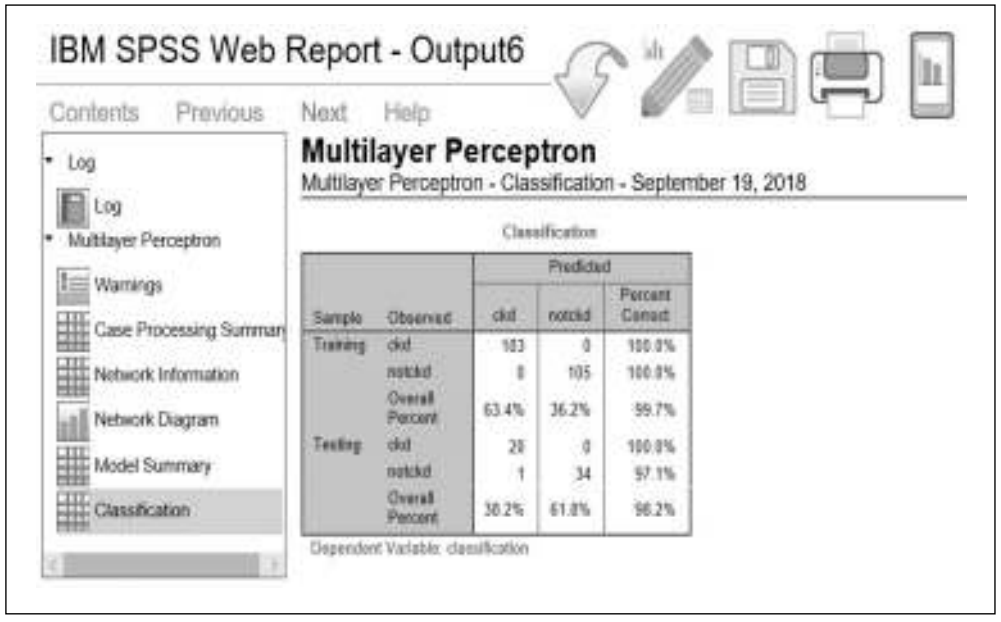

Fig. 9 Chronic Kidney Disease Prediction Results

3.3 IBM OpenPOWER

IBM OpenPOWER[25]was launched by the IBM as an open source model for hard- ware. It was created as a result of the convergence of three different forces that includes the Moore's law, the Google and the quest to extend the reach of Power8 technology. The physics of the Moore's law reached a limit since the microprocessors are no longer driving sufficient cost/performance improvements. Some kind of innovation was required in the system stack to retain the cost/performance track. The system stack consists of the applications, cloud, workload accelerators, advanced memories, optimized system design, custom system-on-chip, system software integration, and the processors. At this time, Google was planning to build their own servers to withstand these challenges. In the meantime, IBM needed a major disruption in the industry by the making the Power Architecture open. These events led towards the foundation of OpenPOWER in 2013. The core mission of the OpenPOWER is to create an ecosystem which is open with the help of the POWER Architecture to serve the advancing needs of the users and the industry. The vision is threefold. Ease the system design for the customers with the help of an alternative architecture.

Support the enterprise hardware and software stack expansion in the data centers. Provide the customers with the flexibility to build the servers best suited for their use case and to the Power architecture.

The OpenPOWER Architecture has different layers like Implementation, Software, Accelerators I/O and memory, Board & Systems and Chip. Currently, there are about 113 members like Hartree Centre, Google, NVIDIA, Wistron, Synapse design at different layers of OpenPOWER.

4 Conclusions

In this survey, the focus has been retained on the real-time pervasive healthcare, uti- lizing the IoT and cloud computing technologies. The current techniques that are ac- cessible for the realization of healthcare services are surveyed and highlighted. The IoT has immense potential to develop advanced services across domains by pushing the technological innovation to different heights. Analytics will be playing an important role in the future as an enabler to all the IoT applications. The case studies in this survey are an indication that these disruptive technologies will be introduced to the people in the near future.

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P.C. James*

The future of Health Insurance in India

Abstract

Health care is costly and its beneficial effects will be clearly tangible when health financing is made universal. This can be done mainly through insurance. The future of health insurance is tied to the directions in which morbidity and healthcare is headed. Areas for consideration include Wellness Focus, Health Savings Account, Critical Are and Long-Term Care. Most important is need to ensure that consumer demand and consumer interests are properly taken care of.

INTRODUCTION

Health insurance is an integral part of social engineering. Disease, accident and disability create downsides in human existence and the costs in dealing with them can be high [1]. Financing and managing health risks is essential not only for the wellness of the individuals concerned but also for their families, which has beneficial effects on community and country burdens as well. Health care is a growing industry owing to the importance that wellness has in the hierarchy of needs of the society. This has made healthcare the largest industry in the world.

As medical capability and services rise, medical costs are also seen to be rising in tandem, making healthcare increasingly unaffordable in day to day settings. A health disaster in the life of a person is an uncertain event, and the payout required is also uncertain and often high. However, since the risk is a frequency risk, it mandates coverage on a universal basis, where the rich and the poor, the young and the old are to be covered in one way or the other. Health insurance is set to grow in many ways facilitated by the many compulsions that health economics face to ensure that health care is made available and affordable to all [2].

Health care systems need to work in harmony and seamlessly to ensure that healthcare and wellness is promoted and proper care is provided to everyone who avails it seamlessly. To enable the insurance industry to face the challenge of insuring all, the shifting of costs and opaqueness in costing of health services need to be

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avoided. The terms and conditions of the policy need to get better understood not only by customers but also by all those providing the services and interpreting the policy conditions [3]. Customer capabilities to get the optimal benefits from all service providers in the system needs to be monitored and strengthened. Health care is an emotional issue and a heavy cost, and hence Regulations, Self-Regulations, best in class corporate/self-governance and professional standards should begin to be seen and felt in the system [4]. Best practices across the value chain should be competitively implemented, duly evaluated by independent agencies and all institutional oversight bodies should enforce minimum standards as required.

2 Meeting Customer Concerns in Health Care Insurance

Consumers incur heavy costs when facing health disasters which may not only include the monetary price, but also more intangible costs such as time cost, energy cost and psychic cost. The concerns that drive consumers of healthcare and health insurance are important in the context of the exigencies faced and should be addressed. These could include the following:

- Customer / Patient protection measures.
- Ensuring privacy and confidentiality of healthcare information.
- Full information disclosure
- Immediate 24x7 access to emergency services.
- Participation in treatment decisions, choice of doctors etc.
- Respect and non-discrimination
- Reducing confusions in the policies, practices, procedures of all agencies
- Cashless, hassle-free care and paperwork and settlement of costs and claims
- Measurement of patient satisfaction and clinical outcomes.
- Ensuring that consumer complaints are heard and redressed quickly.

Customers have expectations as to responsiveness, convenience and trustworthiness. Customer are getting empowered and their attitudes and behaviours are evolving. There is more self-reliance and less subservience to the medical or insurance establishment owing to widespread availability of information and relevant knowledge [5]. There are more instances of self-diagnosis, self-monitoring and self-care, appraisal and study. Consumers are getting more and more empowered as they are receiving increasing proactive assistance from consumer groups, employers and others who will intervene for them.

3 Meet the Rising Aspirations Consumers

3. 1. Consumer demand for meaningful information

Health and health coverage are matters of high personal priority for consumers and hence, assistance in choosing the right product, full disclosure about policy conditions, and other procedures would be necessary. The Regulator has ensured this in the regulations, but insurers, TPAs and care providers are not yet known for providing clear and useful information in simple language and prices, costs, limitations are not clearly spelt out. Terms of high promise and invitation to insure are used in health protection areas and if they fail in the promises expected, the backlash can affect the entire industry. Clear meaningful information is required to be disseminated which should inform customers that insurance is a complex concept, health insurance more so and that the processes can be many, the benefits cannot outrun the costs and so on [6].

3. 2 Performance Measurement and Satisfaction in service rendered needed

Insurers and TPAs will have to benchmark against not only what have been promised in their documents, but also meet increasing customer expectations both as to the time taken to render service, and as to the quality of service. Parameters of service excellence would have to be developed to ensure that customer satisfaction levels are kept high. Speed and responsiveness need to be measured. How fast and how much in terms of the customer expectations which has been created in the mind of the consumer, by the language and promises of insurers and TPAs, need to measured and the gaps addressed, in creating confidence in the system and service providers concerned.

3.3. Meet customer aspirations for innovative products and services.

In the anxiety to enroll numbers and make a profit, insurers may overlook the real needs of beneficiaries, especially in group insurances where the concerns of the employer or the group managers may override the concerns of the beneficiaries. New products and services would have to be developed which could base their attributes on the age, gender, lifestyle and other relevant aspects of consumer's life so as to align the insurance product offerings with their particular health care needs.

3.4. Meet the challenges of customer empowerment

It is possible that over the course of time consumer coalitions, government organizations, industry associations, information websites, and the media may empower customers with a variety of health-related information and services such as:

- Rating of hospitals, physicians, health plans, their quality and performance.

- Provider directories
- Guidelines for choosing hospitals, doctors, health plans.
- Health related news and articles.
- Links to health search engines
- Malpractice issues and other anti-customer activities
- Critical information about insurance policies and plans with comparative charts.
- Evaluation of insurers and TPAs and their services.
- Policy monitoring

Assistance in shopping for health insurance products. Insurers have to fine tune the art of informing and advising across all channels of distribution, communication and interaction with the insureds.

In the scenario of knowledge empowered customers, insurers will have to expand their capabilities, widen their service offerings and deepen their product options to meet customer requirements [7]. Consumer aspirations and activism coupled with competitive pressures will always threaten the status quo and create new avenues for improved quality of coverage, better care, greater efficiencies and at lesser overall costs and hassles.

Ultimately, healthcare issues will be evaluated on a comprehensive set of criteria such as quality, cost, patient satisfaction and health promotion. Insurers and their TPAs would have to make efforts to deliver the same to their insureds at affordable costs with optimal outcomes. In the evolution of healthcare, disease management is likely to give way to care management, which will create an integrated system of managing care, and will move from a focus on the inpatient arena to models that offer a continuum of care. Insurers will need to move in tandem with this to move up in the health value chain.

4. Expansion of Healthcare and Protection Concepts

Health insurers are now orienting themselves to more offerings based on their core competences and new directions of customer demand. Three areas of interest are emerging which will move forward in future:

4.1. Wellness Insurance

There is a rise in the awareness of wellness concepts, which is driven by the rising affluence levels of the population. Shifts in the income and consumption patterns of individuals and households backed by significant discretionary spending capability and the awareness of the beneficial effects of wellness, is prompting people to invest in wellness to enhance the quality of life and to be

disease free. Employers and institutions now focus on health and welfare issues and look to introduce beneficial wellness practices into people's lifestyles. Insurers need to join this movement so as to incentivise better health outcomes, which will result in reduction of disease manifestation and the consequent need for hospitalisation and critical care. Governments are also focusing on this theme by organising polio eradication camps, encouraging vaccinations etc. as part of the preventive care movement. Private initiatives also encouraging activities such as making school children understand the importance of washing their hands before eating.

Wellness can be defined as the process of creating and adapting patterns of behaviour that lead to improved health in various wellness dimensions. Wellness is considered to be the positive component of good health which reflects how one feels as well as one's ability to function effectively. Wellness is understood as a state of good health in which a person is in, before a disease starts or the risk factors for it sets in. Wellness also can be promoted at any stage of illness so that further progress of disease and deterioration of quality of life is prevented. Therefore, wellness is not merely the absence of disease, illness, and stress, but the presence of a purpose in life, active involvement in satisfying work and play, happy social relationships, a healthy body and living environment and general happiness and wellbeing. A wellness lifestyle includes a self-defined balance of healthy habits such as adequate sleep and rest, productivity, exercise, participation in meaningful activity, balanced nutrition, social contact, and supportive relationships.

The IRDAI in Health Insurance Regulations 2016 has foreseen the need to introduce ''Wellness and Preventive" aspects into health insurance offerings. In sec.19, the Regulation states that while wellness and preventive elements as part of product design is encouraged, no policy of insurance shall promote or offer the products and services of third parties who are not Network Providers. Insurers shall neither offer any discounts to the policyholders, in any form, on the products of the third parties either as part of policy contract or otherwise. However, Insurers may endeavour promoting wellness amongst policyholders of health insurance by offering the following health specific services offered by Network Providers,

1. outpatient consultations or treatments or
2. Pharmaceuticals or
3. Health check-ups including discounts on all the above at specific Network Providers.

Regulation also add that: Insurers may also endeavour to put in place procedures for offering discounts on premiums on renewals based on the fitness and wellness criteria stipulated and disclosed. Provided further the costs towards

the above services are factored into the pricing of the underlying Health Insurance Product.

Wellness based insurance products therefore would see a rise in offerings in future and their direction need to ensure better health outcomes, that would reduce the costs of health insurance, to make health care more affordable.

4.2. Savings Linked Health Insurance Plans

Insurance products can combine savings as part of its product proposition. This is welcomed because it allows people to build up financial assets while protecting themselves against insurable risks and shocks. It is well understood that the combination can be excellent when savings made by a person can protect him/her against small health shocks, while insurance covers can protect against large or catastrophic losses. Savings-linked insurance also offers an incentive for regular and longer-term savings.

Savings Linked Health Insurance Plans are health insurance products which are in vogue in some countries. It goes by names such as Medical Saving Account (MSA) or Health Savings Account (HSA) in these countries. A Savings Linked Health Insurance Plan can be a combination of two components:

- A High-Deductible health insurance cover
- A Savings Fund, which can be used to pay for non-covered medical expenses in future.

  Out of the premium paid regularly, a part of it goes towards the coverage of health risks, i.e. the risk premium and the remaining amount is accumulated in the savings fund. The savings fund is an account that the insured owns for the purpose of paying qualified medical expenses for self or dependents. This account is completely at the disposal of the insured and may be withdrawn in times of health care need. Some of the features or advantages of a Savings Linked Health Insurance Plan are:

- Reduced contribution of amount towards risk premium.
- Lower insurance premiums because of the high deductible plans.
- Coverage of routine illness through savings.
- Contributions are encouraged by tax exemptions.
- Choice allowed in the amount of contribution to be made.
- Choice in the utilization of funds.
- Tax exemption on the interest earned from the savings.
- Return of the Surplus amount at the term end.
- Transfer of the savings fund to legal heir(s) in the case of death.

There are a few disadvantages of a Savings Linked Health Insurance Plan also:

- Insured may have to bear the investment risk and cost.
- Accumulated fund maybe insufficient for medical needs in times of need.

The main advantages of this product are that unnecessary hospitalisation episodes can come down since the insured will be required to spend from his/her corpus, which can motivate the reduction of unnecessary treatments and costs. They are supposed to reduce adverse selection and moral hazard seen in normal health insurance. Customer stickiness and loyalty also can increase. Since the plan is for the long term the customer who avail of the plan will remain with the plan for a longer period of time.

These kinds of funds can be set up by insurers, employers, or by the government. The intent of Savings Linked Health Insurance is to encourage those who do not find the usual health insurance of value, except for high cost treatments owing to their younger age and/or very sound health status. This makes the cost of health protection much cheaper than the traditional insurance package. Employers or individuals can then deposit the funds saved into MSAs which can be used for health care or even funding future premiums.

Medical savings accounts [8] can encourage more prudent use of the health care system rather than overuse which may happen when health insurance of the normal kind exists. MSAs provide incentives for consumers to take a more active role in their consumption of medical care services and in their overall health status. These schemes are supposed to encourage saving for future health care expenses, allow the patient to receive needed care without a gatekeeper to determine what benefits are allowed, and make consumers more responsible for their own health care choices through the required High-Deductible Health Plans.

Savings linked health insurances are criticized that they may eliminate risk pooling in favour of individual managing their risk across years rather than across other people as a solidarity pool. This can add to an overall adverse selection problem at the macro-level. In a system having MSAs along with the usual health insurance covers, it is likely that the younger, healthier and wealthier individuals subscribe to MSAs attracted by their tax benefits whereas older, sicker individuals benefit only from staying in traditional insurance [9]. This may create a “de-insurance” as individuals increasingly switch over. There can be an erosion of solidarity as one moves from social health insurance to private health insurance to MSAs, and make normal health insurance unviable. Therefore, the direction of this insurance will require deep study on how to ensure that those who need care are not deprived of very large pool as cost of increase in treatment and consequent insurance premium goes up on one side, and people migrate out of the normal health insurance policy to an MSA on the other.

4.3. Long Term Care Insurance (LTC)

Long Term Care Insurance (LTC) [10] is a product created to protect an individual's assets and help maintain independence by paying for care required due to a cognitive or physical impairment. While these conditions are generally associated with aging, LTC Insurance can benefit all age groups. As the caring society concept expands, it is felt that one out of two senior citizens will need long term care at some point of time. Long Term Care becomes necessary when a chronic physical or mental condition of a person limits his/her ability to perform certain basic tasks, commonly known as Activities of Daily Living (ADL). The policy will cover the cost of benefits provided to the affected insured when the individual is unable to perform one or more ADLs, such as bathing, eating, or dressing. Long term care includes a full range of services, such as nursing home care, assisted living care, rehabilitation, and home and personal care.

Long-Term Care is an ongoing care Programme provided for those who are unable to look after themselves without some kind of support. Long term care can range from a couple of hours a day, through to 24 hour a day care. Long-term care insurance is not a single product. It can include any range of insurance products designed to contribute towards the costs of long-term care. It is normally a protection product (as opposed to investment), which meets some or all of the costs of care for the elderly who are in need of long-term care. A claim is usually defined by reference to failure of activities of daily living and/or cognitive impairment but can also be expressed in terms of amount of care, or assistance, required.

Aging is an irreversible biological phenomenon. One of the major features of demographic transition in the world has been the considerable increase in the absolute and relative numbers of elderly people. Further, the older population itself is aging. At times, old age is associated with unacceptance, denial, depression, loneliness, and a certain degree of alienation from the mainstream of family life. Changing lifestyles, attitudes, values and increasing generation gap compound the problem. The rapidly growing absolute and relative numbers of older people mean that more and more people will be entering the age when the risk of developing certain chronic and debilitating diseases is significantly higher. The 'epidemic' of chronic disease results in high rates of disability in elderly people. There is a deterioration of health for the majority as they grow older. For many elderly people, this deterioration, mental or physical, will become so severe that they become unable to function independently. Many will have disabling medical conditions, which are exacerbated by the frailty of very old age.

Long term care may be required by anyone, not just seniors. Care is usually required as a result of the effects of aging, either because a person has become physically unable to carry out everyday activities or because they experience cognitive impairment, such as Alzheimer's disease. Other times, long-term care may be needed because of chronic disease or while recuperating from an accident or serious illness.

Long-term-care insurance is for anyone

- who has assets to protect and not to lose it owing to high medical or care costs
- who is not wealthy enough to pay for long-term care out of savings
- who is healthy now (at present)

Following are some reasons to plan ahead and purchase long-term-care insurance early:

- A policy is usually guaranteed renewable once the policy in place, for as long as the insured person can continue to pay premiums.
- The premium is based on the age of the prospect at the time of enrolling in the insurance, and the premium is usually locked in for the life term of the policy.

Long-term care can be: skilled nursing care, or custodial care to help with the activities of daily living. The settings for long-term care can be

- in a nursing home
- in an assisted living facility
- in the insured's own home
- in an adult day care centre

Long-term-care insurance, like all insurance, requires one to pay a premium on a regular basis so that there is no need to pay a huge amount later on, in the event of a catastrophic illness or condition. The most common reasons that people might need long-term-care insurance are:

- a prolonged illness, such as cancer
- a degenerative condition, such as Parkinson's or a stroke
- a disability
- a cognitive disorder, such as Alzheimer's disease

The two categories of help that people need are:

- custodial or personal care (For disabled or ill people, this is hands-on help with the activities of daily living such as cooking, eating, bathing, dressing, and using the toilet. For people with cognitive impairments, this means supervision, protection, and verbal reminders to do everyday tasks.)
- skilled nursing care or rehabilitation, either in the home or at a nursing facility.

Long-term-care insurance can pay for long-term care, either in an institution (such as a nursing home) or in a residence, such as an assisted living facility or in one's own home. Because most people prefer an assisted living arrangement, rather than living in a nursing home, they benefit by having insurance to help pay for what they prefer.

5. Conclusions

Healthcare is an integral part of human welfare as good health is a core component of the human capital. Morbidity conditions are widespread irrespective of age or socio-economic classifications, and the risks therefrom are not only frequent, but can at times be of catastrophic dimensions. Invariably it is seen that health costs are rising and becoming increasingly unaffordable unless such risks are passed on to an insurer or to other types of risk bearers. Insurance of health is a superior option because through insurance everyone gets protection and are able to afford the "deep pockets" that an insurance scheme can offer. Health insurance schemes make the affordability attractive through relevant and differentiated products, which can be offered by the many players who are active in both general (including standalone health insurance) and life insurance.

Health underwriting and cost control trough the optimal health purchase capabilities will form the backbone of the growth in health insurance, which is characteristically a high-volume low margin business. The potential in health insurance is certainly a very large opportunity area running into thousands of crores of rupees as everyone has to come under the health protection shield. In order to control the runaway costs of healthcare, insurers will have to utilise many underwriting and managed care techniques to sustain the affordability platform over the long term. In this, the role of Third-Party Administrators will be considerable, and their service will not only involve management of costs, but also many value added services to assist customers.

Universalisation of health insurance is a matter of importance, and in this the Government, the Regulator, the providers, insurers, the TPAs and even the health care providers have a role to play. In offering healthcare to all, social security schemes, community and commercial insurance schemes can exist side by side, obtaining the necessary funds on the one side by taxation and on the other from voluntary premium charges. To make the premium affordable insurers can offer a variety of facilitations, so that the coverage is adequate and continuous.

The future of health insurance in India can only be bright as modern medical care will be virtually impossible without the affordability that can be possible only through risk transfer. Without insurance, the vulnerability of persons to loss of health and wealth is inevitable as health costs are both frequent and at times severe. Certainty of health insurance outcome will not only ease the problems for the individuals who are protected but also for the society and the country. It is therefore imperative

that proactive measures are taken at all levels including that of the government, regulators, insurers, medical providers, etc. to facilitate and propagate conditions favourable to the rapid growth of health insurance in as many ways as possible.

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Role of Women self-help groups in the holistic health care in India

Abstract

Self-help groups (SHGs)-small voluntary association of people from the same socio-economic background with a purpose of solving their common problems through self-help and mutual help. In India, self-help groups are women oriented and most of their activities are concentrated towards savings and credit activities. Since Women empowerment and health are interrelated -women's empowerment cannot be achieved by ignoring issues related to health of women. There have been fewer attempts to address the issue of women's health so as to have an impact on their total wellbeing.

INTRODUCTION

There is a common perception in development literature that increased participation of women in savings and credit activities or economic attainment will empower women and it is an effective tool to alleviate poverty and empower women has garnered considerable interest worldwide. There is also the perception that economic attainment will empower women's status in family and in the community, giving them more power to participate in decision-making process.

In the context of women's empowerment, it is assumed that when women come together, they find strength and move towards further knowledge and awareness. This process leads to further empowerment. Thus, collective action through self-help groups introduces an element of leadership, reduces risk and external threat, and enables women to overcome the oppression of patriarchy, and to realise their own true potential and achieve total wellbeing.

Women's empowerment cannot be achieved by ignoring or denying issues related to health of women. Although women's empowerment has been a central issue on the agenda of various developmental programmes till early 1990's, women's health has got little attention or at best it has been confined to the field of family planning and contraception. Various Government agencies recognised the strength of women

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groups to reach out to the larger sections of society with messages and campaigns related to family planning and use of spacing methods. Andhra Pradesh state witnessed significant improvement in achieving Millennium Development Goals (MDGs) like limiting population growth rates, reduction in child marriages, total immunisation of pregnant mothers and children, increased institutional deliveries, utilisation of mother and child health care services in Government hospitals through maternity benefit schemes of Central and State governments.

A research study conducted by Department of Community Medicine, BMCRI, Bangalore, India and Department of Community Medicine, Army College of Medical Sciences, New Delhi, India [1] made the following observations.

Illustration of the impact of self-help group on women's empowerment.

Indicator	Fully	partly	Un noticeable
Increase in income	-	52.6%	47.4%
Employment opportunity	-	48.4%	51.6%
Got importance in family	26.3%	66.3%	7.4%
Got importance in community	26.3%	66.3%	10.5%
Family empowerment	-	-	100%
Cooperation in social processes	75.8%	24.2%	-
Better relations & more friends	81%	19%	-
Improvement in personal health	21%	66.6%	15.8%
Improvement in family health	17.9%	54.7%	27.4%

Regarding the impact of self-help group on health knowledge and awareness, 69.5% had increase awareness regarding health and hygiene, 64.2% had knowledge regarding contraceptive methods, 50.5% had increased knowledge and awareness regarding care during pregnancy, followed by care of self-post child birth (51.6 %) and 59% had increased knowledge towards infant care.

Impact of self-help group on health knowledge and awareness is as follows

Indicator	Increase	No change
Health and Hygiene	69.5 %	30.5 %
Vaccination	79 %	21 %
Contraceptives	64.2%	35.8 %
Care during pregnancy	50.5 %	49.5 %
Care of self-post child birth	51.6 %	48.4 %
Care of Infant	59%	41 %

Impact of self-help group on empowerment and health regarding decision of seeking medical care and consulting doctor, 68.4% take self-decision on going to doctor, followed by 21% whose husband take decision regarding consultation of doctor. 39% of women discuss with their husband about reproductive health issues, with their husband. 72% women members also stated that their husband discuss Reproductive health care issues with their wife.

Self help groups in Andhra Pradesh prioritised as holistic health of family members and community members as important intervention. Effective health care includes promotive, preventive, curative and rehabilitative dimensions in the projects supported by the World Bank in Andhra Pradesh state [2]. It is with this ethos that the health pilot project planned a holistic approach to community based primary health care to empower people and communities to take care of their own health and take responsibility for the community's health. The three major principles are -

1] Equity, wherein the program must reach everyone, including the poorest of the poor.

2] Integration, where curative and preventive medicine will be integrated with other factors that enhance life and health, such as agriculture, education, and a safe water supply.

3] Empowerment, with a specific focus on women. Within mature SHGs, health activists were identified by the communities to become Community Health Development Workers (CHDWs).

These are to become the first contact persons for the delivery of simple health services, for which communities do not have to depend on the medical doctors. This will also give them opportunity to impart health awareness and education. The goal is for health to become part of daily routine, rather than something to attend to during an episode of illness. There was a base hospital (a charity hospital) to become the epicentre, to provide emergency care round the clock. The outreach activities are organised around this epicentre with the help of the CHDWs. A training centre was a CHE Centre (Continuous Health Education Centre).

Initiatives of Government to provide health care through Self groups in Andhra Pradesh

- Currently there are more than 200 million women members in the SHGs in AP and Telangana states in rural and urban areas.
- Stat Government implemented a plethora of schemes for improving the health of women, children and community.
- In the early 1990s, women members were trained as Mahila swasthya sanghas (MSS means women health groups) and were deployed to spread health messages to community members. Positive results were noticed in improved breast feeding practices among lactating mothers.

- During Janmabhoomi programs conducted in the first decade of the 21st century, communities broke silence on HIV AIDS and discussed preventive and protective measures.
- Substantial improvements were observed in the children of SHG members in the areas of malnourishment in pregnant and lactating mothers and new borne.
- SHGs spread the messages of PCPNDT Act and encourage poor and landless families to avail the benefits of incentives under the Girl Child protection schemes.
- Many SHGs are constructing Individual toilets and also encourage community to construct toilets under Swach Bharat Abhiyan. It is heartening to note that SHG members use savings for toilet construction first and claim subsidies later.
- Andhra Pradesh state has set up Generic drugs shops managed by women self help groups from 2015 onwards. These shops were successfully managed in Visakhapatnam district under the local telugu name **"Anna Sanjeevani shops"** set up **in** good business locations and in the premises of Government hospitals**.** The first ever shop located in KGH, VISAKHAPATNAM and government Hospital, Kurnool made good business. Of course the purpose of establishing these shops is to provide essential generic medicines to patients at an affordable prices, which is normally 30-40% less than other branded medicines and simultaneously provide livelihood opportunities to women SHGs. Later, generic drugs shops were given to SHGs in all districts. Currently more than 300 shops are managed by women SHG members/ women groups in Andhra Pradesh. Women not only developed business skills but are also aware the importance affordable health care and affordable medicines to patients.
- Under the National nutrition Mission launched by Government of India, some districts were selected for piloting the initiatives. Khammam district in Telangana state is one of the selected districts. Status of the district in some health related indicators published by NHFS is as follows:
- National Health Family survey (2015-16) revealed the following [3]

Indicator	Rural	Total
Sex ratio at birth	806	978
Drinking water	87.2%	84.5%
Households with Individual sanitation units	40.1%	50.3
Health insurance	75.6%	71.1
Child marriages	36.2%	32.4
Below 19 years pregnancies	19.9%	16.9

Married women using Family planning devices	69.7%	69.1%
Female sterilisation	69.0%	69.1%
Unmet needs of family planning	3.7%	4.5%
Average spending on delivery in private facility	3699	3499
Janani suraksha yojana received	91.9%	85.4%
Institutional births	92.4%	94.2%
Birth in Government hospitals	34.9%	32.4%
Birth by caesarean section	65%	66.2%
Vaccination in public facility	96.6%	96.7%
Caesarean in private hospitals	77%	78.9%
Children breast fed in 1 hour of birth	46%	49.5%

- From the above information, it's evident that Governments need to provide for family planning needs at the door steps of households and it is only possible to use SHGs as depot holders for FP devices.
- Awareness need to be created amongst pregnant women to try natural deliveries which will ultimately safe guard their health in the long run.
- There is also a need to raise campaign against child marriages in tribal areas.
- Under SWach bharat abhiyan, though toilets are constructed, SHGs should be motivated to construct water storage tanks with their savings amount to ensure utilisation of the units.
- **Talli bidda express** (free transport facility to pregnant women to go to hospital for delivery) is a round the clock service provided by government of Andhra Pradesh is worth emulating!
- Ready to eat food in Anganwadi centres to pregnant women and new borne children under Amruta hastham scheme will create a positive impact to prevent anaemia in mothers and children.
- Convergence of safe sanitation, safe drinking water and organic farming practices by women SHGs in Andhra Pradesh state will improve health status of families.
- Provision of LPG connections to households will reduce the burden of lung diseases amongst women. Initially under the DEEPAM scheme launched by Government of Andhra Pradesh, LPG connections were provided to women SHG members in 2003.

- Currently more than 100 million SHG members availed the benefits under the scheme. LPG connections to poor households not improved respiratory well being of family members, especially women cooking food but also reduced indoor air pollution besides saving forest in the immediate vicinity.
- Ujjwala scheme launched by Government of India in 2015 is a similar initiative to improve the health of women .
- Women SHGs in various states across India are engaged in making low cost sanitary napkins. This scheme will not only provide income generation opportunity poor women but also create awareness on reproductive and personal hygiene of women and adolescent girls.
- Several states in India witnessed women's movements against liquor sales by Governments as revenue earning measure to the State exchequer. One such Women's movement in Nellore district located in the southern tip of Andhra Pradesh state paved the way for women's savings movement in early 1990s. The Women's savings movement originated in Nellore District gave rise to self help movement in the state in which 200 million women helped the state to achieve Millennium Development Goals in the past and sustainable Development Goals in the present [4,5].

Conclusions:

From the above study we can conclude that self-help group is a useful platform to enhance women's health through increased knowledge and awareness on health issues, and financial security during health emergencies etc. it's very active in providing income generating activities.. Hence it is essential to involve the entire community and sensitize men on issues of gender equity. SHGs can play an important role in creating awareness on health issues through group meetings with women, by holding specific capacity-building trainings with the women on health issues.

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A study of AOD based PM2.5 variations in relation to ARI disease occurrence in an urban area

Abstract

Over the last decade, rapid increase of aerosols in the atmosphere across Indian subcontinent resulted in health implications to the community at large especially in urban area. Suspended Particular Matter (SPM) in the air may be hazardous to human health and cause health risks. Hence, there is a need to quantify the Particular Matter (PM) in the air. For this purpose, Vijayawada city, a typical urban area and an integral part of the newly developing capital region of Andhra Pradesh was chosen as developmental activities are being undertaken at rapid pace in this region. The city has a few air quality ground monitoring stations and data is being collected for more than 2 decades. The data collected includes PM10 and PM2.5 among other parameters. In the present study, an attempt has been made to understand the relation between PM collected through ground truth and satellite data and its impact on health in an urban environment. Since there is lack of dense network of ground monitoring stations to measure PM2.5 (particles with aerodynamic diameter<2.5ìm), satellite data was used to estimate surface PM2.5 values, based on the Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD). The space-time variability of bias-corrected (utilizing coincident in-situ observations) PM2.5 over the study area for the period of 2010 to 2016 was studied. Results have indicated that due to various anthropogenic emissions and developmental activities in the region, there is a change in the levels of PM10 and PM2.5 in the study area over six years. As part of the study, Acute Respiratory Infection (ARI) cases reported in and around Vijayawada and its relation to particulate matter was also studied.

INTRODUCTION

Particulate Matter (PM) consists of complex mixtures of organic and inorganic particles that vary in size, composition and origin. PM represents the sum of all the solid and liquid particles suspended in air some of which may be hazardous in

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nature. The PM includes dust, pollen, soot, smoke, and liquid droplets which are either directly emitted for burning or indirectly formed through the conversion of gaseous pollutants previously emitted to air particulate matter. The mass and composition in urban environments in general are grouped into two coarse and fine particles. The **coarse** particles are generally the larger particles with a size ranging from 2.5 to 10 μm (PM10) and the **fine** fraction contains particle size up to 2.5 μm. However, the limit between coarse and fine particles is sometimes fixed by convention at 2.5 μm in aerodynamic diameter for measurement purposes. Mostly the total mass of airborne particulate matter is usually made up of fine particles ranging from 0.1 to 2.5 μm.

Health studies have shown a significant association between exposure to particle pollution and health risks, including premature death (EPA, 2009). While PM10 are of less concern, and they can cause irritation to a person's eyes, nose, and throat, PM2.5 can cause more serious health disorders which include cardiovascular effects, respiratory effects such as asthma attacks and bronchitis etc. They can also enter deep into lungs and get into the alveoli and bloodstream. Scientific studies have revealed a significant correlation between fine particle pollutants and respiratory morbidity and mortality. World Health Organization (WHO, 2018), recognizes air pollution is a critical risk factor for Non-Communicable Diseases, causing an estimated 24 per cent of all adult deaths from stroke, 25 per cent from ischemic heart disease, 43 per cent from chronic obstructive pulmonary disease,29 per cent from lung cancer and 17 percent from acute lower respiratory infection. WHO has measured the levels of fine particulate matter from more than 4,300 cities in 108 countries, according to which ambient air pollution alone caused some 4.2 million deaths in 2016, while household air pollution from cooking with polluting fuels and technologies caused an estimated 3.8 million deaths in the same period. A consensus has been emerging among public health experts in developing countries that air pollution, even at current ambient levels, aggravates respiratory and cardiovascular diseases (WHO,2018).

2. Literature Review

There has been significant research about the effects of PM2.5 and PM10 world-wide which has connected high levels of exposure to these pollutants with significant health problems almost all countries have stringent regulations around maintaining safe levels of PM2.5 and PM10. Table 1 gives the WHO 2005 and Central Pollution Control Board (CPCB), India Standards for PM2.5 and PM10.

Table 1 : WHO and CPCB Standards for PM2.5 and PM10 limits

Pollutant	WHO	CPCB
PM2.5	10 ug/m^3- annual mean 25 ìg/m^3 - 24-hour mean	40 ug/m^3- annual mean 60 ug/m^3 - 24 hour mean
PM10	20 ìg/m^3- annual mean 50 ìg/m^3- 24-hour mean	60 ug/m^3- annual mean 100 ug/m^3 - 24 hour mean
Source: - who.int cpcb.nic.in		

Epidemiological studies examining these impacts rely on long-term ambient (both indoor and outdoor) measurements of particulate matter concentration. In the Indian subcontinent, high aerosol loading and its continuing rapid increase over the last decade (Dey S, Di Girolamo, 2011) is a major concern for the potential impacts on health. Ground truth measurements are provided through air pollution monitoring stations in the study area however, they are sparse and unbalanced in distribution, hence experts are using satellite technology to understand the spatial distribution of particulate matter.

Satellite data of atmospheric pollutants are now more widely used environmental management activities and for improved decision-making. Atmospheric composition satellite data for air quality (AQ) applications is now available and from Aerosol Optical Depth (AOD), Surface Particulate Matter (PM2.5) can be derived. AOD is a measure of the extinction of the solar beam by dust and haze that can block sunlight by absorbing or by scattering light. It gives us the amount of direct sunlight that is prevented from reaching the ground because of these aerosol particles. It is a dimensionless number that is related to the amount of aerosol in the vertical column of atmosphere over the observation location. A value of 0.01 corresponds to an extremely clean atmosphere, and a value of 0.4 would correspond to a very hazy condition.

The quantitative relationships between satellite derived AOD and PM2.5 is established using linear regression models (Hutchison et.al.,2005). Except long-range dust or pollution transport events, AOD is dominated by near-surface emissions sources. AOD retrieved from the visible wavelengths of various remote sensing instruments is most sensitive to particles between 0.1 and 2 micrometers. Studies have found correlations between satellite aerosol optical depth (AOD) and PM2.5 in some land regions. Several studies have also merged AOD with ground PM2.5 measurement to derive PM2.5 surfaces (Zhiyong Hu, Ethan Baker, 2009). The data are primarily collected by instruments on remote sensing satellites operated by the National Aeronautics and Space Administration (NASA) and National Oceanic and Atmospheric Administration (NOAA). There are multiple RS instruments including Moderate Resolution Imaging Spectroradiometer (MODIS), Multi-angle Imaging

Spectro-Radiometer (MISR), and the Sea-Viewing Wide Field-of-View Sensor (SeaWiFS) which provide monitoring of AOD. The annual PM2.5 grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD) with GWR, 1998-2016 consist of annual concentrations (micrograms per cubic meter) of ground-level fine particulate matter (PM2.5), with dust and sea-salt removed is available for interpretation of the PM levels across the world. Considering the fact that the remote sensing satellite data from sensors of various spatial resolutions is being made available for public benefit, the present study was taken up.

3. Objectives of the study:

The study is taken to monitor and correlate the spatial and temporal distribution of particulate matter for the period 2010 onwards to current period as per the availability of the data. The objectives of the study are as follows:

i. To ascertain and validate the potential of PM2.5 grids data from MODIS, MISR and SeaWIFS Aerosol Optical Depth (AOD) so as to understand the annual average distribution of PM2.5 in a typical urban area.

ii. To study the relationship between remote sensing Satellite derived PM2.5 data and ground monitored PM2.5 data, both for validation and real time estimation.

iii. To study the data on occurrence of Acute Respiratory Infections (ARI) in the study area and to find out whether any relationship exists between particulate matter data and ARI.

4. Study area

For this study, urban air quality in and around Vijayawada city, Krishna district of Andhra Pradesh, India was taken (Fig 1) which is approximately 60sqkm. The city is the third most densely populated region in the urban built-up areas of the world. It is also the second largest city in Andhra Pradesh by population. As of 2011 Census of India, the city had a population of 1,476,931and is one of the most densely populated cities with approximately 31,200 people per square km. It is located at 16.52° North Latitude 80.62° East Longitude and the average elevation is about 39 feet above the sea level. It has a tropical climate, with annual mean temperatures range between 23.4–34 °C (74–93 °F); with the maximum temperatures often crosses 40 °C (104 °F) in the month of May and the minimum in December and January months.

Fig. 1: Study area map of Vijayawada city, Krishna District, Andhra Pradesh.

According to the Central Pollution Control Board (CPCB), India, the air quality trends in Vijayawada were low with highest level of particulate matter (PM10). The hair pollution levels in Vijayawada city have been constantly going up in last five years and are exceeding the CPCB standards. The major sources of high PM levels in Vijayawada are vehicle traffic, burning of solid waste, re-suspension of traffic dust, coal-based power plants, waste oil reprocessing industries, stone crusher, foundries, other small-scale industries (Raju, Siva Sankar 2014). Municipal Corporation sanitary workers and private people burn waste material along on canal bunds, road sides and near houses which also add to the increase in particulate matter in the region.

5. Methodology

There are about nine air pollution monitoring stations, in the study area. The data for PM10 is being recorded by these stations and the CPCB derived annual average PM10 data for the period 2010 to 2017 is collected and used for analysis in this paper. Similarly, CPCB derived annual average PM2.5 data for the same period is collected (2014 to 2017) / derived through interpolation (2010-2013).

The global annual PM2.5 grids from AOD data of MODIS, MISR and SeaWIFS remote sensing satellites for the period from 2010 to 2016 are used for the study. In addition, the data on Acute Respiratory Infections (ARI) in terms of cases reported for the period from 2011 to 2017 in the region of the study was collected from the records of Department of Health, Andhra Pradesh.

The Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD) with GWR (Geographically Weighted Regression) for 2010-2016 were taken for the analysis. These datasets consist of annual concentrations of ground-level fine particulate matter (PM2.5) which combines AOD retrievals from multiple satellite instruments. The GEOS-(Geostationary Operational Environmental Satellite Program) Chem-chemical transport model is used to relate this total column measure

of aerosol to near-surface PM2.5 concentration. GWR is used with global ground-based measurements to predict and adjust for the residual PM2.5 bias per grid cell in the initial satellite-derived values. Since PM2.5 data, for the period 2010-2013 was not available from ground truth, the data for this period was derived as per WHO guidelines (WHO, 2014)

6. Results and Discussion

The present study aims to study the relationship between remote sensing Satellite derived PM2.5 data and ground monitored PM2.5 data and identify any relation with the ARI cases reported in the study area using the data sets collected and methods mentioned above.

Based on the WHO guidelines, the ratio PM2.5/PM10 for a period of 2014-2017 was calculated and the PM2.5 values for 2010 to 2013 were derived. The factor for annual mean was calculated and is estimated to be 0.4 as per the data available and analysis undertaken in this study. Similar interpolation studies have been undertaken in countries like USA and Australia and it was found that the conversion factor was 0.6; in Canada it was between 0.3-0.4 (WHO, 2014). Studies have also indicated that for individual cities the values may deviate from 0.4 to 0.8, and should be considered as approximate only. To substantiate this argument studies in California have shown that the conversion factor is about 0.71 (ug/m^3) (Mike Krause; Steve Smith, 2006) and 0.75 daily (ug/m^3) for Hong Kong (EPD, 2009). The PM10, PM2.5 data collected (CPCB) and derived (AOD) and ARI cases is shown in Table 2

Table 2: PM10, PM2.5 and ARI data for the period from 2010 to 2016 for the Vijayawada, Krishna District, Andhra Pradesh

Data \ years	2010	2011	2012	2013	2014	2015	2016
PM10(in ug/m^3) (CPCB)	93	90	95	104	100	110	102
PM2.5(in ug/m^3) (CPCB)	37.2*	36*	38*	41.6*	50	47	47
PM2.5(in ug/m^3) (AOD)	28.2	28.8	26.6	33.4	36.6	35.1	35.6
No of ARI Cases	-	631	1088	2502	2978	3770	1653

*interpolated values

Following the analysis of the data obtained from various monitoring stations, satellite data, the global annual PM2.5 grids from AOD data of MODIS, MISR and SeaWIFS remote sensing satellites for the period from 2010 to 2016 was further analyzed to understand the spatio-temporal distribution of PM2.5 across the 60sqkm urban

area of Vijayawada. Images showing the annual average distribution of PM2.5 derived from global annual PM2.5 grids, in study area are shown in Fig.2

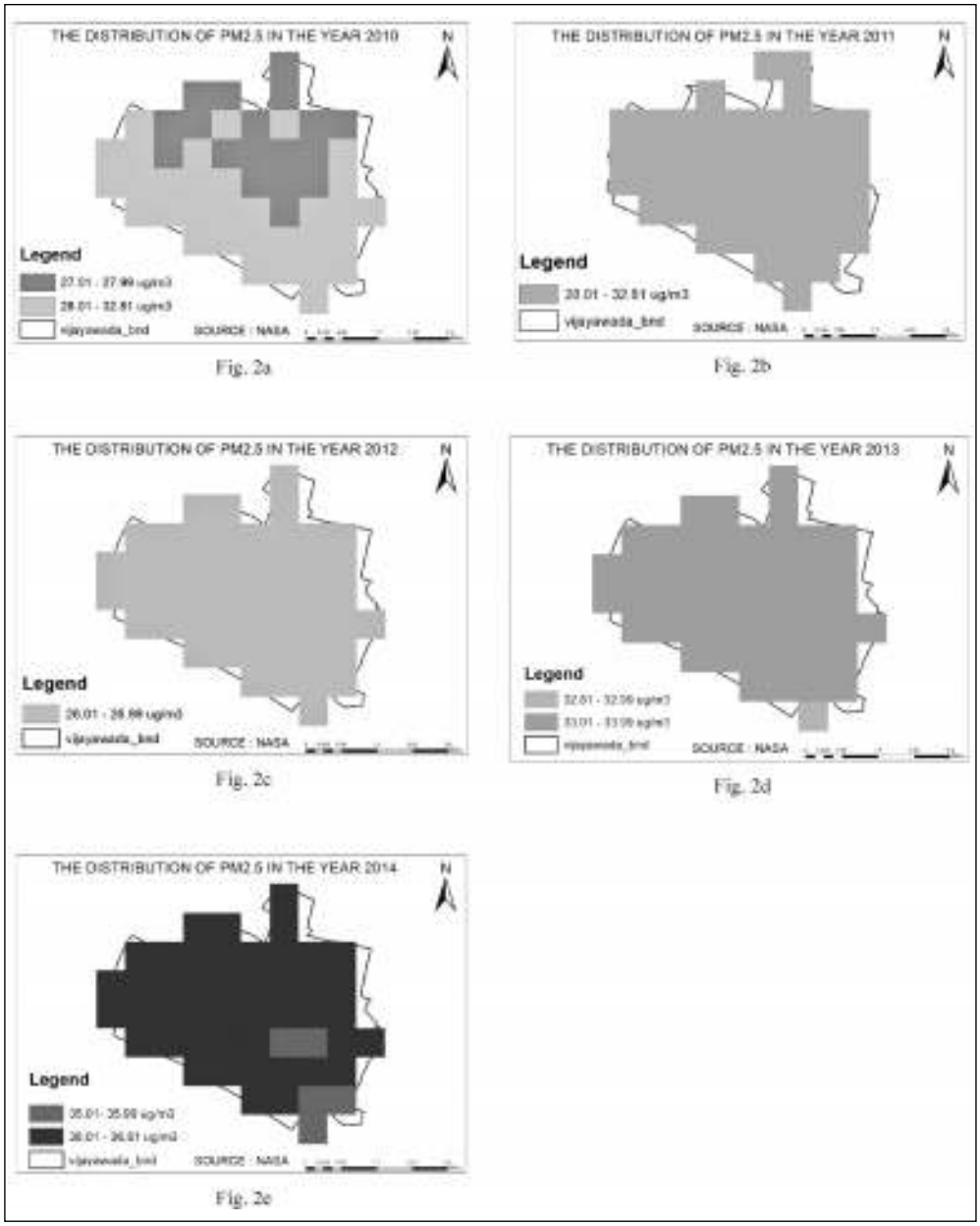

Fig. 2: a - g: Distribution of PM2.5(AOD) in the city of Vijayawada in ug/m^3

Fig. 2 shows the spatial and temporal variation in the annual average values of PM2.5 across Vijayawada from the year 2010 to 2016. The range of PM2.5 variation across the study area can be clearly seen along with the changes in AOD

concentrations across the six years of data. It can be seen that in the year 2010 the range of PM2.5 varied from 27ug/m^3 to 28ug/m^3, while during the year 2011, the AOD concentrations in the atmosphere has increased as can be seen in Fig. 2b. However, during the year 2012 (Fig.2c) a significant decrease in AOD concentrations (26ug/m^3) across the study area is observed.

It can be seen from Fig.2d that for the year 2013, PM2.5 values increased and are seen to be in the range of 32.8ug/m^3 to 33.9ug/m^3. In the year 2014, the PM2.5 values further increased to 36.6ug/m^3 in almost entire city except few southern parts. It is to be noted that through the entire study period the highest levels of PM2.5 was recorded in this year. It is seen from Fig, 2f and 2g for the years 2015 and 2016 the values of PM2.5 has reduced and were in the range of 34ug/m^3 to 35ug/m^3 which is above the WHO standards of PM2.5 indicating that the quality of air in the city is far from satisfactory.

While validating the data, a correlation study was done to measure the strength of the relationship between the satellite derived PM2.5 values and ground station PM2.5 data from CPCB. The correlation of the two datasets showed a positive linear relationship as given in Fig.3.

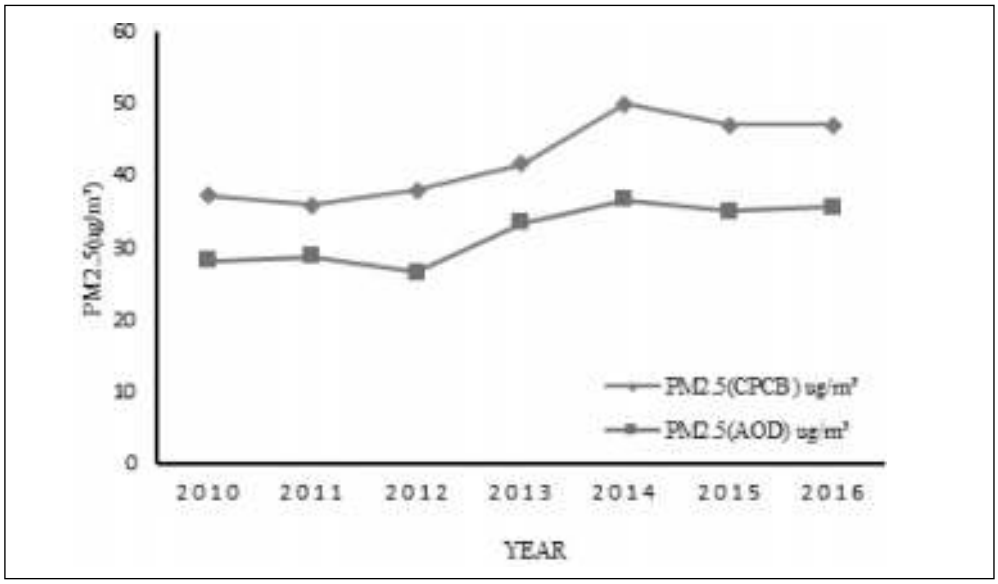

Fig. 3: Correlation between ground monitored PM2.5 and AOD derived PM2.5 values

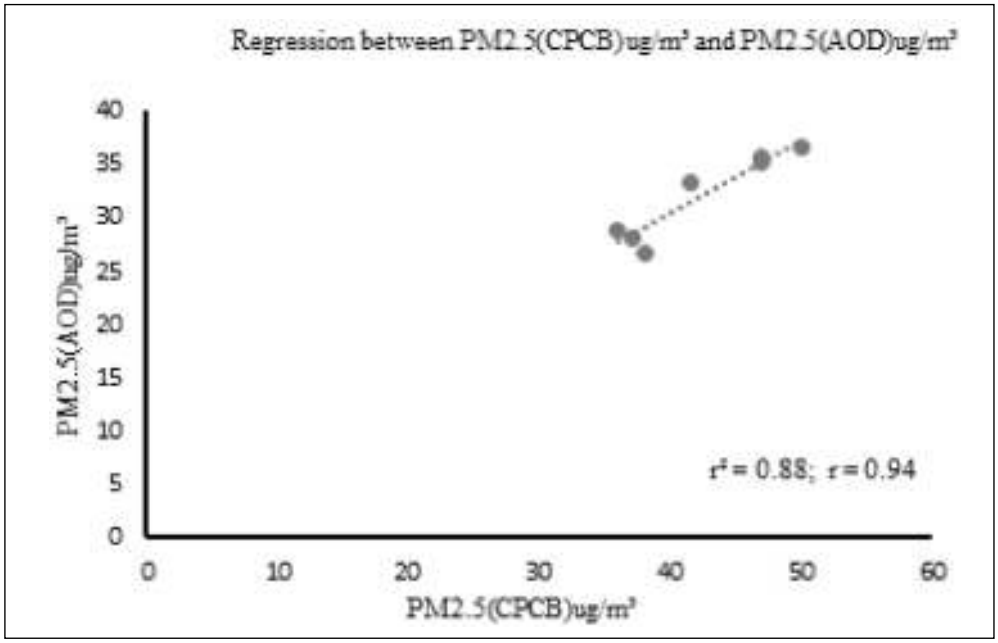

Fig. 4: Regression analysis -PM2.5(CPCB)/PM2.5(AOD)

Regression analysis was attempted to understand the relationship between satellite derived PM2.5 and ground truth data. The study showed the interdependency of the two data sets with an 'r' value as 0.94which is close to 1indicating high correlation between the two datasets (Fig 4). An important output of this study shows that the PM2.5 data obtained from the Global Annual PM2.5 grids are an additional source of datasets which can be used for estimation of suspended particulate matter in the urban environment.

Since the urban study area has shown higher PM10 and PM2.5 concentrations indicating that the quality of air with respect to suspended particular matter is poor, attempts were made to collect the data with reference to health effects due to PM. As established by health data in India and particularly in the city of Vijayawada, acute respiratory infections are one of the most prevalent air pollution related diseases in the region. The ARI data for the six years in the study area was analyzed and Statistical linear correlation was carried out and presented in Fig. 5.

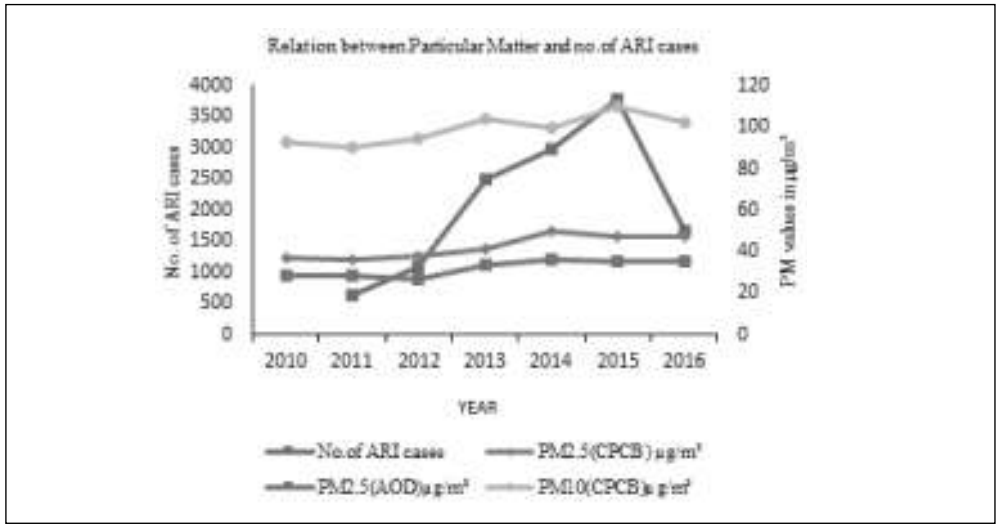

Fig. 5: Relation between Particulate matter and no. of ARI cases

Linear regression analysis between ARI and PM was carried out and is shown in Fig 6 and Fig.7. The regression between PM2.5(AOD) and ARI data showed a moderate positive linear association between them (r= 0.77) from Fig 6. Similarly, the regression between PM10 and ARI data showed a better correlation (r= 0.88) as seen in Fig. 7. This moderate to higher linear association between PM and ARI data suggests that the particulate matter can be one of the potential causes of ARI in the region. Although it is premature to draw a direct relation between ARI and PM the efforts are made in this study to have an order of magnitude qualitative assessment regarding the occurrence of ARI diseases with specific reference to increase or decrease in PM2.5 or PM10 concentration in the air. Accordingly, the regression is to be considered only for establishing the relative magnitude of occurrence of ARI disease and not for estimating the actual number of cases of ARI.

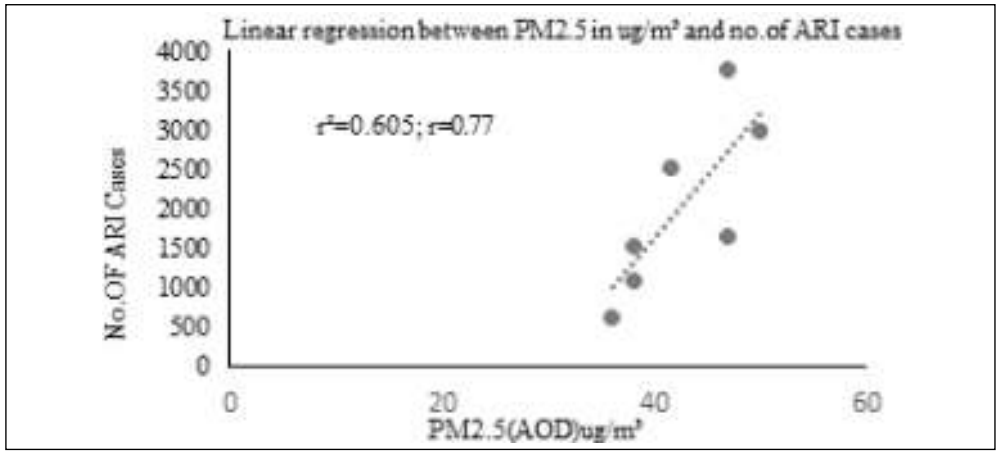

Fig. 6: Linear regression between PM2.5(AOD) and no. of ARI cases

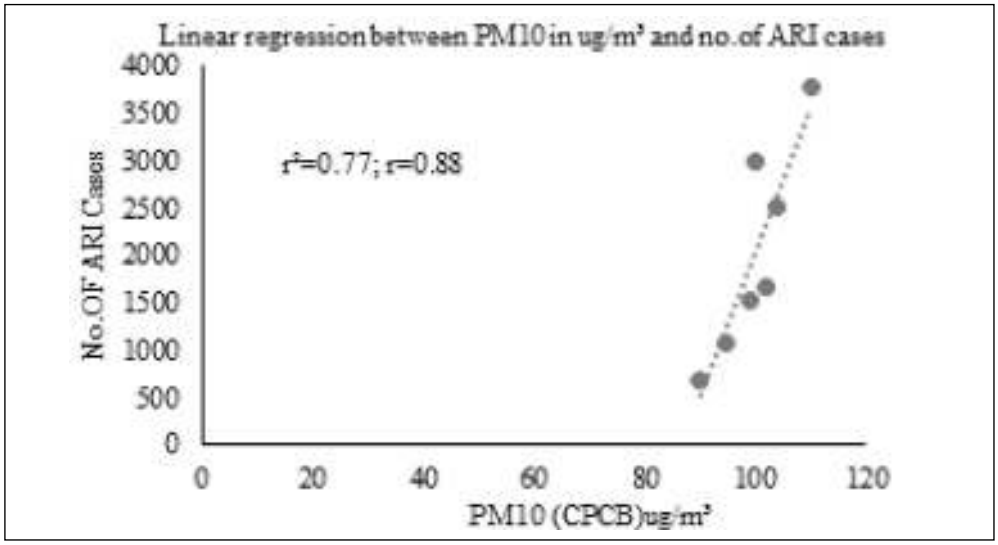

Fig. 7: Linear regression between PM10 and no.of ARI cases

5. Conclusions:

The study attempted to understand the relation between PM and ARI in an urban environment in Andhra Pradesh, India using various parameters of AOD, ground truth data of PM10 and PM2.5 for a six-year period. The Global annual PM2.5 grids data from MODIS, MISR and SeaWIFS Aerosol Optical Depth (AOD) was used to see the linkage between the various datasets.

From the analysis of PM10, PM2.5 data in the study area, it was established that the relation between PM10 and PM2.5 was a factor of 0.4 for the urban city in India. Analysis of PM2.5 derived from AOD and PM2.5 from ground truth showed a positive correlation. The study clearly brings out the relation between Satellite derive and ground truth PM2.5 data, and shows that PM2.5 data derived from AOD can be used to predict the air quality with reference to PM2.5 in the region. The data further showed that increase in PM2.5 concentrations has been seen over the last six years in Vijayawada, which could be attributed to increased urbanization. The regression analysis showed that there is positive linear relationship between the particulate matter and the occurrence of Acute Respiratory Infection in the study area. The increase in number of Acute Respiratory Infection Cases may be attributed to the increased portions of suspended particular matter in the air. The study establishes the applicability of remote sensing satellite derived PM2.5 values as an indicator of air quality for understanding the impact on health.

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N.V.N.S. Solene*

Stress among students of Corporate Junior Colleges in Visakhapatnam City

Abstract

India has one of the highest rates of suicides among students. The reasons may vary but failure in examinations is one of the most important factor. There are many complaints against the Indian educational system which includes long study hours and memorization. A study was done among the selected Corporate junior college students in Visakhapatnam city, by using 'STRESS COPING RESOURCE INVENTORY (SCRI) SCALE'. Results indicate stress coping scores are high in Wellness Scale (mean 3.05) , and low in Thought Control Scale (mean 2.73). Among girls stress coping is high in Wellness Scale (mean 3.29), and low in Active Coping Scale (mean 2.72). Boys stress coping is high in Active Coping Scale (mean 2.89), and low in Thought Control Scale (mean 2.69). Family support plays a key role for students facing stress. Family members and faculty of Junior colleges should provide more support and care to help students cope with various stressors.

INTRODUCTION

ParticulateStress, in a medical or biological context, is a physical, mental, or emotional factor that causes bodily or mental tension. Academic stress is a mental distress with respect to some anticipated frustration associated with academic failure or even unawareness to the possibility of such failure.

Students have to face many demands. For example:

- Performance in exams
- Their health
- Setting goals
- Social life

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- Improving their abilities/skills
- Competing with other students
- Lack of interest in the subject
- Unable to get enough sleep
- Fulfilling teachers and parents expectations and many more

The above demands may exceed available resources of the students, so they can be under stress. It can lead to students being unable to perform to the best of their abilities and accounts for variation in the achievement of goal and also contributes to major health hazards, both physical and mental stress related problems. These problems may not only affect the physical and emotional well being of a student and but also their families and educational institution where they are studying because it may damage the academic relationship between students and the institutions. There are several explanations for increased stress levels in college students. They include academic factors, social factors, family factors, emotional factors, financial factors and many; in addition to these students in college experience stress related to academic requirements, support systems, ineffective coping skills. To reduce the stress there are some mechanisms called stress coping mechanisms and we all use those in our daily lives.

OBJECTIVES:

- To assess the stress coping skills among the students and
- To know the gender differences in coping.

METHODOLOGY:

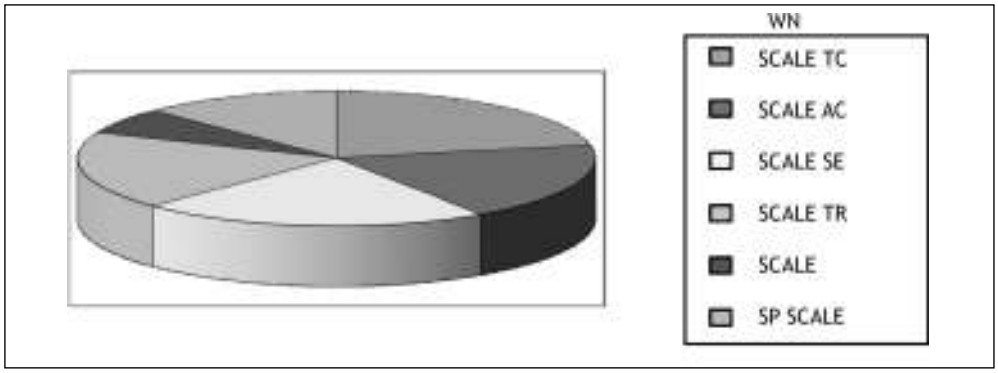
An observational and cross sectional study among corporate junior college students in Visakhapatnam city during the month of October 2016. Three colleges among all the corporate junior colleges in Visakhapatnam city are included in the study by simple random sampling technique (lottery method). From each of the selected college a total of 40 students (20 boys and 20 girls) are selected by using simple random sampling (computerized random number generation technique). Out of the total 120 students (40*3=120) 20 students (10 girls and 10 boys) are excluded of the study due to incompletely filled questionnaire. The students were briefed about the questionnaire and anonymity of the students is maintained and interaction is restricted between the sample group to achieve the legitimate results and the data confidentiality is assured.

TOOL

The students were administered a standard Stress coping resource inventory (SCRI) scale[9]. SCRI scale is 32 point questionnaire divided into 6 sub scales.

1 Wellness scale (1 to 7 questions)
2 Thought control scale (8 to 13 questions)
3 Active coping scale (14 to 20 questions)
4 Social ease scale (21 to 26 questions)
5 Tension reduction scale (27 to 28 questions)
6 Spiritual practice scale (29 to 32 questions) The same is represented in fig.1

Figure 1



Each question is rated from 4 to 1. An overall score (for each sub scale)

3.5 or more a superior stresscoper

2.5 to 3.4 an above average stresscoper

1.5 to 2.4 an average stresscoper

Less than 1.5 a below average stresscoper

The data was analyzed by using MS Excel 2007 and SPSS version 16.Results are expressed as percentages, mean ± SD and 't- test' to test the level of significance. A 'p' value of <0.05 is considered significant and chi-square test (non-parametric) were used.

RESULTS:

Based on means of all the 32 questions results are displayed as

In the present results,

- Out of 32, the top 3 maximum stress coping questions are from wellness scale (2) and social ease scale (1).

The wellness scale tests the health and well being of the people. The questions in the scale are related to their habits and daily life. In the overall study results the means scores are high for not using alcohol and tobacco. The mean scores and standard deviations are 3.9±0.31 and3.94±0.31 respectively. The scoring is given from 4 to 1 for options ranging from never having alcohol to presently abusing alcohol. This indicates the study participants are superior stresscopers without using alcohol and tobacco.

The social ease scale deals with the social relationships. The questions are meant to know their relation with family, friends, and relatives in stressful situations. In this scale the mean scores for relation with their parents is high with a value of 3.61±0.671

- Out of 32, least 3 questions with minimum scores are from active coping scale(resolving stressful situation), social ease scale(intentions of others towards you) and wellness scale(moderate exercise). The means are 2.28±0.90, 2.44±0.96 and2.48±1.41 respectively. According to the grading, it indicates the study participants are average stresscopers in above mentioned situations.

The overall scores for the study are represented in table 1 and fig. 2

Table 1: Stress Coping among the Students

SCALE	MEAN ± SD	STRESS COPING
Wellness (WS) Scale	3.077 ± 0.45607	Above average stresscoper
Thought Control (TC) Scale	3.077 ± 0.45607	Above average stresscoper
Active (AC) Coping Scale	2.76 ± 0.45788	Above average stresscoper
Active (AC) Coping Scale	2.963 ± 0.37547	Above average stresscoper
Tension (TR) Reduction Scale	2.7475 ± 0.7639	Above average stresscoper
Spiritual (SP) Practice Scale	2.98 ± 0.6396	Above average stresscoper

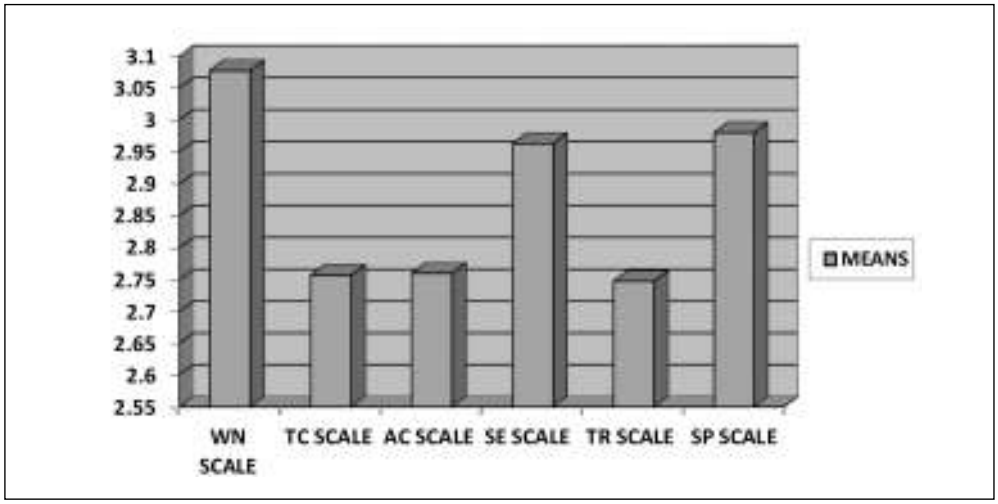


Figure 2

In all the sub scales the highest means scores are observed with wellness and thought control scales and least is seen with the tension reduction and active coping scales.

The results for boys and girls are calculated separately and are compared and presented in table 2 and fig. 3

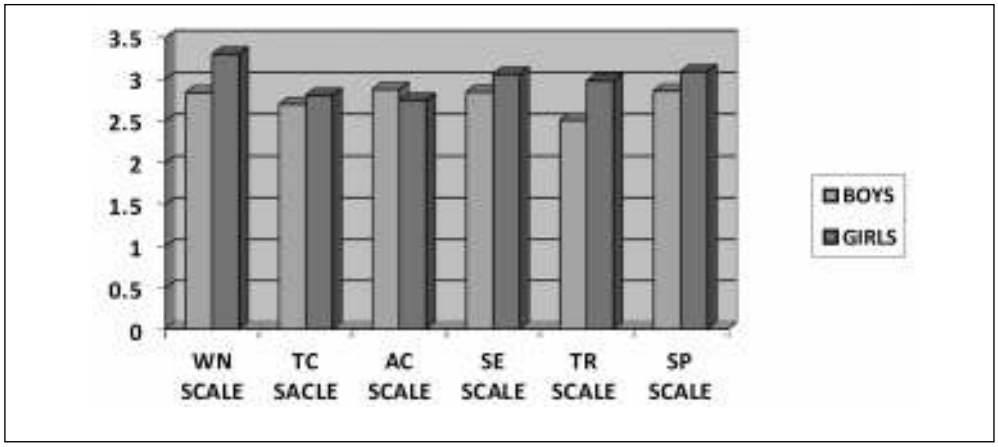
Table 2: Comparison of Stress Among Boys and Girls

SCALE	MEAN±SD OF BOYS	MEAN±SD OF GIRLS	'P' VALUE (t test)
WN SCALE	2.84±0.486	3.30± 0.276	0.000 *
TC SCALE	2.70±0.427	2.81±0.454	0.233
AC SCALE	2.88±0.528	2.75±0.369	0.144
SE SCALE	2.85±0.407	3.06 ±0.309	0.004 *
TR SCALE	2.51±0.850	2.98±0.588	0.002 *
SP SCALE	2.86±0.621	3.09±0.644	0.081

*A value of 'p'<0.05 is considered significant.

Though the mean scores for girls are high compared to boys except in the active coping (AC) scale, the significance by performing 't' test is seen only in the wellness(WN), social ease(SE) and tension reduction(TR) scales.

Figure 3



The following results are from some of the particular activities of the sampled students like sleep habits, moderate exercise, yoga and meditation practices etc., compared to the overall stress coping scores by using chi-square test and a 'P' value of <0.05 is considered significant.

[good stresscopers- overall score e" to 2.5 poor stresscopers- overall score < 2.5 regular- at least three or four times a week]

COMPARISON OF STRESS COPING WITH SLEEP HABITS OF STUDENTS:

	Good Stresscopers (overall score ≥ 2.5]	Poor Stresscopers (over all score < 2.5]	Totals
Students with Regular Sleep	44 (40.42) [0.32]	42 (45.58) [0.28]	86
Students with Irregular Sleep	03 (6.58) [1.95]	11 (7.42) [1.73]	14
Totals	47	53	100

The chi-square test statistic is 4.2733. The 'P' value is 0.038715 and the result is found statistically significant . This represents the students with regular good sleep are better stresscopers.

COMPARISON OF STRESS COPING WITH REGULAR PHYSICAL ACTIVITY OF STUDENTS:

	Good Stresscopers (overall score ≥ 2.5]	Poor Stresscopers (over all score < 2.5]	Totals
Students with Regular Physical Activity studnets with	21 (16.5) [1.23]	54 (58.5) [0.35]	75
No regular Physical activity	01 (5.5) [3.68]	24 (19.5) [1.04]	25
Totals	22	78	100

The chi-square test statistic is 6.2937. The 'P' value is 0.012117 and the result is found statistically significant. This represents the students with regular physical activity are better stresscopers.

COMPARISON OF STRESS COPING WITH REGULAR HEALTHY RELAXING PRACTICES (YOGA, LISTENING TO MUSIC etc.,):

	Good Stresscopers (overall score ≥ 2.5]	Poor Stresscopers (over all score < 2.5]	Totals
Students using healthy relaxing practices regularly	14 (14.45) [0.01]	71 (70.55) [0]	85
Students not using healthy relaxing practices regularly	03 (2.55) [0.08]	12 (12.45) [0.02]	15
Totals	17	83	100

The chi-square test statistic is 0.1126. The 'P' value is 0.737247 and the result is found statistically NOT significant.

COMPARISON OF STRESS COPING WITH REGULAR MEDITATION OF STUDENTS:

	Good Stresscopers (overall score ≥ 2.5]	Poor Stresscopers (over all score < 2.5]	Totals
Students who regularly mediate	45 (39.1) [0.89]	40 (4.9) [0.76]	85
Do not regularly mediate	01 (6.9) [5.04]	14 (8.1) [4.3]	15
Totals	46	54	100

The chi-square test statistic is 10.9911. The 'P' value is 0.000915 and the result is found statistically significant. This represents the students who regularly meditate are better stresscopers.

DISCUSSION:

The results from my study are congruent from the contemporaries(2). The contemporary studies have shown that girls are high stresscopers than boys. In the present study stress coping in girls is significantly high than boys in wellness scale ($p<0.05$ i.e. 0.00), social ease scale ($p<0.05$ i.e. 0.004) and tension reduction scale ($p<0.05$ i.e. 0.002). This indicates girls are using better coping skills in problems related to social relationship, changing their thoughts in stressful situations and also in maintaining their health for better well being.

In the remaining scales (active coping, spiritual practice, thought control) no significant difference is observed. The results of comparison of overall scores with stress coping mechanisms like regular sleeping habits ($p<0.05$ i.e. 0.038), regular physical activity ($p<0.05$ i.e. 0.0121), and regular meditation ($p<0.05$ i.e. 0.00091) are significant and is consistent with contemporaries[12,13]. One of the observation shows that healthy relaxing practices (yoga, listening to music) makes no difference ($p<0.05$ i.e. 0.737) in the stress coping of the studies but the result can be masked by the practice of other methods like of some of them mentioned above and there are many other studies proving the benefits of yoga[10,11].

LIMITATIONS:

No attempt is made to correlate stress and academic performance.

Only behavioral parameters were assessed and biochemical parameters could not assessed through questionnaire to confirm the stress.

CONCLUSIONS:

In the present study the stress coping is high in wellness and thought control scale and low in the tension reduction and active coping scales. In particular for girls stress coping is high in wellness scale and low in the active coping scale and for boys high in active coping scale and low in tension reduction scale. Girls and boys experience distinctly different patterns of stress during adolescence and mechanisms for coping are also different. As we have seen the results, stress coping is minimum in some issues. The following observations are made from the study that the stress coping is good in those students who regularly do the physicalactivity, who do have regular good sleep and those who do meditate regularly and who regularly follow the healthy relaxing ways of practices (yoga, listening to music).

RECOMMENDATIONS:

In a stressful situation we have to take active step without waiting because that makes a big difference in reducing mental agony. Embarrassment doesn't make a lot of sense. Since others intentions are only focusing a small portion of there thoughts onto judging you, your self-judgment is overwhelmingly larger. Exercise and other physical activity produces endorphins and also improve the ability to sleep, which in turn reduce stress. The practices like yoga, meditation, sleep, listening to music etc., are very helpful in reducing the stress. The teachers also play a very important role, they should provide support and care to help students to cope up with various stressors.

Family members should try to understand their interests, specialties, and abilities so as to avoid having too high expectations of them and causing additional stress. Thus family support plays a key role for students facing stress.

According to the present study results there should be counseling programs for the college students. Counseling programs must include various stressors of social, psychological and academic aspects.

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Mindfulness-based meditation to decrease stress and anxiety in college students : A narrative synthesis of research Mandy D.Bamber Joanne Kraenzle Schneider. https://doi.org/10.1016/j.edurev.2015.12.004

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