Public Health in China: Organization, Financing and Delivery of Services

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Section 1. Introduction

China's public health system has produced dramatic gains in health over the past 55 years. The burden of many major communicable diseases, such as sexually transmitted diseases, filariasis, schistosomiasis, malaria, and immunizable diseases has been substantially reduced. Infant mortality was reduced from 200 per 1000 live births in 1950 to 30 per 1000 in 2003. Child immunization coverage passed 90% in the same year; and life expectancy increased from 35 years before 1949 to 71.4 in 2000 (Health, 2004). Sanitation and water have been improved, and food hygiene, immunizations, maternal and health care and infectious disease control have all been remarkably successful in reducing the burden of infectious diseases, increasing the quality of life and improving health outcomes.

In recent decades, however, economic reforms and their impact on the public health system may have slowed China's progress and possibly caused some significant setbacks. The elimination of the collective system and a shift toward a market-based economy in the early 1980s dramatically altered both the public health system and the health care system as a whole. In addition to numerous structural, administrative and programmatic changes, China experienced a decline in spending on public health (Table 1) and a shift from government financing to the generation of service revenues (Table 2).

What is public health? Public health services are those collectively provided by a society to ensure the conditions in which people can be healthy; that is, they are organized community efforts to prevent, identify, preempt, and counter threats to the health of the public (Larsson, 1997). Public health services are usually **public goods** from which all citizens benefit; giving them to one person does not take away from another person and no one can be excluded from using them. Because these services, which include immunizations, public health campaigns and other initiatives, are not always efficiently provided by private markets and usually provide a community benefit in which the actions taken to benefit an individual have benefits to the larger population, government subsidization of public health has traditionally been required.

The benchmarks and goals of a successful public health system are well understood and have been universally applicable to nations in varying degrees of development.

They include:

1. Structural adequacy and effectiveness, including effective surveillance systems, outbreak investigation and control, disease prevention and intersectoral initiatives to promote public health and others.

2. A government commitment to financing that is adequate to provide public services, prudently allocated among alternative uses, with a recognition that public health services are usually public goods.

This paper outlines critical benchmarks for public health systems and assesses China's progress to date. It provides a brief historical summary and compares China's progress with similarly-situated nations. Based on these discussions, recommendations on key items necessary to meet the Millennium Goals are presented.

Section 2. Historical perspective

Prior to 1949, China's public health and health services were minimal and no organized, publicly-financed health system existed at national, regional or provincial levels. Few venues existed for the provision of health services; it is estimated that there were no more than 430 hospitals in China prior to 1949, with a small health clinic in each of the 2000 counties (Cook & Dummer, 2004; Hillier S, 1994). In 1949, there were 0.67 doctors per 1,000 population; 3,600 health institutions, 2,600 of which were located in county-level cities and inaccessible to 87% of the population in rural areas (Anson & Sun, 2004).

The government created a health system delivered at the community level through multiple tiers including the village brigade station, commune-level health centers and county hospitals or city facilities. Public health and clinical care functions were both offered at the grassroots level through "barefoot doctors." The were linked to village or brigade stations and provided cost-efficient health care services including some basic public health functions such as sanitation, safe water and immunizations. These doctors, trained for three to six months, were funded by government monies, cash payments from patients and support from local insurance pools (Shenglan, 1997). The government funded the entire budget of county and township health care facilities, including supplies, equipment and salaries. At the provincial level, and in larger cities, "anti-epidemic stations," (later Epidemic Prevention Stations), provided back-up public health capacity.

At the national level there was a governmental agency with some responsibility for public health but primarily focused on research – The National Center for Preventive Medicine (later renamed the Chinese Academy of Preventive Medicine and now called the China CDC). While the anti-epidemic stations had some routine public health department responsibilities such as disease surveillance, outbreak investigation and control, and food hygiene and inspection, they were usually not responsible for STD and TB control, or for health education. In many localities, these functions were assigned to other units (and, in the 1980's, chronic disease was added to their responsibilities, but without added resources).

China's economic and social structure was dramatically altered by a number of market-oriented economic reforms that began in the late 1970s, including the elimination of rural collectives, the privatization of state-owned enterprises in urban areas, tax reforms and fiscal decentralization. These reforms all have had significant impacts on China's public

health structure, financing and priorities (W. Hsiao & Liu, 1996)[1] and some have suggested that they have compromised its effectiveness and efficiency with some evidence of negative effects on health outcomes.

As China entered the new century it had accomplished remarkable gains in public health, including infant and under-five mortality, life expectancy and infectious disease control. Nevertheless these gains may be relatively less impressive than gains made in comparably developed countries such as Thailand. A new set of public health challenges await the country, including SARs, HIV/AIDs and chronic diseases; and it will take a concerted effort to put in place the structure, financing and public health professionalism necessary to overcome these concerns and to meet its Millennium Goals.

Section 3. Measures of public health systems effectiveness: how does China measure up?

As previously mentioned, the effectiveness of a public health system can be measured by considering its progress toward a number of goals including effective disease surveillance, outbreak investigation and control, prevention, intervention and health promotion programs and policy development and information-sharing systems (World Bank). These are essential components of successful public health systems (CDC reference) and the progress made on these goals can be measured by assessing them individually as well as through targets such as the Millennium Goals. For the purposes of this discussion, these goals, as well as a few others, have been grouped into two broad categories: structural adequacy and effectiveness and financial support sufficient to provide services.

A. STRUCTURAL ADEQUACY AND EFFECTIVENESS

Countries with structurally sound and successful public health programs (e.g. Australia, United Kingdom, Sweden, USA, Netherlands, Mexico, Brazil) have several things in common. First, they have established public health programs at all levels of government, with clearly defined roles. The higher levels of the system provide technical support and information on innovative approaches and new information is shared throughout the system, both vertically and horizontally. In successful systems, the most sophisticated technology is shared from the top levels downward; technology is matched appropriately with problems. In well-run public health programs, there exists a mix of functions including epidemiology, laboratories, health communications, behavioral science, data management and others, all under the same roof. Research is conducted at higher levels, directed toward practical problems with immediate applicability (reference, Principles of Public Health Practice, 1996).

For description of the economic reforms, please see the health policy and institutional review prepared by Yunni Yi and Xingzhu Liu for the World Bank.

Surveillance

Regardless of whether a public health unit is based at the local, provincial or national level, all levels need to be able to address, with appropriate technology and financial resources, and in varying breadth and depth, the issue of surveillance (*Field Epidemiology*, 2002). In an ideal public health surveillance system, data gets collected at the local level. It is regularly assessed for timeliness, accuracy and completeness. At the provincial level, this information is further collated with that from other units or areas of the province, often with some analysis attached. At the national level, the data is further collated with data from the entire country or regions within it, then subjected to in-depth analysis. Some of the data collected might be lab based; while other data might come from physicians, clinics and/or hospitals or based upon surveys or direct consumer reporting. A vital element of a successful surveillance system is the prompt analysis and dissemination of information up the public health hierarchy, from local to national, as well as across agencies at all levels. Information on the results of the data must be provided to the persons who collected it; those who collect, collate or analyze data at the different levels must be able to see the results of their efforts (*Monitoring the Health of Populations*, 2004).

Animal and human surveillance need to be better coordinated given the dangers of infectivity across species seen in SARS and avian influenza and likely to be seen in other new diseases. Addressing threats to public health often involves collaboration between professionals with very different skill sets and experiences. The grouping together of professionals including those specializing in infectious and chronic diseases, environmental and occupational health, health education, and others in one institution can be very helpful and efficient. This is part of the value of having experts under one roof.

Communication of the information collected from surveillance systems remains a challenge. If the collection, analysis and interpretation of data are inadequately communicated, it hinders officials' ability to identify outbreaks and control them. It also demoralizes those who initially collect and report the case information. Their efforts seem disconnected from any result or action that might reinforce their work. In order to be effective, disease surveillance must go beyond simple "monitoring" to the provision of the information "to those who need to know" (Langmuir, A.D. (1963) The surveillance of communicable diseases of national importance. New England Journal of Medicine 268:182-192). This includes public health decision-makers at all levels of the system and also requires feedback of the results to those who originally collected the data (*Monitoring the Health of Populations*, 2004).

Disease surveillance in China has made considerable progress over the years and includes data from selected representative sites on specified reportable diseases and data electronically delivered in near real time for all patients being seen in participating health care facilities. However, to date there has not been an adequate objective evaluation of the characteristics and operating qualities of this system, namely:

1. the completeness of reporting,

2. the integration of laboratory and epidemiologic information,
3. the accuracy of diagnosis and reporting,
4. the speed of notification,
5. the technical adequacy of the analysis and ability to recognize trends, aberrancies and new associations,
6. the use of surveillance for outbreak identification, planning and program evaluation,
7. the dissemination in a timely manner of the results and conclusions to public health workers at **all** levels of the system and,
8. the use of the data and conclusions by decision makers in setting health policies.

There is evidence largely through observation and anecdote that many of these elements require improvement (local, provincial and central site visits, government publications, absence of a systematic published recent evaluation, etc.) A robust surveillance system is the bedrock of and an absolute necessity for an effective public health system.

Outbreak investigation and control

The SARS epidemic in 2003 brought attention to weaknesses in the outbreak investigation and control capacities of the Chinese public health system. Challenges were noted in regard to the early recognition of suspect cases, the early notification of authorities, the sharing of information collected, the quality of both laboratory and epidemiologic investigations and coordination across public health institutions – both up and down the hierarchy of public health institutions and within these institutions. Other challenges included communications to the general public and to the world health community, hospital infection control practices and outbreak control approaches (Academies, 2004). Outbreak investigations should be strengthened through early and improved reporting of suspect cases (working with health care providers, clinics, and others), rapid investigation of suspect cases, standardized case definitions, accessible laboratory back-up, and prompt collation. Summarization and analysis and feed-back of the information should be generated to those who provided the raw data as well as throughout the public health system.

While there has been a considerable increase in investment in public health in China as a response to the problems experienced in the SARS outbreak, the funds seem to have been disproportionately spent on buildings and facilities and equipment. There has been less attention paid to workforce development, training and skill-building. Improved performance of the surveillance system and outbreak control response may be more dependent on professional capability and competence than bricks and hardware. There needs to be an assessment of staff knowledge, skills, methods, reporting and collaborative relationships and support and incentives for good performance at all levels of the public health system. Where inadequacies are found, vigorous efforts should be made to address them.

Public health institutions are uniquely positioned to react to the health consequences of emergencies and disasters. At all levels of the system, each unit needs to have ready an action plan and appropriate materials and supplies to address such threats, be they earthquakes, typhoons, chemical spills, nuclear accidents, outbreaks of emerging infectious diseases or biological weapons. There is considerable overlap in skill sets and methods between disaster response and outbreak investigation and control. Thus national public health agencies such as the China CDC should be delegated responsibilities in this area.

There is a widespread need for many well-trained field epidemiologists at all levels in China. Such field epidemiologists (of the kind trained for over fifty years in the Epidemic Intelligence Service (EIS) of the CDC – Atlanta) are a key element in outbreak investigations and the design and operation of surveillance systems. There is a fledgling program modeled after the EIS which is now in its second year at the China CDC, the Field Epidemiology Training Program (FETP). It needs to be markedly expanded at the central level and analogous training programs need to be created in large municipalities and provinces. The existing FETP may need to be revised further to make it more effective, including permitting supervisory staff to accompany trainees to field sites and placing FETP graduates in provincial CDCs.. The concept and training of such field epidemiologists requires clearer definition of the role and responsibilities of this entity. It is an element of the need for more "professionalism" in the public health workforce that will be discussed further below.

Disease prevention and control and health promotion

Disease control is another area in which great strides were made in the 1950s and 1960s but where progress seems to be stalled today. In the early days of Post-Liberation China, in addition to the formally structured public health programs, there were intermittent targeted mass campaigns in which individuals participated "voluntarily." Classic examples of such mass public health action were the schistosomiasis control efforts that involved diverting and draining waterways and removing snails (schistosome hosts) by hand and the "away with all pests" campaign, intended to reduce disease by elimination of insect vectors and rodents. With the advent of economic reforms during the past several decades, these efforts have been greatly reduced and group effort requires individual compensation. Nevertheless, there have been some successful population-based prevention programs, most notably in Tianjin, targeting chronic diseases and the previously mentioned World Bank Health VII Loan for Health Promotion which targets tobacco use. While the initiators and organizers of these programs believe their efforts have been successful, it is very important for future health promotion work in China and globally to conduct a formal evaluation of the Tianjin Chronic Disease Project and the World Bank Health VII project to determine if they met their objectives and what were the effective elements of their interventions.

China is faced with a number of challenges for which behavior change interventions are urgently needed. HIV/AIDS is of particular concern: from its start in rural areas (where

80% of those infected live) and its spread to urban areas, the epidemic is rapidly becoming a nationwide problem. Current estimates put the number of people living with HIV/AIDS in China at over a million, which would equal a prevalence of almost 0.1 %. The Chinese Academy of Preventive Medicine predicts that 7 million people could be living with HIV by 2005 and 10-15 million by 2010 (*At a glance: China*, 2005). Fewer than 6% of those infected with HIV/AIDS have been tested (Wu, Rou, & Cui, 2004).

Behavioral changes traditionally associated with industrialized Western nations are on the rise, particularly in urban areas. High cigarette smoking prevalence (predominately in men), increased fats, sugars and calories in the diet, decreased physical activity, etc are all aspects of a Western lifestyle that results in significant and costly increases in several diseases, including heart disease, stroke, cancers, hypertension, diabetes, osteoporosis and chronic lung disease. The prevalence of hypertension in 2002 was 18.8%. (2004).

China faces a similar situation with Type 2 diabetes; it is estimated that there are more than 20 million diabetic patients in China, plus nearly 20 million people with impaired fasting blood sugar levels. The prevalence of diabetes in China is significantly higher in urban areas than in rural areas. (2004). Obesity is also becoming more prevalent; from 1992 to 2002 the adult prevalence of overweight increased by 39%, and the adult prevalence of obesity increased by 97%. It is predicted that an even larger increase in obesity rates will occur in the near future (2004). A 2002 Ministry of Health survey found that urban residents are consuming too much meat, oil, and fat (*The Nutrition and Health Status of the Chinese People*, 2004). Lastly, of particular concern is the trend toward higher rates of suicide in rural areas, where 93% of suicides occur. Rates for women are 25% higher than men. (Phillips, 2004).

China can benefit from the lessons of other nations, where population-based programs to limit the spread of HIV/AIDs (Thailand), increase physical activity (Singapore), decrease skin cancers and tobacco use (Australia) and reduce motor vehicle injuries and deaths (U.S.) have successfully reduced morbidity and mortality.

There are a few studies that suggest a set back in public health progress. Data reported by the Shandong Department of Public Health in 1992 show that immunization rates decreased 36% in Shandong from 1979 to the mid 1980's *after* charges for immunizations were instituted. While this study did not include all regions of China, it exemplifies the adverse impact of charges for public health services, particularly for the poor (Xingzhu Liu, 2002). A review of China's schistosomiasis program showed that schistosomiasis prevalence increased from 540 per 10,000 population in 1980 to 788 per 10,000 population in 1990 (Yu et al., 2001). Likewise TB rates seem to have plateaued, rather than declined. The World Health Organization cites poor organization, facilities and staffing in some provinces as key concerns (2003). Data from China's National System of Leprosy Surveillance show that the disease has been well controlled in most areas of the country but is still excessive in some regions (Chen, Li, Jiang, & Ye). For STDs, changing social conditions, economic opportunities and internal migration have also affected disease rates and trends. An analysis of national surveillance data indicates that the incidence of STDs has increased significantly in recent years, from 12.32 per

100,000 in 1989 to 50.66 per 100,000 in 1998. Among these, syphilis increased from 0.17 per 100,000 to 4.31 per 100,000 (Cheng, 2000).

Likewise, a lack of a strong, national anti-tobacco policy that includes the many proven effective elements of tobacco prevention and control including consumption taxes has exacerbated increases in tobacco use, which has huge implications for health care costs for many decades to come. The World Bank Loan Project VII, which targets tobacco use in seven cities, may provide evidence of effectively reducing smoking prevalence through multi-focal prevention interventions, including school health education, workplace programs, mass media campaigns, health promotion activities and economic incentives, but a formal evaluation remains to be performed and communicated. Other countries have found a significant direct correlation between increases in tobacco excise taxes and reductions in smoking prevalence (Jha P, 1999) (Waverly Brigden L, 2003). There is a high prevalence of smoking in China, largely confined to men, 63% of whom smoke. If present smoking patterns continue (two thirds of Chinese men become smokers by the time they are 25) about 100 million of the 300 million Chinese males now aged 0-29 will eventually be killed by tobacco (B. Liu et al., 1998). According to one study, 60% of Chinese adults do not know smoking causes lung cancer while 96% do not know it causes heart disease. This situation is already dire; it will become even more urgent if tobacco products begin to be effectively promoted to women.

Structure Sufficient to Provide Access

An underlying goal of successful public health systems is to provide a structure that is adequate to make services available to all persons, regardless of income, age, gender or geographic location. Public and private health care systems play an important role in the delivery of public health services by providing the infrastructure through which many of those services are delivered, including immunizations, infectious disease control and interventions to reduce risk factors. There is evidence that in rural and poor areas it has been increasingly difficult for farmers and poorer residents to obtain health care and that those that do seek care frequently do so in later stages of their illness. There is also data showing increasing rates of schistosomiasis and tuberculosis in some areas of China. However the clear relationship between decreased access to health care and worsening rates of preventable or easily treatable diseases has not been demonstrated. The ability to clarify this relationship is made more difficult by the imprecision and unreliability of the surveillance system which, if accurate and consistent, could offer insight in to changing disease rates. There is some evidence that urban populations have better access to health services and are healthier than their rural counterparts for many indicators (Bloom) (Lawson & Lin) (Anson & Sun, 2004) (Shen, Habicht, & Chang, 1996). Services are not evenly distributed between urban and rural areas. About 70% live in rural areas but are served by only 37.5% of "national technical health workers (Lee, 2004). Deaths due to all major causes are between 10% and 100% higher in rural areas; deaths from infections are relatively higher in some provinces (Lawson & Lin). Infant mortality between rural and urban areas is particularly striking; some estimate a ten-fold difference in infant mortality between rural and urban populations (Hesketh & Zhu, 1997). These discrepancies in outcomes may be due to multiple factors, the relative contributions of each have not been

established. Some contributors to the difference in outcomes among different populations include:

- inaccurate measurements of disease rates and levels of intervention coverage
- differences in economic growth between rural and urban (Shen et al., 1996)),
- inadequate public health programs and/or
- inadequate health care access.

While the focus of this report is on the public health system rather than the health care delivery system, each of these systems is dependent on the other for their outcomes and performance. The inability of the PH system to control the use of tobacco will lead to huge further burdens of illness with which the delivery system will have to cope – and for which the government, society, citizens and health care providers will have to pay. Inadequate delivery of vaccines, HIV testing, health education messages and cancer screening will compromise the effectiveness of all public health interventions and the achievement of public health objectives.

Development of a Chinese model of public health professionalism

In China, through all levels of government, from the late 1980's on, there was a desire to improve public health functions. The Centers for Disease Control and Prevention (CDC) in the United States had a widespread and favorable reputation in China and it became a model for a modern successful public health organization. By the late 1990's, reorganizations were taking place nationally and in city and provincial health departments that sought to create local "CDCs." However, the role and responsibilities of the U.S. CDC were misconstrued. The U.S. CDC is a national and international reference center as well as a technical referral center. There is a broad state and city based-system beneath it, the functions and staffing of which are not duplicative of the federal agency but rather appropriate to local or state needs and resources. Shanghai was one of the first to reorganize and rename itself the Shanghai CDC, followed at the national level by Chinese Academy of Preventive Medicine, becoming the CDC China in 2002. At the same time many provincial and city health departments were merging several existing public health entities (for example, five in Shanghai) and creating "CDCs." The relative roles and capacities of the CDCs at each level have not been well defined or limited. There is no set of core capacities for municipal versus provincial versus national CDCs nor is there a clear policy for how they relate to each other (Peng, Zhang, Lu, & Chen, 2003). It seems as if each "CDC" in large municipalities and provinces is intent upon establishing its own "national" capacity. For example, local public health units need generalist epidemiologists capable of investigating any general or undiagnosed potential problem and use their skills to obtain basic and relevant information. They need to be able and willing to recognize the limits of their expertise and experience in the face of a more complex challenge and call for assistance from higher levels, e.g. large municipalities and/or the Province. Provincial CDCs may have more specialized field epidemiologists with particular foci on viral diseases or immunizable diseases and thus provide valuable consultation and assistance. In a similar

manner China CDC will need to develop a cadre of sophisticated generalist epidemiologists whose specialty is the investigation of complex or extensive outbreaks and also multiple specialist epidemiologists, focused on specific diseases. A similar rational division of skills and breadth and depth of specialty should apply to laboratory functions up and down the system. Simpler, less expensive, commonly needed tests should be done locally, while more sophisticated tests should be done at the city or province levels. Quality assessment and specialty tests should be undertaken at the national level, which has the capacity for large volume testing.

Changes at the national level have exacerbated some inefficiencies. The Ministry of Health had long been the only central governmental department conducting the administrative functions of public health. In recent years some of its functions were separated from the Ministry, resulting in a multi-departmental and duplicative administrative structure for public health. For example, the Ministry of Science and Technology has much responsibility for health research, the State Food and Drug Administration, State Family Planning Council and others also have a great deal of authority over health matters (*Public Health Options for China Using the lessons learned from SARS*, 2003).

A striking ambiguity of role and responsibilities and a likely source of inefficiency are the two components of the Ministry of Health that address similar public health concerns: the China CDC and the Disease Control and Prevention Division in the MOH.

The SARS epidemic revealed weaknesses in the public health system and led to an increased allocation of resources to public health institutions. However a considerable proportion of these funds went to capital improvements and equipment acquisition. The salary and benefit support of the workforce were not addressed. Training and skill-building were not a priority.

The mixture of perverse incentives and lack of attention and support for the public health workforce impedes critical improvements. The concept of professionalism needs to be developed for workers at all levels and incentives provided that are not financial but that involve job and task satisfaction and recognition for superior performance. Accurate disease reporting or thorough outbreak investigation should not be encouraged by a monetary bonus (rather the workers should receive an adequate salary) but by a strong sense that their job is of vital importance and that they derive satisfaction by a job well done and likely approval and public recognition from their supervisors.

Regular training and oversight of performance need to be part of this approach, both to enhance knowledge and skills and as further testament of the worth of the work to be done and the worker doing it.

Non-financial incentives, regular retraining, recognition, and adequate salaries will all contribute to the development of an improved sense and culture of professionalism in public health. A further aspect of successful public health professionals worldwide is their sense that their primary function is to provide service to their community (not fee

for service) and that they are technically skilled public servants, not academicians. An aspect of this professionalism is the development of different standards of accountability and ethical behavior.

China has at many times been a world leader in the practice of public health, with numerous scholars and practitioners whose work has been emulated throughout the world. In recent years, however, the focus of research has tended to be individual-based projects rather than population based research. A new focus on innovations that will benefit society as a whole is needed. Research should not be the primary priority in any public health institution. Service should be the top priority with research and training supporting the service needs. Thus research directions and priorities should be based on priority health problems that need new information and discoveries to improve these programs.

At the national level, China CDC can be more effective if it sharpens its focus on a core mission of service and applied research while making a concerted effort to increase its capacity in field epidemiology.

Quality Assessment and Evaluation

As discussed above, the public health system needs to institute routine evaluation and assessment of many of its routine functions and special projects. Evaluation and quality assessment are not part of the system or the "culture." Currently, there is no national or regional structure in place to conduct quality assessments or to evaluate the quality of public health practice.

Elements of the public health system that would benefit from quality assessment and evaluation include the following:

1. the disease surveillance system
2. the capacity to investigate and control disease outbreaks
3. the impact of health care access on health outcomes
4. the success of current chronic disease prevention and control and tobacco control programs
5. immunization coverage

The last example, immunization coverage, has been the subject of evaluation by WHO in 2002 (Deming, 2002). It is also being reevaluated in 2005 by a WHO team. The conclusions are troubling. Determining immunization coverage and impact is very dependent on accurate surveillance information of both on the vaccinations themselves and on the immunizable diseases they prevent. The report concluded that both the denominators and the numerators by which coverage was calculated were unreliable. There were unclear and conflicting data on the population of immunizable children (denominator) and similar lack of confidence on the number of children actually

vaccinated (numerator). There is no evidence that this situation has improved. This means that when immunization coverage is reported as 98% for a given region that number is not likely to be true. It may well be 80-90% or even lower; a more accurate estimate is unknown. This makes program assessment and improvement impossible, impedes planning and thoughtful resource allocation and reinforces a weak system with false perceptions of performance.

Intersectoral action for better health

Many of China's current health challenges require an intersectoral approach to facilitate prevention and control. For example, the increase in HIV/AIDs cases can be addressed through both the educational system and the justice system. Controlling and preventing outbreaks of avian flu must be addressed jointly by experts in agriculture, veterinary medicine and public health.

Likewise, to effectively address motor vehicle injuries and deaths health authorities need to work closely with transportation and law enforcement authorities. With increasing development has come huge increases in the number of cars on the road. Road traffic crashes increased from 6,000 in 1951 to 413,000 in 1999; injuries increased from 5000 to 286,000 and fatalities from 852 to about 84,000. Of those killed in 1999, only 10% were automobile drivers (Wang et al., 2003). There are huge productivity losses from injury; an estimated $12.5 billion U.S. per year, almost four times China's public health services budget (Zhou, Baker, Rao, & Li, 2003). Motor vehicle accidents are the number one cause of death for those aged one to 44 and the fifth leading cause of death overall (Zhou et al., 2003).

There are many other opportunities for intersectoral cooperation, including indoor air pollution, water and sanitation, disease vector control, tobacco control, school health and education and others. In China, growing industrialization has led to an increase in environmental pollution and occupational risks (Lee, 2004). By the late 1990s the World Health Organization had ranked six of China's major cities as the most polluted in the world; respiratory diseases caused 14% of urban deaths in 1999 and this number is expected to increase (Cook & Dummer, 2004). In rural areas, respiratory disease remains the leading cause of death. Over 800 million people use coal in their homes. Although great strides have been made in water supply sanitation, water safety remains a concern. An estimated 700 million Chinese are estimated to drink contaminated water and over 30 billion tons of urban sewage are discharged into water annually, with 2.7-10% remaining untreated (Beach, 2001).

B. FINANCIAL

Public health financing is the mobilization and allocation of funds for the provision of public health services. Funds mobilization encompasses both the sources and total

amount of funds; and funds allocation means the allocation of funds among alternative uses within the public health system.

Sufficient financing requires that the public health funds generated from various sources should be enough to cover the costs for assuring the performance and the provision of defined public health services. It also requires that resources should be allocated among alternative uses in a manner that maximizes the level of public health system performance.

After 1980, changes in financing profoundly impacted the organization and delivery of public health and health care services in China; the funding that Anti-Epidemic Stations received from the government was often inadequate to support all services. At the same time, funding for hospitals and township health centers was limited to employee wages and capital costs. The government set prices for most services below cost except for new high tech services and drugs. In response, local health care providers at every level became entrepreneurial and charged fees to make up the difference (White, 1998) (Huang, 2002) (Feng, Tang, Bloom, Segall, & Gu, 1995). Prior to 1980 workers had earned only a salary; under the new system they earned a salary based on years of experience, a bonus based upon their caseload and the revenue from their drug prescriptions, and commissions from selling drugs (Dong, Bogg, Rehnberg, & Diwan).

Between 1978 and 1988 government financing for preventive programs increased from 0.47 Yuan to 1.20 Yuan per capita (U.S. 21cents), but as Hsaio has noted, "In real terms, expenditure per capita remained unchanged" (W. C. Hsiao, 1995). Government spending patterns appear to have been most detrimental in rural areas, where a sharp reduction in government investment in preventive services and maternal and child health have been noted (Shen et al., 1996). The schistosomiasis program provides evidence of shifting sources of financing (Table 3) and diminished program effectiveness (Yu et al., 2001).

Reductions in public health coverage were worsened by increases in cost by the private sector. The increased cost of health services has led to a decrease in the use of services in some areas, especially for perceived minor illnesses or early in course of illness. In some cases, patients instead resort to self-treatment (Gao, Qian, Tang, Eriksson, & Blas, 2002). In addition, there appears to be a trend of decreasing access to health care and insurance in China (G. G. Liu & et al., 2003). The proportion of people forced into poverty due to education or health expenditures was greater in the poorer regions than in other regions; some have posited that this, and the cost shift from the government to individuals, has had a direct impact on the financial well-being of many citizens (Gustafsson B, 2004).

Private health expenditures increased by as much as 192% from 1988 to 1995 and health expenses constitute a much higher percentage of all expenditures for those in lower income households. While individual clinical health care is not population-based health care, there are important inter-dependencies including immunizations, cancer detection, health education, diet, maternal and child health, STD identification and prescriptions.

The SARS epidemic brought to light many areas for which improvements are needed. After the outbreak, the public began to pay great attention to public health and systems building. The central government announced increased investments for buildings and equipment for the CDC system and the communicable disease treatment system. The local governments also announced investments in the two systems following the call from the central government and the new principals of the Balanced Development Vision. In the last two years, the different levels of government have invested significant new resources into the public health system. For example, following the SARS outbreak, the central government transferred 1 billion RMB to help the western and middle provinces develop their public health system. In 2004, this amount was to be increased to 3.7 billion RMB to be invested in four areas: medical treatment (communicable diseases) system projects (0.72 billion), the Health Inspection System (0.36 billion), rural health development projects (1.09 billion) and prioritized diseases (1.53 billion) (*Announced during the proceedings, National Health Conference 2005*, 2005). To cope with public emergencies, the governments at different levels launched an initiative, largely aimed at improving buildings and facilities and upgrading equipment and instrumentation, which was to include 10.9 billion RMB for CDC system construction and 11.4 billion RMB for treatment system building. To help meet the needs of western and poor counties, the central government announced the purchase of 1771 mobile vehicles for these counties (*Announced during the proceedings, National Health Conference 2005*, 2005) .

To put these investments in perspective, the costs of inadequately controlled disease outbreaks are considerable. A recent private sector report estimated that avian influenza has cost Asian nations between $8 billion and $12 billion (Bradsher, 2005). When avaian flu can spread from person to person the cost in human disease and death and in financial loss will be many folds greater. The SARS epidemic was estimated to cost $40 billion globally(*Learning from SARS*
Preparing for the Next Disease Outbreak, 2004); Toronto, Canada is estimated to have lost $1 billion in revenues and $12,000 jobs in 2003 (*The Public/Private Response to Sudden Disease Outbreak*, 2005).

The government's current system, which monitors and provides rewards for financial successes but not for health outcomes (Bloom), may have an adverse impact on quality. Charging fees for services can reduce demand and increase the risk of disease transmission. It has been noted that a reduced government contribution to public health services is likely to reduce efficiency in the health sector (W. Hsiao & Liu, 1996). Indeed, there appears to have been a drop in public health utilization in China after private market systems were introduced (Bloom).

<u>All effective public health systems in other nations have a government-supported budget for the vast majority of public health functions .</u>

<u>Section 5: Recommendations</u>

Several recommendations are made to strengthen the public health system, including a modification in financing and addressing the organization, roles, relationships and priorities of the system itself. These items are supported by numerous recent reports from institutions that are highly respected for their work in China and elsewhere.[2]

- Establish clear roles and responsibilities that differentiate levels and compliment each other for the various institutions in the public health system. Local and provincial levels need to define and to take pride in their mission and to see it as valuable and yet different from national roles. When each level sees its mission and role as identical, the public health system loses efficiency and effectiveness;

- Strengthen the surveillance system through attention to its accuracy, consistency, completeness and timeliness. Ensure results are communicated to all participants and are used in improving programs and recognizing unusual patterns of disease;

- Make quality assessment and evaluation integral parts of the public health system;

- Improve coordination horizontally and vertically, particularly on surveillance and outbreak investigation and control; The relationship between local agency, provincial and national may be pyramidal but the working relationship between staff must be collegial and respectful and one of partnerships. Technical consultants assisting from "higher" to "lower" determine the quality of this collaboration and if unsuccessful, the likelihood of future request for assistance is diminished;

- Develop and encourage a culture of professionalism in public health. Encourage respect for public service. Provide non-financial recognition of superior performance. Invest more in workforce skills and capacity building rather than in capital improvements and equipment;

- Break down professional barriers; promote better integration of epidemiology, laboratory, communications, health education, and other expertise;

- Markedly increase the number of trained staff and the capacity of public health institutions at all levels in field epidemiology;

- Improve intersectoral coordination, such as better coordination of human and veterinary public health and epidemiology;

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[2] (*2004 International Review of the Expanded Programme on Immunizations (EPI) in China*, 2004). (*Public Health Options for China*
Using the lessons learned from SARS, 2003) (*The Public/Private Response to Sudden Disease Outbreak*, 2005); (Deming, 2002).

- Promote the development of a service culture that recognizes and values disease prevention and control as its primary mission and sees research as a tool to improve that service;

- Ensure that public health improvements occur at the grassroots level; and,

- Ensure adequate state financing of each of the above-mentioned goals to ensure that primary public health missions are achieved rather than being diverted to income-generating activities which are often secondary at best in meeting the priorities for improving the population's health.

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Table 1. Changes in the sources of financing of the 50 county anti-epidemic stations in Jiangsu Province (average revenue per station)

Year	Total revenue (000 yuan)	Government budget (000 yuan and %)		Service revenue (000 yuan and %)	
1988	491.7	361.3	73.48	130.4	26.52
1989	553.4	351.0	63.43	202.4	36.57
1990	650.2	409.8	63.03	240.4	36.97
1991	683.6	440.9	64.60	242.7	35.50
1992	754.5	434.8	57.63	319.7	42.37
1993	1030.6	497.8	48.30	532.8	51.70
1994	1331.3	627.7	47.15	703.6	52.85

Sources: Ref (Han, 1997).

Table 2. Changes in the sources of financing of the schistosomiasis control programme in Songzi County, Hubei Province*

Year	Total Revenue	Government Budget	% of total Government	Service Revenue	% of total Service Revenue
1980	355	294	82.82	61	17.18
1982	390	275	70.51	115	29.49
1984	570	380	66.67	190	33.33
1986	655	315	48.09	340	51.91
1988	1005	345	34.33	660	65.67
1990	1285	415	32.30	870	67.70
1992	1609	469	29.15	1140	70.85

*Sources: Ref (Zhang et al., 1995) * all figures in (000) yuan*

Box 1.

Immunizations in China

China has made considerable progress in using population wide immunization programs to lower the incidence of once common infectious diseases. With China joining WHO's Expanded Program on Immunization (EPI), higher coverage rates of vaccines for measles, polio, diphtheria, tetanus and pertussis have led to dramatic declines in these diseases. Despite these achievements, weaknesses in the health system have led to policy constraints that as a consortium of international public health agencies observes "may limit future progress and place the programme at risk of slipping backward." (2004 International Review of EPI in China, WHO/Unicef/CDC, et al). They report that recent data suggest immunization coverage is declining in some poorer areas, due to inadequate funding of programmes and skewed incentives. Health care providers cannot be expected to provide high-quality immunization services to all children without adequate compensation. The weak links in the Chinese immunization program have also been described in recent WHO reports (2002 and 2005) assessing vaccine coverage. The consultants conclude that estimates of vaccine coverage are unreliable, due to imprecision in both the numerators and the denominators. Many target children are not entered in vaccination registers and "reported-coverage" estimates are used in lieu of firm measurements (numerators). Target-dose denominators (expected number of target children in the birth cohort) are used in some locations and census denominator estimates (census data) in others, leading to inconsistency and overestimates and underestimates. Thus the national coverage rates are uniformly high (97% and higher in 2001) and difficult to verify.

Brazil is another large populous country with a developing economy and regional differences in growth. It also has had a successful immunization program. However some features of the program and the public health structure that supports it differ from the Chinese model. Vaccinations are free to all children, adolescents and adults and public health workers are salaried with little need to supplement their incomes in meeting their professional responsibilities. The public health system supports the vaccination program in other ways. Disease outbreaks are investigated quickly and with competence. Thus outbreaks of vaccine preventable diseases are investigated and causes are identified. In considering a measles outbreak, it is imperative to distinguish between vaccine failure (the child was injected with vaccine of inadequate potency) and failure to vaccinate (the child was never vaccinated). The correction in the immunization program involves

improving the "cold chain" in the former cause and improving the delivery services in the latter. In addition, the cold chain is well maintained throughout Brazil and good data permit accurate calculation of coverage rates that are used to direct program activities.

Both China and Brazil have made remarkable strides in reducing the incidence of vaccine preventable childhood diseases in their populations. Each has unique circumstances that prevent comparisons of their challenges and approaches from being completely analogous. However, improving disease surveillance systems, outbreak investigation capacity and vaccine coverage data and structuring and financing the public health system such that there are no perverse incentives for complete and timely vaccinations will all strengthen any country's immunization achievements.

BOX 2: The SARS Outbreak: Varied Responses

The SARS outbreak of 2003 provided a vivid example of the value and role of a well functioning public health system after the disease originated in China and spread around the globe. It was a new disease of unknown origin, seemed to spread rapidly, especially with selected "super spreaders", and caused serious illness and relatively high mortality. No public health system or health care delivery system is ever completely prepared for such an outbreak but some have personnel, procedures, resources and professional conduct that permit them to better control the disease. In particular, the core capacities of disease surveillance and outbreak investigation and control are required to effectively cope with infectious disease epidemics.

The first cases appeared in Guangzhou and were investigated. However, multiple elements of the public health response proved sub-optimal and contributed to further disease spread. Many of these weaknesses in the response could be

attributed to years of underinvestment in the public health system, including the workforce, its training and facilities. The system was also weakened by a lack of full budgetary support with adequate salaries and benefits for staff and a related lack of professionalism. With this background, disease surveillance was not timely, thorough, consistent or well-communicated. Most health professionals worked hard and in a highly competent manner but nevertheless the system in which they worked was inadequate. Aspects of the response that played a role in delaying control of the outbreak included: a lack of urgency or need for immediate action in response to early reports of cases; inadequate analysis and interpretation of the increasing cases and lack of coordinated efforts between layers of government, misdiagnosis of the causative organism by a national authority with subsequent erosion of confidence, lack of transparency in sharing the information bilaterally or with WHO, a dearth of experienced field epidemiologists and inadequate infection control procedures.

In any given stressful acute disease outbreak in any nation, these flaws can occur. In the aftermath of the SARS events of 2003, China has made a major effort to strengthen its public health system and has made a major investment toward this end. The several other countries with SARS transmission during 2003 had experiences that offer further insight into what helps and what hinders efficient disease control.

Vietnam provides as example of how a prompt aggressive response (with a dose of good fortune) can more quickly control a disease. While it was fortunate that only one index case arrived in Vietnam, the quick identification of the patient and his illness, the rapid decision making that led to containment in one hospital of patients and staff, strong political commitment, prompt notification and welcome of assistance of international authorities, the near immediate establishment of a national steering committee on SARS, the application of infection control training with appropriate equipment all led to limiting the hospitals involved to only two and bringing the outbreak to a quick resolution but still resulting in 61 cases and 6 deaths. In a similar manner, Singapore used rapid contact tracing, strict containment, and 10 day quarantine of all contacts with the result that 80% of SARS patients in Singapore did not infect anyone else and the outbreak was quickly controlled.

A large enough or severe enough disease epidemic can severely tax any country's public health preparedness- whether anthrax in the U.S., Foot and Mouth Disease in the UK or SARS in Toronto. Those not sorely challenged may look better than others due to luck rather than superior performance. However, the experience of all countries over the past 100 plus

years of modern public health history is that a robust, well-structured and supported, highly professional, experienced and aggressive public health system is the most effective tool a nation has to control epidemic disease.

Box 3: Tobacco and Health

Tobacco use is the major preventable cause of death in most developed countries and an increase threat to the developing world. Developing countries already account for half of all deaths attributable to tobacco. Of all male deaths in China at ages 35-69, the proportion attributed to tobacco will rise between 1990 and 2030, from 12% to about 33% (as happened previously in the United States) (Niu SR et al. 1998, Emerging tobacco hazards in China. BMJ; 317:1423-4). With 60 % of men smoking and aggressive marketing potentially increasing the smoking prevalence of women, the health burden on China from years of life lost and economic costs is immense. In many aspects of tobacco as a health issue, China resembles the United States in 1960 with: high smoking prevalence; a robust tobacco industry flourishing from farm to marketed products; little public health response, few governmental anti-tobacco interventions, (e.g. increased excise tax, indoor pollution regulations, etc.), poor understanding of the health effects of tobacco by the general population and little change in the social norm such that smoking in public and closed spaces is still tolerated.

There are many examples of countries at varying levels of development, of different sizes and with different histories and traditions of tobacco use and cultivation who have addressed the tobacco threat with aggressive effective interventions and have begun to see the positive results of these efforts. Poland is a good example. In the mid 1970's, 65-75% of Polish males smoked. Through public health efforts, this figure dropped to 39% in 1998. Prices of cigarettes were increased through taxation to levels where a person earning the average wage would have to work for 40 minutes to earn the price of the pack. This increase made cigarettes much more costly that in countries of similar size and development. Public health advocates used broader political and social changes to advance their health agenda, including tobacco control. In the 1990's, Poland enacted strong comprehensive legislation in 2 steps: first, better information for consumers and restrictions on smoking and tobacco advertisements; second, tax increases. Also local research supported the body of evidence on the negative health impact of tobacco and the positive economic implications of tax increases. The rapidly changing social norm, regarding tobacco use, reinforced the legislation and supported the legislators and enforcers. The legislation in turn encouraged the changing social norms.

Many Tobacco producing countries, such as China and the United States, have been slow to take aggressive steps to diminish tobacco consumption. However for all nations, the outcome is inevitable; smoking cigarettes causes unnecessary disease and deaths and will burden the health system at considerable cost for many decades. The United States, Australia, Canada, the Nordic countries, South Africa and Thailand have all made tobacco control a public health priority. The sooner China does so, the sooner its population's health will improve.

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