Geographic Information Systems (GIS) in health care

Natural Resource Model for Kaniyambadi block

Data Source: RRSSC, ISRO, Bangalore

Christian Medical College
Vellore
PART I

AWARD APPLIED BY:

PRIVATE SECTOR ORGANIZATION
PART II

INTRODUCTORY INFORMATION

PROJECT NAME: Geographic Information Systems (GIS) in health care – The CMC story
INSTITUTE: Christian Medical College, Vellore
AWARD CATEGORY APPLIED FOR: SKOCH DIGITAL INCLUSION AWARD - Health
ADDRESS:
Christian Medical College,
Ida Scudder Road,
Vellore, Tamil Nadu – 632004
India
Telephone: 0416-2282010
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PROJECT COMMENCEMENT DATE: 2001
PROJECT COMPLETION DATE: Ongoing

DETAILS OF RESPONDENT:
Dr. Sunil Chandy,
Director,
Christian Medical College,
Vellore, Tamil Nadu – 632004
India

Telephone: 0416-2282010
Email: directorate@cmcvellore.ac.in
GEOGRAPHIC INFORMATION SYSTEMS IN HEALTH CARE – THE CMC STORY

Brief overview of the project

The Christian Medical College, Vellore (CMC) is an unaided, Christian minority health care institution which seeks to promote health and wholeness in individuals and communities, especially those who are disadvantaged, marginalized and vulnerable. The use of innovative, appropriate and cost-effective technology in order to improve health care delivery to these sections of society is central to this vision.

One of the central tenets of public health is the complex relationship between disease states and the human socio-cultural-environmental continuum. Public health solutions, in order to be successful, need to be multi-pronged, and multi-tiered. However, most initiatives are hampered by the inability to study multiple interconnected factors simultaneously – a problem of money, manpower and willpower in equal measure.

The Department of Community Health at CMC, believed that a technology called Geographical Information Systems (GIS) could provide additional insights to better understand the complexities in disease transmission and inequalities in health among communities. GIS uses geographical data to map the distribution of people, natural resources and built up structures, and had hitherto found application chiefly in agriculture, industry, civic planning and defense. CMC’s involvement with GIS began in the year 2001 when an alumnus working at the Environmental Systems Research Institute (ESRI), California helped the Department of Community Health to spatially map a rural development block in Vellore district. This initiative
was later expanded to include the road networks, water, and sewage distribution systems in 82 villages of Kaniyambadi Block. More importantly, the spatial data was integrated with an existing Health and Demographic Surveillance System (DSS) for a population of over 100,000 people. This integration allowed researchers at CMC to explore spatially, the relationships between public health problems, affected populations, their living and built up environments, and climatic conditions, thus paving the way for appropriate public health interventions among the affected population.

We believe the use of GIS has improved the effectiveness of health care delivery in the target areas, and can serve as a template for replication all over India and other developing countries.

**Challenges faced before deployment of the project**

Since the concept of GIS and its applications was totally new to CMC, the lack of technical expertise in capturing, editing, cleaning and mapping of spatial data using GIS software was a major challenge faced by researchers at the Institution. Skill acquisition has been a steep learning curve, which started initially as self-learning under guidance of an expert in the year 2001. Later, two of the interested faculty from the Community Health Department picked up additional skills by attending GIS training workshops and national level Health-GIS conferences in India. A middle level Community Health physician acquired basic skills in Remote Sensing Systems and spatial analysis during his MPH training at Tufts University, Boston, USA in 2009. Building on this, the Institution conducted a GIS training workshop in the year 2011 with focus on spatial data capturing methods, mapping, and data visualization, to equip interested researchers across the Institution with the needed skills.
The objectives of the project

The main objectives of integrating a geospatial domain to the existing Demographic Surveillance Systems (DSS) was to better understand the epidemiology of prevalent health problems in the community, encourage and train young researchers in GIS methodologies and to apply relevant spatial analytical methods to public health related research activities undertaken at the Institution.

Description of the implemented project

GIS involves the use of an information system to capture, store, analyze and display geographical data in order to inform decision making. By allowing multiple layers of data to be displayed on a single map, GIS helps to describe the spatial relationships between people, their geographical location and the distribution of characteristics or events that are of interest to investigators.

The Department of Community Health at CMC has been actively involved in studying the spatial epidemiology of commonly prevalent health conditions in order to develop analytic approaches and solutions where needed, and GIS provided the perfect platform with which to approach this problem. The flowchart given below briefly outlines the steps involved in setting up the GIS for use by researchers at CMC.
Timeline of Health and GIS work at Christian Medical College, Vellore, India

2001
- First contact with GIS technology
- Initial exploration, self-learning

2001-2004
- Mapping a rural block (Kaniyambadi block); population = 120,000
  - Using hand held PDAs, driving around the village boundaries, walking through the streets and capturing house co-ordinates.
  - Around 26000 houses in 82 villages were mapped over 184 sq. km

2004-2006
- In collaboration with ISRO, natural resources were integrated for the rural block

2007-2008
- Spatial database created for 2 urban slums (population of 40,000)
- Environmental mapping initiated; water supply, distribution and sewage networks were mapped for both rural and urban areas.
- Started using available GIS data for routine surveillance and research activities in the Institution.

2008-2010
- GIS mapping of tribal hamlets (population of 45000) in Jawadhi Hills of Vellore district.
- Additional skills in Remote Sensing and advanced Spatial analyses acquired during MPH training at Tufts University

2011-2012
- Conducted first inhouse GIS workshop at CMC using internal faculty
- Creating Geodatabases from all existing spatial datasets

2013-ongoing
- Further expansion of coverage area to include additional 110,000 population in Vellore town
  - Environmental mapping ongoing
  - Continuous process of updation ongoing
  - Currently the Geodatabase covers a population of 300,000
  - Health utilization data, mortality and morbidity data spatially linked for over 150,000 population
  - In collaboration with NRSC, ISRO, a Health-GIS web portal launched
Once the GIS was operational, the Department of Community Health applied the information obtained to study the geographical clustering of various health conditions and develop health care delivery strategies that would benefit those sections of the population at greatest risk. The various multidisciplinary projects undertaken using GIS by are summarized below.

1. A network analysis of the roads in the villages helped to optimize the routes for mobile treatment units.
2. Spatial analyses of health conditions like epilepsy, low birth weight patterns, mortality patterns etc. enabled the identification of villages at higher risk and also identified clusters and hotspots at the micro level that were targeted for intervention.
3. Important junctions on the National Highway (NH46) and stretches of the NH with higher risk of fatality were mapped by linking police First Information Report (FIR) data on road traffic accidents and geospatial data in Vellore.
4. GIS in disease outbreak investigations, such as cholera and dengue, helped identify sources, map spread, plan interventions and implement strategies to control and prevent future disease outbreaks.
5. The Division of Gastrointestinal Sciences at CMC extensively used spatial techniques in its community based research initiatives to map the etiology and spread of enterically transmitted infections among children from urban and rural communities of Vellore, and their relationship to rainfall, temperature and humidity.
6. Monitoring of drinking water quality in Vellore town and spatial exploration of relationships between the living environment, water distribution systems and sewage networks have facilitated a better understanding of the relationships between domestic
consumption of water, risk factors for contamination of piped water supply, and sewage contamination, in determining enteric infectious disease in the urban slums of Vellore.

7. Combining laboratory investigation with geospatial analysis has permitted the detection of clustering of strains and emergence of new viruses that were not identified by routine methods.

8. The spatial exploration of the burden of Soil Transmitted Helminthiasis (STH) in tribal hamlets resulted in the identification of zones with higher burden of STH; this has helped in studying the associations between human behaviour, sanitation and hygiene practices and the transmission of STH in tribal areas of Vellore, which in turn has permitted planning of appropriate health interventions.

9. In collaboration with overseas partners, including Tufts University, integration of geospatial, meteorological (temperature, rainfall, humidity etc.) and health data, including human behavioral patterns, has provided further clues on the transmission dynamics of specific diseases in this region.

Thus, the use of GIS technology in CMC has been focused on identifying disease transmission pathways and designing interventions in order to reduce disease burden in the communities served by the Institution.
Illustrations highlighting the application of GIS in Public Health at Christian Medical College, Vellore, India
Diarrhea morbidity among children aged under five years

<table>
<thead>
<tr>
<th>Diarrhoeal morbidity</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence rate</td>
<td>0.28</td>
<td>0.55*</td>
</tr>
<tr>
<td>(per child per year)</td>
<td>(0.22 - 0.36)</td>
<td>(0.47 - 0.64)</td>
</tr>
<tr>
<td>Longitudinal</td>
<td>0.60</td>
<td>1.30*</td>
</tr>
<tr>
<td>Prevalence rate</td>
<td>(0.51 - 0.71)</td>
<td>(1.17 - 1.44)</td>
</tr>
<tr>
<td>(per child year)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Family size and cooking inside the house emerged as significant risk factors.

Significant hotspots for diarrhea were detected which varied by different seasons of the year.

Application of GIS technology for environmental mapping

Kaliyambadi Block - Virupachpura village, water supply lines, sewage channels and garbage.

Water pipes & sewage running closely

Areas of potential contamination
Spatial analysis in a vector borne disease - dengue outbreak

Clustering of cases in space and time

Mosquito breeding in areas where cases were clustered

Hotspots for Road traffic injuries in Vellore

Proportion of fatal RTIs around major junctions on the NH 46 (Jan 2005 to May 2007)

- State roads
- National Highway
- Police Stations

% Fatal injuries:
- 0.0 - 8.4
- 8.5 - 16.8
- 16.9 - 22.9
Description of the hardware and software products, technologies and solutions deployed in the project

The Institution has a ten user license for ArcGIS 10 software (ESRI, Redlands, CA, USA), which permits multiple users to work simultaneously across the different campuses of CMC. The software allows users to perform dynamic data visualization, spatial data management, and has the capability to perform advanced spatial analyses. Some of the spatial analytical methods which are often performed at the Institution include spatial interpolation, analyzing patterns in the distribution of health events, mapping clusters using cluster and hotspot detection, network analysis, and Geographically Weighted Regression techniques.

Details of coverage of targeted population

Table 1 gives details of the population covered by the project across rural, urban and tribal areas, while Figure 1 gives details of the areas in Vellore district for which GIS mapping has been completed.

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Name of the area</th>
<th>Type</th>
<th>Area (sq. km)</th>
<th>Settlements</th>
<th>Population</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Kaniyambadi Block</td>
<td>Rural</td>
<td>184</td>
<td>82</td>
<td>116000</td>
</tr>
<tr>
<td>2</td>
<td>Vellore Block</td>
<td>Urban and Rural</td>
<td>17</td>
<td>43</td>
<td>150000</td>
</tr>
<tr>
<td>3</td>
<td>Jawadhi Hills</td>
<td>Tribal</td>
<td>3100</td>
<td>80</td>
<td>45000</td>
</tr>
<tr>
<td></td>
<td>Total population covered</td>
<td></td>
<td></td>
<td></td>
<td>311000</td>
</tr>
</tbody>
</table>
Comparison of the pre-deployment scenario and the post deployment scenario

Over the last 13 years, from being a census database with 100,000 records, the DSS and geodatabases have expanded to cover a population of over 300,000 and spans rural, urban and tribal areas in Vellore district. For over half this population, the census and health/disease indices are spatially integrated.

CMC’s work on application of GIS to public health problems has been extensively published in indexed journals, a few of which are cited below:


Note on cost effectiveness of the project

Table 2 gives a breakup of the approximate costs for setting up the GIS lab. The initial investment pays sustained dividends as the geospatial data so generated can be used to study the distribution and characteristics of multiple disease conditions within the same population.

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Cost (INR)</th>
<th>Cost (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hardware</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GPS Mapping units X 10</td>
<td>250000</td>
<td>4545</td>
</tr>
<tr>
<td></td>
<td>Desktop computers X 2</td>
<td>100000</td>
<td>1818</td>
</tr>
<tr>
<td></td>
<td>All in one Laser jet Printer</td>
<td>30000</td>
<td>545</td>
</tr>
<tr>
<td></td>
<td>Server cost</td>
<td>300000</td>
<td>5455</td>
</tr>
<tr>
<td>2</td>
<td>Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ArcGIS 10 institutional edition – 10 licenses</td>
<td>750000</td>
<td>13636</td>
</tr>
<tr>
<td>3</td>
<td>Training costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Attending GIS workshops at Delhi- 2 members</td>
<td>200000</td>
<td>3636</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>1630000</td>
<td>29636</td>
</tr>
</tbody>
</table>

Note: Personnel and Infrastructure costs are not included

Details on extent of integration with other e-governance projects

In collaboration with the Indian Space Research Organisation (ISRO), a Research and Development initiative was undertaken with a team from the Regional Remote Sensing Center, Bangalore, in which health, geospatial and natural resource data at the block level were
integrated, and spatial epidemiology of common health problems were studied. As an academic center, we considered it necessary and appropriate to share our experiences with other scientists both within and outside India and our partnership with the National Remote Sensing Center at Hyderabad has enabled us to achieve this through ‘Bhuvan’, the Geoportal of ISRO. Our work applying GIS technology to better understand health problems is available for public use at http://bhuvan-staging.nrsc.gov.in/projects/health/health.php.

Details of cyber security measures in the project

The ArcGIS 10 software runs on a dedicated research server situated in the Community Health and Training Center, Department of Community Health, CMC, Vellore. The client versions are installed on Institutional computers which are connected on a secure network throughout the Institution. The research server has its own Kaspersky antivirus program which is updated on a daily basis, has programmed security measures in place, and is inaccessible to anyone outside the network. Data on the server is made accessible only to respective authorized personnel and is continuously monitored by an administrator. Accessing internet on the client computers is possible only by logging through Cyberoam, a network security client. All GIS data is stored on a dedicated folder in the server. The research server has mirroring provision, with the entire data on the server being backed up on extra hard disks and an external storage device on a daily basis.
Future road map on coverage, upgradation and integration with existing systems

The Department of Community Health at CMC hopes to widen the geographical coverage of Health & DSS information in the communities served by the Institution. A new area that is currently being studied is the spatial epidemiology of Scrub Typhus, since the morbidity and mortality associated with the disease is high in this region. We also want to strengthen the environmental component of our GIS database by adding air quality monitoring to existing Water, Sanitation and Hygiene (WASH) initiatives by collaborating with local partners and ISRO.

Members of the GIS application team

The following individuals were pivotal in setting up, upgradiing and maintaining the GIS work at the Institution.

<table>
<thead>
<tr>
<th>Name</th>
<th>Department</th>
<th>Specific role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Retd. Prof. Vinohar Balraj</td>
<td>Community Health</td>
<td>Initiating the GIS work</td>
</tr>
<tr>
<td>2 Prof. Venkata Raghava Mohan</td>
<td>Community Health</td>
<td>GIS administrator and local expert</td>
</tr>
<tr>
<td>3 Prof. Jasmine Prasad</td>
<td>Community Health</td>
<td>Program Manager for Rural and tribal areas</td>
</tr>
<tr>
<td>4 Prof. Gagandeep Kang</td>
<td>Gastrointestinal Sciences</td>
<td>Program manager for Vellore Block DSS</td>
</tr>
<tr>
<td>5 Dr. Rajiv Sarkar</td>
<td>Gastrointestinal Sciences, Wellcome/DBT India Alliance, middle level research fellow</td>
<td>Actively involved with research in urban areas</td>
</tr>
<tr>
<td>6 Mr. Mark Rohit Francis</td>
<td>Wellcome Trust Masters training fellow</td>
<td>Actively involved with research in rural and urban areas</td>
</tr>
</tbody>
</table>
Venkata Raghava Mohan, M.D., MPH
Professor

Christian Medical College
Department of Community Health
Bagayam, Vellore 632002, Tamil Nadu, India
Phone: 91416-2284207  FAX: (416) 2262268
E-mail: venkat@cmcvellore.ac.in

EDUCATION:

1999  MBBS  Medicine, Kempegowda Institute of Medical Sciences, Bangalore University, India
2004  MD  Community Medicine, Christian Medical College, Dr. MGR Medical University, India
2010  MPH  Epidemiology, Biostatistics, Tufts University, Boston, USA

ACADEMIC APPOINTMENTS:

<table>
<thead>
<tr>
<th>Duration</th>
<th>Institution</th>
<th>Appointment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999- 2000</td>
<td>Kempegowda Institute of Medical Sciences, Bangalore, India</td>
<td>Resident</td>
</tr>
<tr>
<td>2001- 2004</td>
<td>Dept. of Community Health, Christian Medical College, Vellore, India</td>
<td>Post graduate Registrar in Community Health</td>
</tr>
<tr>
<td>June 2004 –Sep 2009</td>
<td>Dept. of Community Health, Christian Medical College, Vellore, India</td>
<td>Assistant Professor</td>
</tr>
<tr>
<td>Oct 2009 – Oct 2013</td>
<td>Dept. of Community Health, Christian Medical College, Vellore, India</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>Oct 2013 – present</td>
<td>Dept. of Community Health, Christian Medical College, Vellore, India</td>
<td>Professor</td>
</tr>
<tr>
<td>Dec 2010 - present</td>
<td>Dept. of Public Health &amp; Community Medicine, Tufts University School of Medicine, Boston, USA</td>
<td>Adjunct Associate Professor</td>
</tr>
</tbody>
</table>
AWARDS AND HONORS:

2009  Best poster award for poster on applications of GIS in Health at Winter Symposium, CMC, Vellore.

2010  Runner up award at 2010 Tufts annual GIS poster exposition, Tufts University, Medford, USA.

2012  Best poster, Use of Remote Sensing in detecting land cover changes and trends of Malaria, ISEE, Hyderabad

MAJOR RESEARCH INTERESTS:

- Geographic Information System and health applications
- Outbreak investigation and management
- Epidemiology of Taeniasolium infections in humans
- Health Information Systems
- Road Traffic Injury research
- Remote sensing technology and health applications

MEDICAL REGISTRATION

2000  Registered with Karnataka Medical Council, India. No. 56760
2001  Registered with Tamil Nadu Medical Council, India. No. 67493

CERTIFICATIONS

1999  Orissa cyclone Medical relief camp, Indian Medical Association.
2000  2nd National Conference on Rabies, APCRICON, Bangalore, India.
2002  Principles & Practice of Epidemiology, CMC, India.
2003  Short course on Case control study designs, CMC, India.
2003  Short course on Clinical Trials, CMC, India.
2003  Short course on Economic basis of Health care intervention, CMC, India.
2003  Cochrane workshop on Meta-analysis, Bangalore, India.
2006  Staged Diabetes Management Training program, International Diabetes Center & CMC, India.
2006  Training of Trainers program, IMNCI, Vellore, India.
2007  Geographic Information System Training Programme, CMC, Vellore, India.
2008 Analysis using Stata, CMC, Vellore.
2008 Time series epidemiology jointly organized by CMC and InForMID, Tufts University.
2009 Statistical principles for assessment of associations jointly organized by CMC and InForMID, Tufts University.

RESEARCH ACTIVITIES

- Co-investigator in a study assessing the burden of active epilepsy and neurocysticercosis in Vellore district.
- Co-investigator in a study to reduce the burden of taeniasis in Vellore district.
- Co-investigator in a study looking at insulin sensitivity patterns among low birth weight males in South India.
- Principal investigator in studies looking at road traffic injuries in Vellore.
- Co-investigator in NIH funded Mal-ED project looking at the effect of enteric infections on growth of under five children in India.
- Co-investigator in a CDC-ICMR funded study looking at “Environmental predictors of water safety and enteric infections in the vulnerable population”.
- Principal investigator in a vaccine trial looking at the safety and immunogenicity of indigenously manufactured Killed Bivalent (O1 and O139) Whole Cell Oral Cholera Vaccine.

PUBLICATIONS: Over 25 papers in national and international journals
BIO DATA

Name: N. Jasmine Prasad
Sex: Female
Date of birth: 8.11.1959
Address: Department of Community Health
Christian Medical College, Vellore 632 002
S. India

Educational Qualifications:
MBBS Government Medical College, Tirunelveli
MD (Community Medicine) Christian Medical College, Vellore
Dip NB (Maternal & Child Health) Christian Medical College, Vellore
MPH Tufts University, USA

Designation
Professor in Community Health, Christian Medical College, Vellore

RESEARCH ACTIVITIES
a) Prevalence of reproductive tract infection among young married women in rural Tamil Nadu (funded by Rockefeller Foundation).
b) Sexual behaviour of adolescents in rural Tamil Nadu (Rockefeller Foundation)
c) Prevalence of induced abortions in rural Tamil Nadu.
d) Prevalence and types of domestic violence against women in rural Tamil Nadu.
e) Community based intervention – diagnosis and treatment for sexually transmitted infections and reproductive tract infection (Rockefeller Foundation)
f) Randomised trail on two methods of caesarian section - MisGav-LadacvsPfannenstiel
g) Prevention of mother to child transmission of HIV in Kaniyambadi block
h) Guide in HIV training course for Physicians

PUBLICATIONS: 28 publications in national and international journals
Bio Data

Gagandeep Kang, MD, PhD, FRCPath, FAAM, FASc, FNASc
Professor and Head
The Wellcome Trust Research Laboratory
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E-mail: gkang@cmcvellore.ac.in

EDUCATION AND TRAINING

Education

1986  Christian Medical College, Vellore, India. Degree: MBBS
1991  Christian Medical College, Vellore, India. Degree: MD
1997  Christian Medical College, Vellore, India. Degree: PhD
2000  Royal College of Pathologists, London, UK. Degree: MRCPath
2003  FondationMerieux, France. Advanced Vaccinology Certification

Medical Training


1988-1991  Demonstrator (Resident) in Clinical Microbiology, Christian Medical College, Vellore

1998-1999  Visiting Fellow, Central Public Health Laboratory, Colindale, London, UK

1999-2000  Visiting Scientist, Dept. of Molecular Virology, Baylor College of Medicine, Houston, TX, USA.

Professional Experience

2013-present  Head
Division of Gastrointestinal Sciences
Christian Medical College, Vellore

2008-present  Head
The Wellcome Trust Research Laboratory
Christian Medical College, Vellore

2000 –present
Professor of Microbiology
Department of Gastrointestinal Sciences
Christian Medical College, Vellore

1998-2000
Associate Professor of Microbiology
Department of Gastrointestinal Sciences
Christian Medical College, Vellore

1996-1998
Reader in Microbiology
Department of Gastrointestinal Sciences
Christian Medical College, Vellore

1991-1996
Lecturer in Microbiology
Department of Gastrointestinal Sciences
Christian Medical College, Vellore

1988-1991
Registrar in Microbiology
Department of Clinical Microbiology
Christian Medical College, Vellore

1987-1988
Senior House Officer in Ophthalmology
Dr. Rajendra Prasad Centre for Ophthalmology
All-India Institute of Medical Sciences, New Delhi

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Royal College of Pathologists
Indian Association of Medical Microbiologists
Indian Association of Pathologists and Microbiologists
Indian Society for Gastroenterology
Hospital Infection Society-India
American Society for Microbiology
Indian Academy of Tropical Parasitology
American Society for Tropical Medicine and Hygiene
Indian Society for Clinical Research

OTHER PROFESSIONAL ACTIVITIES

2000-2007
Secretary, Hospital Infection Control Committee
Christian Medical College, Vellore

2007-2009
Deputy Chairperson, Hospital Infection Control Committee
Christian Medical College, Vellore

2008-2012
Vice-Principal (Research), Christian Medical College, Vellore

2012-
Member, Research Advisory Board, Christian Medical College,
Vellore.

PEER REVIEW ACTIVITIES

Institutional Committees

2007-2008           Member, Research Committee
2007-present        Member, Institutional Biosafety Committee
2008-2012           Deputy Chairperson, Institutional Review Board
2008-present        Member, Institutional Animal Experimentation Committee
2009-2012           Member, Institutional Animal Care and Use Committee
2008-2012           Member, Steering Committee, CMC-DBT Stem Cell Research Centre

PUBLICATIONS: 163 publications in national and international journals
Curriculum Vitae

RAJIV SARKAR

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Dept. Tel: +91 416 228 2052, Fax: +91 416 228 2486
Cell Phone: +91 98940 84944, Email: rsarkar@cmcvellore.ac.in

Educational Qualifications

CHRISTIANMEDICALCOLLEGE (CMC) (Tamil Nadu Dr. MGR Medical University)
Doctor of Philosophy (Ph.D.) in Epidemiology
2008-2012

CHRISTIANMEDICALCOLLEGE (CMC) (Tamil Nadu Dr. MGR Medical University)
Master of Science (M.Sc.) in Epidemiology
2004-2007

NATIONAL INSTITUTE OF HOMOEOPATHY (NIH) (University of Calcutta)
Bachelor in Homoeopathic Medicine and Surgery (BHMS)
1995-2002

Employment

CHRISTIAN MEDICAL COLLEGE (CMC) Vellore, India
Wellcome Trust /DBT India Alliance Early Career Fellow
May 2013 – Present

CHRISTIAN MEDICAL COLLEGE (CMC) Vellore, India
Study Co-ordinator
March 2012 – February 2013

CHRISTIAN MEDICAL COLLEGE (CMC) Vellore, India
Project Manager
December 2009 – February 2012

CHRISTIANMEDICALCOLLEGE (CMC) Vellore, India
Senior Research Fellow
July 2007 – November 2009

PUBLICATIONS: 39 publications in national and international journals
Mark Rohit Francis BSc., MSc.
Research Fellow
Department of Gastrointestinal Sciences, Christian Medical College, Ida Scudder Road,
Vellore – 632 004, Tamil Nadu, India.
Cellular: +91-88709-60953, Email: elysium28@gmail.com

Education/Training:

<table>
<thead>
<tr>
<th>Date (mm/yyyy)</th>
<th>Degree</th>
<th>Subject</th>
<th>University/Institution</th>
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<tbody>
<tr>
<td>11/2013</td>
<td>MSc/DLSHTM</td>
<td>Epidemiology</td>
<td>University of London &amp; London School of Hygiene and Tropical Medicine, London.</td>
</tr>
<tr>
<td>02/2013</td>
<td>PG Dip.</td>
<td>Epidemiology (Distance learning)</td>
<td>Indian Institute of Public Health, New Delhi.</td>
</tr>
<tr>
<td>04/2008</td>
<td>B Sc.</td>
<td>Zoology</td>
<td>Madras University, Madras Christian College</td>
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Academic Appointments:

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<td>Sep 2013 - present</td>
<td>Wellcome Trust Masters training fellow</td>
<td>Department of Gastrointestinal Sciences, Christian Medical College, Vellore.</td>
</tr>
</tbody>
</table>

Training/Certifications:

- **Community Health Programme (CHP)** - Basic Epidemiology, Health Care System Studies, and Project Planning (2008).
- **Short Course in Biostatistics** - Principles of Epidemiology, Fundamentals in Biostatistics and SPSS, CMC, Vellore (2008).
**Born Care**, USAID and John Hopkins Bloomberg School of Public Health (Online certification) (2009).

- Workshop on **Qualitative data analysis and Data entry** using CSPro and Epiinfo, MCH-Star, New Delhi (2010)
- Workshop on **Mathematical Modelling of Infectious Diseases** at IDTRC, CMC, Vellore (2010).

**Publications:** 8 publications in national and international journals

**Research Interests:**

- Water, Sanitation and Hygiene interventions in developing countries
- Gastro-intestinal Infections
- Spatial Epidemiology and Geographic Information Systems
  Epidemiology of infectious diseases