

REMOTE SENSING, GIS AND PUBLIC HEALTH

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Abstract

The role of remote sensing (RS) and Geographic Information Systems (GIS) in public health is potentially great. As computer technology it continues to transform our ability to gather, analyze, and map health data, new roles for RS and GIS in public health may emerge.

Keywords: Public Health, Disease Mapping

I. Introduction

Remote sensing (RS) and Geographic Information Systems (GIS) have capabilities that suite for use in public health and epidemiology fields such as infectious disease surveillance and control. They are also highly relevant to meet the demands of outbreak investigation and response, where prompt location of cases, rapid communication of information, and quick mapping of the epidemic's dynamics are vital.

Geographic information (i.e. disease mapping) in public health and epidemiology has a long history and maps showing the geographical distribution of yellow fever were produced in 1798¹, and in the 1850s an English anesthesiologist, John Snow (**Figure 1**), mapped the locations of cholera cases in Soho, London (**Figure 2**), leading him to the conclusion that water from the Broad Street pump was responsible for the cholera outbreak^{2,3}.

However, until recently, the use of both RS and GIS tools in public health were limited due to problems: high cost of hardware and great complexity of GIS software that made it extremely time-consuming as well as costly to extract information relevant to the practical demands of disease prevention and control. The situation has changed dramatically over the past few years. Hardware prices have

dramatically dropped, simple new devices are now available, and a new generation of civilian satellites is in orbit, circling the world.

Practical uses of RS and GIS in public health area can be as follows,

- Determining geographic distribution of diseases
- Analyzing spatial and temporal trends
- Mapping populations at risk
- Stratifying risk factors
- Assessing resource allocation
- Planning and targeting interventions
- Monitoring diseases and interventions over time

II. WHO's public health mapping programme

WHO's public health mapping programme has been started since 1993, to promote and implement GIS into decision-making for a wide range of infectious disease and public health programmes. The Public Health Mapping Program based WHO Communicable Diseases⁴ has been developed with the goal of providing greater access to simple, low-cost geographic information and related data management and mapping systems to public health administrators at all levels of the health system.

In support of remote field data collection activities, WHO has been routinely using GPS

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Figure 1. John Snow

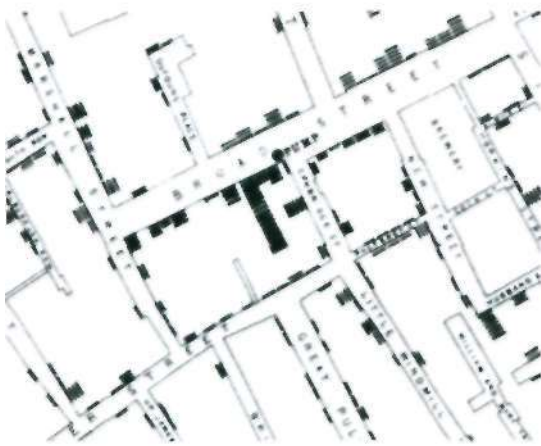


Figure 2. Broad Street Pump Outbreak



Figure 3. GPS/CDMA device (SECOM)
height 7.9 cmxlength 4.3 cmxthickness 1.82
cmOwight: approximately 48 g (including battery)

to map and track infectious diseases at community levels. GPS are now routinely used by village outreach teams for infectious diseases such as onchocerciasis, guinea worm, African Trypanosomiasis (sleeping sickness), lymphatic filariasis. The systems are used during the investigations of disease outbreaks for rapid mapping of cases and deaths and within the context of complex emergency situations they are being used for mapping internally displaced persons, refugee camps and rapid epidemiological assessments. This is one of the most successful programs that utilize RS/GIS techniques in public health area.

III. Analysis of Japanese elder's behavior using human RS (our attempts)

In Japan, we are now facing aging society rapidly. Therefore, to support elderly person and sustain their comfortable life (golden years), it is necessary to detect trivial behavioral change of elderly in daily life as early as possible, and prevent behavioral abnormality such as "TOJIKOMORI (in Japanese word, means behavioral abnormality that elderly lock or shut themselves in a room or house, or generally withdrawing), leading to bed-ridden.

Until recently assessment of elderly behavior, wcusually collect subjective information by using questionnaires responded by elders themselves or their cohabitant families. However, since cognition impairments (recalling bias) or family cohabitant status would influence behavioral assessment using questionnaire, their reproducibility and validity is quite doubtful.

We aimed to investigate the behavioral change and the factor that is tied up to the abnormal behavior of elderly, using commercially available device, which had dual remote sensing system composed of both GPS and CDMA technique (Figure 3, GPS/CDMA device, SECOM, Tokyo Japan, height 7.9 cmxlength 4.3 cmxthickness 1.8 cm, weight including battery: approximately 48 g).

CDMA technique could improve position sensing by intercommunicating with cellular phone stations frequently, and the device could collect demographic data more accu-

rately (highest precision level: 5^Δy10 m). Although GPS position sensing by itself works only 20% approximately in daily life of elderly at urban area in Japan (our preliminary data), due to obstacles such as high buildings, high trees, and indoor stay, CDMA technique covers the shortcomings of GPS.

We recorded GPS/CDMA log (Figure 4) of 7 non-institutionalized community-dwelling elders (mean age 78) in Kawasaki city urban area, Japan who do not need nursing care. There was neither hospital patient nor bed-bound individual. We evaluated the maximum moving velocity (MMV) during 7 days by GPS/CDMA logs, and we found that the MMV seems to correlate with right grip strength. (Figure 5)

Low grip strength is known for one of the risk factors of low bone density⁵, falls, and fractures⁶ in elders. Therefore, evaluating behavioral changes or predicting grip strength by MMV using RS indirectly might have pos-

sibilities to prevent senior public health problems, such as "bed-ridden".

Our findings suggest that RS application to human could provide useful biomechanical

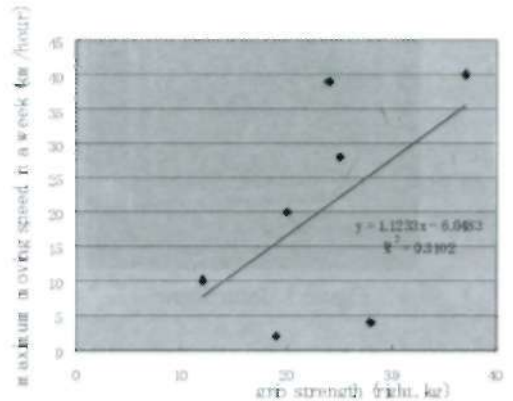


Figure 5. grip strength (right, kg) and maximum moving speed in a week (km/hr) assessed by GPS/CDMA portable device in 7 Japanese elderly. They showed significant correlation ($r^2=0.31$).

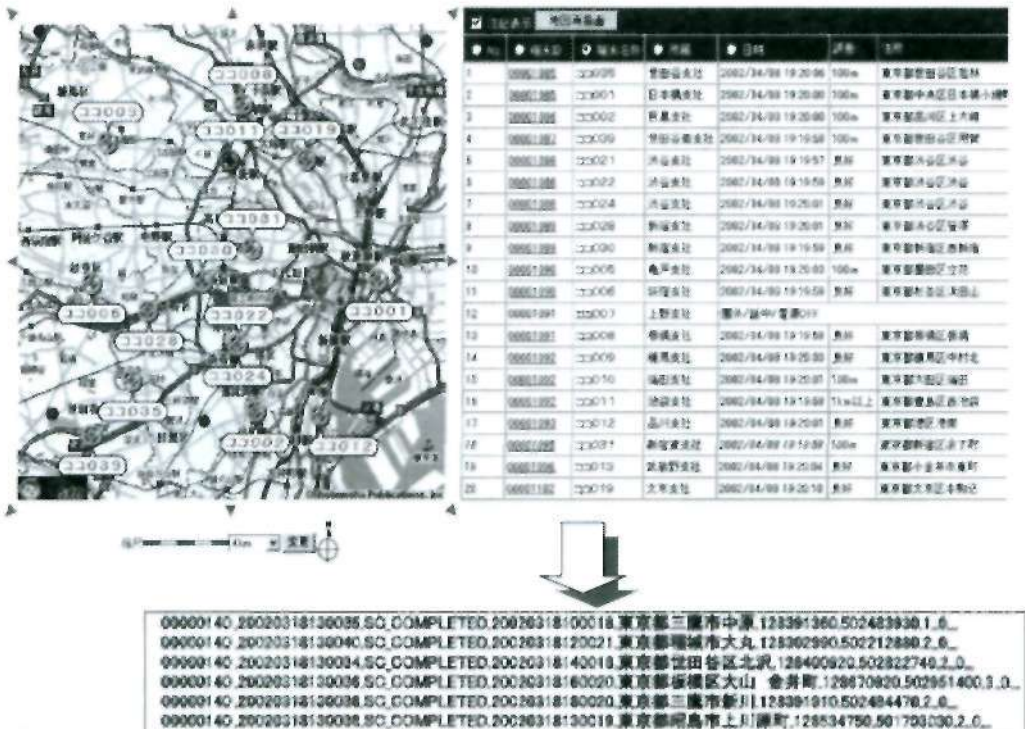


Figure 4. G-manager Remote sensing subjects' position (longitude, latitude, address) and concurrent time

cal parameters for analysis of human behavior, and hence RS could contribute to improvement of public health.

Acknowledgement

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