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Public health services in Shenzhen: a case study

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SUMMARY

As one of the fastest growing cities in Pearl River Delta of southern China, Shenzhen accommodates a higher percentage and increasing number of internal migrants, mainly coming from the inland areas. The public health issues that challenge its local government include the special population structure, high incidence of infectious diseases, high prevalence of mental problems, rising chronic disease burdens, and maternal and children's health issues, although progress has been made in the past years. The health authority of Shenzhen has realized that provision of high quality equitable public health services to its residents, including migrants is of high priority, and should be supported by innovations in the health insurance system and establishment of community-based primary care networks. Making changes within the national-level health reform framework and learning from international experiences are necessary and important.

Introduction

This paper will describe the emerging issues facing the public health services in Shenzhen, its healthcare organization, problems faced and strategies for reform in the future.

Shenzhen, once a remote fishing village by the South China Sea with a population of less than 30,000,[1] is now one of the fastest growing cities in the world and southern mainland China's major financial centre,[2] celebrating its 30th anniversary. Its location near to Hong Kong creates a unique context for its citizens. It has a high gross domestic product which reached 780.65 billion Yuan (76.43 billion pounds sterling) in 2008, with growth ranked the fourth highest in China. Financial revenue for 2008 was more than 80 billion Yuan (7.83 billion pounds sterling), representing an annual growth of 21.6%. Every year, the revenue contribution to the Central Government is more than 200 billion Yuan (19.58 billion pounds sterling). There are 2440 health and medical organizations in the city, including 100 hospitals. Currently, 634 community health centres (CHCs) employ more than 50,000 health workers. This is a rapid growth from less than 300 CHCs in 2005. The total annual investment in health in 2008 was 2.8 billion Yuan (270.5 million pounds sterling), an increase of 25% compared with 2007 but accounting for only 3.16% of total municipal spending. The gross investment for health per capita in 2008 was 323 Yuan. Traditional Chinese medicine and hospital-based health services account for 48.67% of the budget, while 9.98% is allocated to the CHCs, 13.31% designated for disease prevention and control, 5.68% for public health supervision which includes monitoring food and environmental hygiene, 0.07% for traditional Chinese medicine, 4.23% for health administration fees, 2.69% for health

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insurance subsidies and 10.68% for other supplementary health services. The remaining 4.70% was allocated to health-centre-based maternal and child health services.[3]

The population of Shenzhen is unique, with the majority of those in the city being migrant workers.[4] It is difficult to obtain accurate population figures, not only because of the mobility associated with migration but also because of the fluctuations linked to economic circumstances. The majority of residents in Shenzhen are not born locally, are young, and tend to keep close social and economic links with their home towns and families.[5] Population estimates for those requiring services in 2009 vary between 9 and 13 million, 80% of whom were migrant workers, some officially registered and others described as 'floating'.[6]

This large migrant workforce reflects the rapid expansion of Shenzhen, and the very high mobility of its population. This poses problems for developing and implementing legislation and policy to support the healthcare system, particularly for action to guarantee the equity and equality of health services delivery. Unsurprisingly, the standard formulae used for central resource allocation do not reflect this unique demographic complexity, and health resources are severely constrained. Although comparison of health indicators between Shenzhen and other developed regions of China or industrialized countries show that progress is being made, gaps still exist. For example, the maternal mortality rate in Shenzhen was 30.16/100,000 in 2007, compared with 25.57/100,000 in Shanghai,[7] 4/100,000 in Germany and 8/100,000 in the UK.[8] However, if the 'HuKou' population (residents who hold a formal household registration in Shenzhen) is considered alone, the maternal mortality rate was only 14.79/100,000 in 2007 (compared with 15.58/100,000 in Shanghai in 2007). These figures highlight the differences in health outcomes experienced between the different groups in the population.

The development of public health organizations in Shenzhen lags behind cities such as Beijing and Shanghai, especially in human resource capacity, public health infrastructure, progress in reform, quality control of the services and health research. In addition, the resource distribution and development of the public health system is unbalanced as a consequence of the rapid developments in some areas, and the public health network at community level is immature with significant gaps between needs and supply.

Major challenges for Shenzhen city's health administration are are follows:

- the population density of 3596 persons per kilometre in Shenzhen is the highest in China;
- the flows of people and cargo are extremely high: in 2008, the total number of people entering/leaving the country across the Shenzhen border was 173,000,000, accounting for 49.4% of the total mainland statistics. Vehicles entering/leaving the country across the Shenzhen land border hit 15,368,000, accounting for 74.9% of the mainland total;
- the geographical proximity of Hong Kong and Macao contribute to high border flows, and increased crossborder activities to control infectious diseases such as H1N1 have increased demands on disease prevention and control from the residents and Shenzhen Government [9];
- the city faces the dual burden of acute and chronic infectious diseases that challenge the public health services. The incidence of type A and type B notifiable infectious diseases in Shenzhen more than doubled between 2002 and 2008 from 150/100,000 to 348.11/100,000. The incidence of common infections such as measles (26.21/100000 in 2008) shows there is a long way to go for the health authority to control it to under 1/1,000,000 by 2012.[10] Another infectious disease of concern is hand, foot and mouth disease,[11–13] which has been a type C notifiable infectious disease since May 2008. The incidence rate in 2009 was 104.46/100,000. Long-term infectious diseases are also of significance. The transmission of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) from the high-risk population to the general population has been increasing rapidly.[14] Positive HIV antibody results from maternal screening rose from 0.85/10,000 in 2003 to 1.4/10,000 in 2008. Other long-term infectious diseases of concern include gonorrhoea, syphilis [15–17] and pulmonary tuberculosis (TB). Newly emerging and re-emerging infectious diseases are an additional concern. Imported Dengue fever, severe acute respiratory syndrome,[18,19] Norovirus infections, H5N1 avian influenza[20] and *Escherichia coli* O157:H7 infection have been seen since 2001, and influenza A H1N1 occurred in 2009.[21] Re-emerging infectious diseases include human rabies and TB,[22] including multiple-drug-resistant TB (MDRTB). The average multi-drug resistance rate was 5.5% between 1999 and 2002 in Shenzhen, and the prevalence of MDRTB amongst TB patients has continued to rise for the past 5 years. This trend has contributed to a mixed and complex spectrum for control of infectious diseases, with almost all the national notifiable infectious diseases having been found in Shenzhen;
- there is an increasing burden from chronic diseases. There has been a steady increase in the reported incidence rate of malignancy, hypertension, cardiovascular diseases, cerebrovascular diseases and diabetes mellitus.[23] The number of stroke-related deaths has almost tripled in the last 6 years. One population screening study carried out in Shenzhen found that the prevalence rate of hypertension in the adult resident population was 14.53% in 2008, but overall hypertension awareness and treatment rates were low. In all, 70% of patients surveyed did not know that they suffered from hypertension, and 75% of them did not receive formal and standardized treatment. This is in line with a national survey,[24] which reported an overall prevalence rate of 20.4% but hypertension awareness of 40.7% amongst patients. However, as the incidence of hypertension in Shenzhen has doubled in the 12-year period between 1997 and 2009, the burden of this disease has increased dramatically, as well as the problem of providing quality health care to hypertensive patients. The adult incidence rate for diabetes in Shenzhen was 5.14% in 2009, and was higher in men than women (5.69% vs 4.73%). Awareness of diabetes (51.52%) was better than that for hypertension. However, a comparison of the figures for the incidence of diabetes in Shenzhen between 1997 and 2009 shows there has been a significant increase (4.23% in 1997);
- being a very young city, Shenzhen is not yet facing a serious ageing problem as in some other large Chinese cities. The median age in Shenzhen was 25.3 years in 2004, compared with 38.41 years in 2005 in Shanghai and 35.9 years in 1998 in Beijing. As a result, cancer registry data show comparatively low morbidity and mortality for cancer.[25] However, after

standardization with the national census data adjusting for gender and age structure, the prevalence and incidence of cancer, especially malignant tumours, was surprisingly high in Shenzhen, and the rates have been rising (incidence rose from 29.48/100,000 in 2000 to 79.64/100,000 in 2005).

The rising trend of malignant cancer has been found in both the local 'HuKou' population and in the migrant non-'HuKou' population, and is prevalent in both the elderly and the young; children aged 0–14 years had a standardized incidence rate of 176.88/100,000 in 2005 compared with 39.84/100,000 in 2004. Lung cancer, liver cancer and stomach cancer were the most common cancers. Air pollution, vehicle emissions, indoor smoking and food safety issues may all have contributed to this rising trend of cancer incidence.[26] In general, the future disease burden related to cancer in Shenzhen will most likely be based on three major factors: the increasing population, demographic structural change associated with the rising number of older people, and environmental deterioration which can be linked to serious environmental health risks.[27] It is estimated that the prevalence rate of cancer may double in Shenzhen in the coming 20 years if an effective preventive strategy is not implemented.

Mental health problems are also common and are often unrecognized and untreated.[28] As both a social and public health problem, mental health accounts for 20% of the overall disease burden in Shenzhen. A recent study of migrant factory workers in Shenzhen found that 21.4% of workers had scores implicating clinically relevant depressive symptoms.[29]

In addition, there are increasing needs for and demands of maternal and children's health services, and resources are limited. The average obstetric hospital bed occupancy is 99.64%, which is a heavy burden for the system. Equality and equity in health services and health outcomes is a particular challenge in maternal care. Due to incomplete health insurance provision, there is an unbalanced distribution of maternal healthcare facilities between the local and the migrant-dominated communities. High physical mobility rates amongst migrant women and low levels of health literacy amongst those using maternity services for the floating population in Shenzhen are major public health issues. Managing medical records is challenging the provision of continuous care, and low levels of clinical data recording in early pregnancy impact on management of pregnancy, particularly amongst pregnant women in the floating population. The targets for the next 5 years will be: (1) to provide each pregnant woman with at least five prenatal medical check-ups and at least two neonatal home visits; (2) to provide pregnant women with physiological and psychological screening in order to detect, manage and intervene where there are high health risks; and (3) to connect and establish health profiles for all newborn babies through home visits to new mothers. The aim is to deliver these services and sustain them in all communities independent of the woman's 'HuKou' status, thus achieving better health equity in line with the Millennium Development Goals.

Migrant communities are also at risk from major occupational diseases. Risks are high because of the large number of migrant workers in factories engaged in industrial processing. Sociobehavioural factors associated with the large migrant population create problems and stresses in the healthcare system, exacerbated by lack of government resources and failure of allocation of health professionals to provide for the needs of migrant factory workers.

With a large young migrant population, lifestyle health promotion and disease prevention are important aspects of the healthcare system. The migrant worker study[30] showed that the current smoking prevalence rates for males and females were 27.3% and 0.7%, respectively. This is lower than the national average (48.0% and 2.6% in males and females above 15 years of age in 2008 [31]), but rates are increasing amongst both male and female workers in all age groups as their working years in Shenzhen accumulate. Alcohol consumption is also increasing, whilst physical activity is falling. In all, 29.19% of adults in Shenzhen are overweight and 9.26% are obese. In 2009, 47.69% (57.45% in males and 40.21% in females) of adults over 18 years of age had raised cholesterol levels, more than double that found in a national survey in 2002 (21.0%).[32] In addition, obesity amongst children has become a prominent public health concern in Shenzhen since the 1990s.[33]

Not only are the health needs complex, but the provision of health systems to meet these increasing needs is very challenging. In line with the general direction of health reforms in mainland China, more is being invested in providing universal coverage and promoting community-based primary care. However, the health insurance system has yet to cover all residents in Shenzhen. Good initiatives have been started and priority has been given to the health insurance system for migrant employees.[4] Early in 2004, Shenzhen's Government issued a regulation concerning the development of a healthcare system to cater for migrant workers, recognizing that failure to provide adequate health care increases the risk of deepening health and social inequalities. From 1 March 2005, an experimental Co-operative Healthcare Service System for Migrant Workers (CHSMW) was initiated to provide coverage for services by contracting specific designated healthcare providers. In June 2006, CHSMW formally developed into the Medical Insurance System for Migrant Employees (MISM). This new system was open to all migrant workers in the city and is compulsory for employers. However, because MISM is an employment-based scheme, those with very high mobility are often excluded from it, as are those with less formal employment. A study in 2005 found that the health insurance system was inequitably distributed amongst migrant workers, although health service utilization by migrant workers was largely improved compared with that before 2004.[5] Younger, less-educated women who are paid less are more likely to be uninsured and therefore to pay out of pocket for their care. To echo the national reform theme, a health blueprint of Shenzhen was drafted and finalized in 2006, which set three categories and 34 items of health outcome indices for accomplishment by 2010. These three categories are health indicators, health resources allocation, and key management and practice indices. The highest priority is being given to the establishment of the hospital-based CHC network to ensure the provision of high-quality, community-based basic medical and public health services. However, there are many barriers to be overcome, including training of qualified general practitioners, data sharing supported by a stable information system, insurance schemes covering the majority of the population, and a financial mechanism that links payment with quality assurance of the health services.

Current challenges

The current challenges and public health priorities that exist will be addressed through a programme of action to tackle problems and promote health of the people living in the community. Key actions will be as follows:

- to develop a high-quality, scientifically based, efficient and well-organized public health system. It is the Government's responsibility to provide efficient and high-quality public health services. Inadequate public health services are socio-economic problems, not just an issue within the health administrative system. The strategy needs to clarify functional boundaries for all health organizations, and to consolidate operational mechanisms so that accountability and efficiency can be achieved;
- to extend the coverage of the public health service system with clear definitions of responsibility, improved responsiveness, development of sensitive and co-ordinated teams, and self-sustainability of the systems as long-term goals;
- to build capacity to deal with emergencies, especially serious and urgent infectious disease epidemics or outbreaks, and other major infectious diseases. Also important is to strengthen capacity building for sudden public health emergency response resilience and preparedness;
- to establish and use a system of evaluation indices for public health services which are based on the principle of equity and application of scientific evidence;
- to facilitate construction of a solid infrastructure, particularly at basic levels where development of health facilities has long been overlooked;
- to develop public health primary care services in the communities and promote equal access to health services across the city. This includes action to meet the high demands for public health services from the general public, and to realize health equity aspirations regarding financial and physical health service accessibility;
- to establish and improve public health co-ordination mechanisms at the government and community level. A high-quality and equitable health service system depends on co-operative efforts by communities, government departments including Shenzhen's health authority, social organizations and all residents of the city. Community mobilization and help from the media should be considered and prioritized;
- to strengthen health education and health promotion, and to increase public health literacy. Given the demographic features of Shenzhen with many young and mobile populations, information for high-risk populations about certain health conditions and behaviours is needed;
- to strengthen international and regional co-operation in disease prevention and control.

Conclusion

As a young and booming metropolitan area typical of many of mainland China's large cities, Shenzhen has great opportunities in economic development. This also creates a unique opportunity for the local government to establish and maintain a more efficient and equal public health service system for all people living in the city. However, increasing disease burdens and special features of Shenzhen's population structure are major challenges for the city's health authority. It is essential to integrate the local priorities with needs in the communities and with national-level health reform goals in the coming years, and to learn from international experience for all health system renovation.

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Competing interests

None declared.

REFERENCES

1. Chen X. Magic and myth of migration: a case study of a special economic zone in China. *Asia-Pacific Popul J* 1987; **2**:57–76.
2. Xiao J, Tsang MC. Human capital development in an emerging economy: the experience of Shenzhen, China. *China Quart* 1999;**157**:72–114.
3. Shenzhen health, population and family planning commission. statistics on Shenzhen health. Shenzhen, China: Shenzhen Health, Population and Health Commission; 2008. Available at, http://www.szhealth.gov.cn/wsj/main?fid=open&fun=show_news&from=view&nid=12041; 2009 (last accessed 20/05/2010).
4. Zhu M, Dib HH, Zhang X, Tang S, Liu L. The influence of health insurance towards accessing essential medicines: the experience from Shenzhen labor health insurance. *Health Policy (Amsterdam)* 2008;**88**:371–80.
5. Mou J, Cheng J, Zhang D, Jiang H, Lin L, Griffiths SM. Health care utilisation amongst Shenzhen migrant workers: does being insured make a difference? *BMC Health Serv Res* 2009;**9**:214.
6. Goodkind D, Wes LA. China's floating population: definitions, data and recent findings. *Urb Stud* 2002;**39**:2237–50.
7. Zhu L, Qin M, Jia W. Analysis on materal deaths of floating population during recent 10 years in Shanghai. *Zhongguo Fuyou Baojian* 2007;**22**:2751–4 [in Chinese].
8. UNICEF. *Information by country and programme*. New York, USA: UNICEF. Available at, http://www.unicef.org/infobycountry/; 2010 (last accessed 20/05/2010).
9. Wenzel RP, Edmond MB. Listening to SARS: lessons for infection control. *Ann Intern Med* 2003;**139**:592–3.
10. Yang S, Zhou F. Analysis of clinical epidemiology for 208 patients of measles and some lessons learned. *Zhonghua Liu Xing Bing Xue Za Zhi* 2000;**21**:352–4 [in Chinese].
11. Li L, He Y, Yang H, Zhu J, Xu X, Dong J, et al. Genetic characteristics of human enterovirus 71 and coxsackievirus A16 circulating from 1999 to 2004 in Shenzhen, People's Republic of China. *J Clin Microbiol* 2005;**43**:3835–9.
12. Zhang SB, Liao H, Huang CH, Tan QY, Zhang WL, Huang Y, et al. Serum types of enterovirus and clinical characteristics of 237 children with hand, foot and mouth disease in

Shenzhen. *Zhongguo Dang Dai Er Ke Za Zhi* 2008;**10**:38–41 [in Chinese].
13. Zhang HM, Li CR, Liu YJ, Liu WL, Fu D, Xu LM, et al. To investigate pathogen of hand, foot and mouth disease in Shenzhen in 2008. *Zhonghua Shi Yan He Lin Chuang Bing Du Xue Za Zhi* 2009;**23**:334–6 [in Chinese].
14. Lau JT, Tsui HY, Siah PC, Zhang KL. A study on female sex workers in Southern China (Shenzhen): HIV-related knowledge, condom use and STD history. *AIDS Care* 2002;**14**:219–33.
15. Cheng JQ, Zhou H, Hong FC, Zhang D, Zhang YJ, Pan P, et al. Syphilis screening and intervention in 500,000 pregnant women in Shenzhen, the People's Republic of China. *Sex Transm Infect* 2007;**83**:347–50.
16. Cheng JQ, Zhou H, Zhong WM, Hong FC, Zhang D, Zhang YJ, et al. Study on the status of syphilis infection and its influence factors on pregnant women in Shenzhen. *Zhonghua Liu Xing Bing Xue Za Zhi* 2008;**29**:23–6 [in Chinese].
17. Hong FC, Feng TJ, Cai YM, Wen LZ, Pan P, Lan LN, et al. Burden of syphilis infections in Shenzhen, China: a preliminary estimation. *Int J STD AIDS* 2009;**20**:115–8.
18. Shang G, Biggerstaff BJ, Yang B, Shao C, Farrugia A. Theoretically estimated risk of severe acute respiratory syndrome transmission through blood transfusion during an epidemic in Shenzhen, Guangdong, China in 2003. *Transfus Apheres Sci* 2007;**37**:233–40.
19. Zhang SX, Jiang LJ, Zhang QW, Pan JJ, Wang WY. Role of mass media during the severe acute respiratory syndrome epidemic. *Zhonghua Liu Xing Bing Xue Za Zhi* 2004;**25**:403–6 [in Chinese].
20. Cheng X, Wu C, He J, Lv X, Zhang S, Zhou L, et al. Serologic and genetic characterization analyses of a highly pathogenic influenza virus (H5N1) isolated from an infected man in Shenzhen. *J Med Virol* 2008;**80**:1058–64.
21. Gu LN, Cheng XW, Zhang SX, He JF, Hu DS, Lv X, et al. Study on molecular epidemiological characteristics of influenza H1N1 viruses circulating in Shenzhen, China from 2005 to 2007. *Zhonghua Liu Xing Bing Xue Za Zhi* 2008;**2008**(29):459–63 [in Chinese].
22. Cheng JQ, Yang YZ, Xie RQ, Zhong WM, Tan AG, Luo YX, et al. Comparative study of the factors in tuberculosis treatment between immigrant workers and local residents in Shenzhen. *Zhonghua Yu Fang Yi Xue Za Zhi* 2009;**43**:141–5 [in Chinese].
23. Peng J, Zhou H, Cheng J, Luo B, Yang R, Li Y, et al. Epidemiological feature on diabetes mellitus among permanent inhabitant in the special economic zone of Shenzhen. *Zhonghua Liu Xing Bing Xue Za Zhi* 2000;**21**:114–6 [in Chinese].
24. Wu Y, Huxley R, Li L, Anna V, Xie G, Yao C, et al. Prevalence, awareness, treatment, and control of hypertension in China: data from the China national nutrition and health survey 2002. *Circulation* 2008;**118**:2679–86.
25. Yang L, Parkin DM, Ferlay J, Li L, Chen Y. Estimates of cancer incidence in China for 2000 and projections for 2005. *Cancer Epidemiol Biomarkers Prev* 2005;**14**:243–50.
26. Liu G, Cheng J, Huang G, Liu N, Yu S, Wu H. Analysis on characteristics of population with malignant tumor in Shenzhen, 2000 ~ 2005. *Chin J Dis Control Prev* 2008;**12**:490–3.
27. Xiong J, Zhou H, Chi H, Peng J, Zhou H, Cheng J, et al. Epidemic trend study of malignant tumors incidence from 1999 to 2004 in Shenzhen. *Chin J Cancer Prev Treat* 2006;**13**:572–6 [in Chinese].
28. Hu JZ, Hu CY, Duan WD, Gao H, Zhang X, Tang ZR, et al. Survey on mental disorders among registered residents and non-registered residents in Shenzhen. *Zhonghua Liu Xing Bing Xue Za Zhi* 2009;**30**:543–8 [in Chinese].
29. Mou J, Cheng J, Griffiths S, Wong S, Hillier S, Zhang D. Internal migration and depressive symptoms amongst migrant factory workers in Shenzhen, China. *Am J Community Psychol.*, in press.
30. Mou J, Fellmeth G, Griffiths S. A cross-sectional survey of smoking patterns and associated factors among rural-to-urban migrant factory workers in Shenzhen, China. Shenzhen Centre for Disease Control and Prevention and School of Public Health and Primary Care, the Chinese University of Hong Kong (in preparation).
31. Chen R. Mortality attributable to smoking in China. *N Engl J Med* 2009;**360**:1911.
32. Wu Y, Huxley R, Li M, Ma J. The growing burden of overweight and obesity in contemporary China. *CVD Prev Contr* 2009;**4**: 19–26.
33. Hui L, Bell AC. Overweight and obesity in children from Shenzhen, Peoples Republic of China. *Health Place* 2003;**9**: 371–6.