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# Changing health in China: re-evaluating the epidemiological transition model

Ian G. Cook\*, Trevor J.B. Dummer<sup>1</sup>

*School of Social Science, Liverpool John Moores University, Henry Cotton Campus, 21–25 Webster Street, Liverpool L3 2ET, UK*

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## Abstract

This paper reviews the changing health situation in China, which has shown remarkable improvement in the 50 years since the founding of the People's Republic of China (PRC) in 1949. At first sight this improving health situation follows the classical epidemiological transition model. Just three decades ago health in China was characterised by high rates of infectious disease and early mortality (diseases of poverty) in a mainly peasant society. More recently infectious disease rates have decreased, with corresponding and extended morbidity and mortality associated with an aging population in a rapidly urbanising society. This process has given rise to new health problems, including chronic and degenerative diseases (diseases of affluence). Nonetheless, while there is some validity in the application of the epidemiological transition concept, further analysis demonstrates that China faces a new epidemiological phase, characterised by increasing life expectancy and diseases of affluence coupled with the emergence and re-emergence of infectious diseases. We demonstrate that China's state policy plays a major role in defining the parameters of health in a Chinese context. We conclude that, today, China is faced with a new set of health issues, including the impact of smoking, hypertension, the health effects of environmental pollution and the rise of HIV/AIDS; however, state policy remains vital to the health of China's vast population. The challenge for policy is to maintain health reform whilst tackling the problems associated with rapid urbanisation, widening social and spatial inequalities and the emergence of HIV/AIDS and other infectious diseases. © 2003 Elsevier Ireland Ltd. All rights reserved.

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## 1. Introduction

On 1st October 1949 the People's Republic of China (PRC) was founded. The new government was faced by a complex and difficult situation, including

an economy and population shattered by years of war, both with Japan and between the Communist Party and the Guomindang. In health terms, floods and famine had taken a huge toll from the nineteenth century onwards, exacerbated by increasingly high levels of poverty. Such conditions enabled health threats, including malaria, typhus and other infectious and parasitic diseases, to flourish. The Chinese Communist Party (CCP) sought to overcome these increasing health problems via a range of measures linked to wider socio-economic development policy. Of these,

\* Corresponding author. Tel.: +44-151-231-4071; fax: +44-151-231-4359.

E-mail addresses: [i.g.cook@livjm.ac.uk](mailto:i.g.cook@livjm.ac.uk) (I.G. Cook), [t.dummer@livjm.ac.uk](mailto:t.dummer@livjm.ac.uk) (T.J.B. Dummer).

<sup>1</sup> Tel.: +44-151-231-4063.

the ‘barefoot doctors’ campaign associated with the rise of the communes in the late-1950s is probably the best known, but related policies included the utilisation of traditional Chinese medical practices as well as Westernised approaches, investment in the public health sector, and improved sanitation practices as part of the drive to improve the living conditions of the peasantry. These policies were markedly successful. By the late-1990s, China’s health situation had improved to such a level that life expectancy had doubled to 70 and infant mortality—a key indicator of a nation’s development—declined from 300 per 1000 births in 1950 to 31 per 1000 births in 1999 [1,2].

The concept of the epidemiological transition provides a useful model to describe and analyse the changing health situation in rapidly developing countries [3]. The concept provides a framework to interlink changing mortality and morbidity patterns with population change and developments associated with modernising societies [4,5]. The classical epidemiological transition model moves through a series of three stages linked to a country’s development: the age of pestilence and famine; the age of receding pandemics; the age of degenerative and human induced diseases [4]. Initially, within undeveloped societies, mortality is associated with famine and infectious disease epidemics (diseases of poverty), but as society develops there is a decline in infectious diseases coupled with increasing mortality and morbidity caused by lifestyle and degenerative (chronic) diseases that are associated with increasing life expectancy (diseases of affluence). The term “health transition” is increasingly used in place of the epidemiological transition because it is considered more wide-ranging, encompassing cultural, social and environmental determinates of health, focusing on more than just improvements in medical and public health care [5]. Developments to the classical epidemiological (health) transition model have been proposed where some improvements in health are apparent as a result of medical developments and socio-economic changes, but uneven development results in many continuing and emerging health problems [5,6]—such refinements are applicable to countries such as China. Indeed Islam and Tahir [7] argue that many developing nations face health problems in a new health transition phase, health problems that are associated with rapid unplanned urbanisation, emerging and re-emerging infectious

diseases and increasing obesity linked to the nutritional transition [8]. Further Heuveline et al. [9] show that whilst the global burden of infectious diseases has fallen, in line with global development, health problems facing the world’s poorest people are still dominated by infectious diseases—importantly, China accounts for 20% of the world’s poor. Thus, such a complexity of problems presents fresh challenges for health planning and policy development in China.

This paper reviews China’s changing health situation since before the founding of the PRC in 1949 to the present day, via application of the epidemiological (health) transition model, in order to consider whether the health improvements are merely an inevitable consequence of the PRC’s development trajectory, or whether they more fundamentally reflect state policy, and the conflicting health priorities with which the Chinese state has grappled. We consider the applicability of the concept of the epidemiological (health) transition. We begin by summarising the health situation in the years before the PRC was founded.

## 2. Pre-revolution health in China

The pre-revolutionary health situation in China was poor. Worth [10] summarises common diseases, including:

- enteric infections, such as typhoid fever, bacillary dysentery and cholera;
- hookworm disease;
- childhood measles (often fatal), smallpox epidemics, diphtheria and tuberculosis, malaria, kala-azar, schistosomiasis, tetanus of the umbilical cord, venereal diseases;
- more widely, high death rates caused by impact of floods, drought, war or epidemic which we would refer to as ‘systemic breakdown’.

These epidemics and threats had a variable spatial impact. The Huang He (Yellow River) was known locally as ‘China’s Sorrow’, and the traditional heartland of north China was the locus of floods or famine every 2–3 years. There were 1500 recorded instances of the Huang He bursting its banks in a recorded history of more than 3000 years, while 1056 droughts were recorded from 206 B.C. to 1949 [1]. At their worst, such disasters caused immense loss of life, while at

Table 1  
Health in pre-revolution China

Causes of death and health problems in pre-revolution China	Source
Annual death rate from tuberculosis in the 1930s which ranged from 208 per 100,000 in a rural northern setting through to 500 per 100,000 in an urban, southern location. In 1948, 18.2% of students at one university in Beijing were found to have active tuberculosis.	[10]
4–5% of villagers died of kala-azar in the plains between the Huang He and the Yangtze, especially children and young adults (early-1930s).	[10]
10 million cases of schistosomiasis and 50 million cases of hookworm (1930s). In parts of Zhejiang province, half of deaths were attributed to schistosomiasis or complications (1936).	[10,11]
900,000 deaths caused by the deliberate flooding of the Huang He by the nationalist Guomintang government to delay invading Japanese forces in 1938. An estimated 10 million people lost their homes, with 50 million directly affected, when the Yangtze flooded in 1931.	[1]
9–13 million deaths in 1876–1879 from a catastrophic drought across the four provinces of Shaanxi, Shanxi, Henan and Hebei. 500,000 deaths and nearly 20 million declared destitute in 1919 following a drought which hit Hebei especially, plus Shandong, Shanxi, Shaanxi and Henan provinces.	[1]

best they would have a marked impact on the health profile of the peasantry especially. Table 1 summarises the major causes of death and health problems in pre-revolution China.

In the face of such enormous problems, and in part prompted by the rise of communism, the nationalist Guomintang government sought to establish a health care system. Prior to this the health care system combined traditional medicine with some Western-based approaches. Their law, however, did not run over the whole country, half or more was controlled by warlords, and the Japanese, whose full invasion from their base in Manchuria (*Manzhouguo*) began in 1937. The founder of the Guomintang, Dr. Sun Yatsen, was himself a western-trained medical doctor, but one unfortunate by-product of a clash between modern western techniques and training compared with traditional medicine practitioners was the marginalisation and exclusion of the latter. These traditionalists—many of whom were scholarly and employed acupuncture, moxibustion and traditional herbal remedies—numbered up to 500,000 across the country. But such resources as were available were directed towards the 12,000–20,000 (estimates vary according to source) Western-trained doctors who were too few in number to have much of an impact, especially in more remote rural areas [10,11]. With regard to hospitals, Hillier and Zheng [11] provide a figure of 430 for the whole of China prior to 1949, although they note that each of the 2000 counties had a small health clinic. In sum, China's health care provision was wholly inadequate, with considerable scope for improvement.

### 3. State policies under Mao

The first leader of the PRC, Mao Zedong, who died in 1976, developed the revolutionary doctrine termed Maoism, a variant of Marxism applied to the specific conditions of the peasant society which was China. Refined in the long struggle with both the Guomintang and the Japanese, revolutionary theory was fused with practice in the 'base areas' dominated by the CCP. In the new People's Republic, however, there were two divergent strands within health care, with a marked contrast between those trained in the Soviet Union along more conventional Western lines, and with the ex-guerrillas who had worked closely with the peasantry to improve basic conditions, especially in sanitation practices [11]. The new Ministry of Health (MoH) was dominated by the Soviet-trained officials but further down the pyramidal structure, which reached the township and county hospitals, came the party cadres and others who were motivated more by ideological concerns for revolutionary change rather than for health care per se. Thus, conflicts between these two groups arose, particularly due to contrasts between the top-down, centralised, Soviet-style approach and the Maoist, decentralised, bottom-up approach.

Contrasting outcomes of these policies include: mass campaigns in the 1950s against the parasitic and infectious diseases noted above, involving environmental clean-ups, inoculation programmes at the local level, the introduction of free health care within the communes in the late-1950s (abandoned later), along with the introduction of 'barefoot doctors' who were

would now term medical auxiliaries or paramedics. These people would receive basic training to deal with sanitation matters and hygiene, traditional herbal remedies and medical practices including acupuncture and would work at the commune level [12]. The famines and high death rates which followed the Great Leap Forward (GLF) led to a backlash against Mao's policies, which were widely perceived as trying to do too much too soon. Thus, the Ministry of Public Health once again took over the running of health care until the Mao-inspired Great Proletarian Cultural Revolution (GPCR), which led to attacks on these and other officials and bureaucrats in other ministries in another attempt to revolutionise the direction of China's development trajectory. The move back towards the local level led to the "heyday" of the barefoot doctors, and by 1972 there were 2,000,000 of these across China funded as part of a Cooperative Medical System which also provided medicines, a portion of hospital costs and clinic equipment [11]. But Mao's death and the rise to power of Deng Xiaoping heralded a markedly different direction for health care in China, and it is to this that we now turn.

#### 4. The Dengist route to market socialism and public health provision

Deng Xiaoping 'always had a clear vision about China's progress—economic development and material progress had to take precedence over political mobilisation' [13]. Deng until his death in 1997 led China towards market socialism, a policy which has been broadened and deepened by his successor Jiang Zemin, now retired. The CCP would remain paramount but would engage fully with the international community via the Open Door Policy, and would follow the 'Four Modernisations' to transform China. China today is now a markedly changed society, with an estimated 200 million middle class, mainly urban, located especially in the eastern provinces along the coast. Peasant society too has been transformed; beginning with the abolition of the communes in the 1980s and the introduction of the 'Household Responsibility System', which permitted peasants to sell surplus produce in open markets. These agricultural reforms and the concomitant breakdown in collective endeavours heralded the demise of the Cooperative

Medical System and the introduction of a more privatised health care system. Barefoot doctors faced pressures to acquire more skills via training and examinations, and although many chose to become 'rural doctors' instead, others opted for alternative employment. The proportion of government expenditure on preventive public health institutions (PHIs) has decreased, in line with the wider drive towards greater efficiency across the state-run sector, and greater funding is directed instead towards hospitals [14].

Table 2 shows official data for changes in the number of health institutions in China since the founding of the PRC in 1949. The data is not presented for 1960 due to upheavals following the GLF and the widely accepted view (both in China and outside) that statistics presented by the Chinese government at that time cannot be trusted [1]. We consider the reliability of the China Statistical Yearbooks data in more detail later. Interesting patterns can be seen in this table. The total number of health institutions multiplied by approximately 90 times in this 50-year period, with a dip however in the late-1960s to the early-1970s, which mainly reflects a marked decline in the number of clinics in the country, from 170,430 in 1965 to 79,600 in 1970. This was the period of the GPCR, when China was torn apart in the drive by Mao to reassert his power and revolutionise the masses. He had attacked the Ministry of Public Health in a speech in 1965 in which he accused it of urban bias and only working for 15% of the total population of the country [11]. The ministry was closed down, and small mobile health teams and the barefoot doctors were sent out to rural areas. The table fails to reflect this small-scale dissemination to the local level, with the clinic level of provision being the one that deteriorated during this controversial period. Note that the number of sanitation and anti-epidemic agencies also shrank from 1965 to 1970, before a rapid recovery of provision took place as ideological attacks were reined in during the years after 1971 when it was realised that too much damage was being done to key facilities and provisions such as these.

Table 2 also shows how, for nearly a decade, hospital provision was exclusively at or above the county level, from 1949. The GLF period did bring a greater deconcentration of these facilities, evidenced by the 1962 data. Since then, although large hospitals have continued to grow in number, by a factor of 3, smaller hospitals have also grown in number, albeit by a smaller

Table 2  
Number of health institutions, 1949–2001

Year	Total	Hospitals	Hospitals at and above county level	Clinics	Sanitation and anti-epidemic agencies	Maternity and child care centres
1949	3670	2600	2600	769	0	9
1952	38987	3540	3540	29050	147	2379
1957	122954	4179	4179	102262	1626	4599
1962	217985	34379	5300	172708	2208	2636
1965	224266	42711	5445	170430	2499	2795
1970	149823	64822	6030	79600	1714	1058
1975	151733	62425	7757	80739	2912	2025
1980	180553	65450	9478	102474	3105	2610
1985	200866	59614	11497	126604	3410	2724
1990	208734	62454	13489	129332	3618	2820
1995	190057	67807	14771	104406	3629	2832
2000	324771	66509	15446	240934	4065	2598
2001	330348	65424	15431	248061	4253	2548

Source: China Statistical Yearbook 2002 [15].

factor of around 2. In terms of health personnel, total numbers, as shown in Table 3, grew 10 times from 1949 to 2001. It is with reference to doctors of Western medicine, paramedics of Western medicine and nurses that the growth has been greatest. There are some paradoxical trends, however, again during the GPCR in particular. Thus, the attack on those with ‘bourgeois tendencies’ would seem to have been concentrated more on the doctors of traditional medicine (associated with feudalism and superstition by leftist CCP leaders) rather than those trained in western methods (associated in contrast with modern rational methods and techniques). As the table portrays,

numbers of the former declined from 321000 in 1965 to 225,000 in 1970 and rose only a little to 229,000 in 1975. Numbers have recovered since, but there was another decline in the 1990s. This was due to the forces of economic modernisation being unleashed in China, rather than the political emphasis of the GPCR, and the drive towards all things Western. Note that by 2000, the numbers of those engaged in traditional Chinese medicine was the same as it had been in 1957, over 40 years previously. In contrast, the doctors of western medicine have grown steadily since the founding of the PRC, with particular growth during the 1980s as Deng unleashed his modernisation project. Paramedic

Table 3  
Number of persons engaged in health institutions, 1949–2001 (thousands, except final column)

Year	Total health personnel	Doctors of traditional Chinese medicine	Doctors of western medicine	Paramedics of western medicine	Senior and junior nurses	Doctors per 1000 population
1949	541	276	38	49	33	0.67
1952	819	306	52	67	61	0.74
1957	1254	337	74	136	128	0.85
1962	1685	344	120	224	200	1.02
1965	1872	321	189	253	235	1.05
1970	1793	225	221	256	295	0.85
1975	2594	229	293	356	380	0.95
1980	3535	262	447	444	466	1.17
1985	4313	336	602	473	637	1.33
1990	4906	369	1058	331	975	1.54
1995	5373	359	1186	365	1126	1.58
2000	5591	337	1330	395	1267	1.67
2001	5584	334	1364	387	1287	1.69

Source: China Statistical Yearbook 2002 [15].



Table 4  
Number of beds in health institutions, 1949–2001 (thousands, except final column)

Year	Total health institutions	Total hospitals	Hospitals at and above county level	Hospital beds per 1000 population
1949	85	80	80	0.15
1952	231	160	160	0.28
1957	462	295	295	0.46
1962	933	690	577	1.03
1965	1033	766	621	1.06
1970	1262	1105	712	1.33
1975	1764	1598	948	1.73
1980	2184	1982	1192	2.01
1985	2487	2229	1487	2.11
1990	2925	2624	1847	2.30
1995	3141	2836	2053	2.34
2000	3177	2948	2155	2.38
2001	3201	2976	2176	2.39

Source: China Statistical Yearbook 2002 [15].

numbers declined after the first flush of modernisation, however, as policies and resources were directed instead to better trained doctors supported by nurses, numbers of which have expanded by a factor of 400 since 1949.

As for number of doctors per 1000 people in China, the final column of Table 3 shows that, indeed, it was during the years of the GPCR that ratios dropped, from 1.05 in 1965 to 0.85 in 1970 and some small recovery to 0.95 in 1975. The proportion of hospital beds (Table 4) did not decline in that period, however, and this was where the non-traditional doctors were more likely to be located. Hospital bed provision at or above county level, has continued to increase steadily over the decades, but it was not until the GLF that there were beds made available at a more local level, with 113,000 by 1962. Since the reform era led by Deng, bed numbers of this localised level has remained constant at around 800,000 from 1980. It is the growth at the larger scale that has been more pronounced. This is laudable in terms of such parameters as economies of scale, expertise and variety of provision, but there remains the problem that the increase in resources to such curative activities has diminished the budget for preventative medicine [14], especially in a time when market imperatives have been introduced, with charges being levied on immunisation services to the detriment of take-up of these and a resultant increase in communicable diseases such as measles, polio, TB or schistosomiasis.

Patterns of disease, health and death changed markedly during the Deng era as China's social and economic development trajectory moved it through the late stages of the epidemiological transition. Table 5 shows incidence of major infectious diseases for the period 1994–2001. There was an overall decline in incidence of infectious diseases, with marked falls in cholera, dysentery, hepatitis and typhoid—these are the traditional diseases of poverty and

Table 5  
Incidence (per 100,000 population) of infectious diseases, 1994–2001

Infectious disease cause	2001	1999	1994
Total causes	188.62	197.63	203.68
Cholera	0.22	0.37	3.06
Viral hepatitis	65.15	68.93	76.83
Dysentery	39.52	45.91	76.83
Typhoid and paratyphoid fever	4.84	3.87	8.77
AIDS	0.03	0.00	0.00
Gonorrhoea	14.62	20.63	11.05
Syphilis	4.56	4.16	0.19
Measles	7.24	4.67	7.54
Pertussis	0.52	0.49	0.69
Epidemic encephalitis	0.18	0.23	0.56
Scarlet fever	0.91	1.15	2.13
Hemorrhagic fever	2.73	3.74	5.73
Encephalitis B	0.76	0.65	1.70
Malaria	2.00	2.22	5.6
Newborn baby tetanus	16.18	16.55	–
Pulmonary tuberculosis	44.06	39.03	–

Source: China Statistical Yearbook 2002, 2000, 1995 [15,18,19].

Table 6  
Death rates from major causes, urban and rural areas, 1989–2001 (as percentage of total deaths)

Cause of death	Urban	Rural	1999		1995		1989	
			Urban	Rural	Urban	Rural	Urban	Rural
Malignant tumour	24.9	17.7	23.9	18.4	21.8	16.5	21.42	15.33
Cerebrovascular disease	20.44	19.0	21.6	18.4	22.1	16.35	20.94	15.53
Heart disease	17.6	13.1	16.8	12.4	14.9	10.4	15.96	12.07
Respiratory disease	13.4	22.5	13.9	22.0	16.1	25.3	15.76	24.95
Trauma and toxicosis	5.9	10.7	6.3	11.0	6.7	12.0	7.43	11.58
Digestive diseases	3.1	4.1	3.0	4.0	3.5	4.8	3.93	5.15
Urinary disease	1.6	1.5	1.5	1.5	1.5	1.3	1.55	1.31
Mental disease	1.0	–	1.1	–	–	1.8	–	–
Neuropathy	1.0	–	0.9	–	0.9	–	–	–
Internal system, nutrition, metabolite and immunity	3.2	1.1	2.9	1.1	2.2	–	–	–

Source: China Statistical Yearbook 2002, 2000, 1995, 1990 [15,18,19,20].

under-development. By contrast, there was a rise in some infectious diseases, including sexually transmitted diseases (STDs)—partly diseases of lifestyle. Coinciding with the overall fall in infectious diseases was an increase in deaths from chronic diseases, including heart problems and malignant tumours (see Table 6)—the predominant diseases of an aging and more affluent population. Interestingly, Table 6 also highlights disparities in causes of death between urban and rural areas, with rural areas lagging behind urban areas with regard to the move from infectious disease to chronic diseases. However, within China as a whole, the burden of disease has shifted from childhood disorders, high infant mortality and infectious diseases to chronic (non-communicable) diseases, accidents and injuries [16]. For example, in 1990 75% of the burden of disease was attributable to non-communicable diseases and injuries, a percentage approaching that for Western developed countries (92%) and much greater than that for developing na-

tions as a whole (52%) [17]. In addition, under Deng, infant mortality continued to decline, although somewhat less rapidly than the huge decreases experienced between 1960 and 1980, where infant mortality fell from 300 to 50 per 1000 births [2]. However, differences in infant mortality between rural and urban areas have widened—the rural/urban infant mortality ratio increased from 1.67 in 1981 to 1.75 in 1990, and there was considerable variation in rates within rural areas [2].

The shifts in population health experience outlined above, although variable between urban and rural areas, are indicative of a rapidly modernising and developing country that is utilising advances in public health care and medicine.

In terms of evidence for the success or failure of health provision in China, the WHO's healthy life expectancy (HALE) index is a useful and reliable data source to complement the official China data [21], providing an estimate of the years of good health for

Table 7  
International comparisons of healthy life expectancy (HALE) at birth (years)

Country	Population life expectancy at birth	Male life expectancy at birth	Female life expectancy at birth	Male expected lost healthy years at birth	Female expected lost healthy years at birth
China	62.1	60.9	63.3	8.0	9.7
India	52.0	52.2	51.7	7.6	11.0
Indonesia	57.4	56.5	58.4	6.9	9.1
Russia	55.5	50.3	60.6	9.1	11.4
UK	69.9	68.3	71.4	6.5	8.5
USA	67.2	65.7	68.8	8.2	10.7

Source: WHO, 1992 [21].



the population at birth, and separately for males and females. The WHO index also calculates years of lost healthy years. Table 7 provides the figures for China, contrasting with India and Indonesia, two similarly large developing countries, plus Russia, the US and the UK for comparisons with developed nations. The data shows that overall population healthy life expectancy is 62.1 years (the table omits uncertainty bands), 10 years more than India and only 5.1 years less than for the USA. The gap between expected female life expectancy for China and India is even more marked, although there is some way to go relative to the UK for example. The levels are also much better than for the Russian Federation and 5 years better than for Indonesia, indicating a high rate of relative progress. However, the expectation of lost healthy years at birth for both males and females is relatively high. For males, the figure of 8.0 years is only just better than for India, for example, and for females the figure of 9.7 years is actually worse than for Indonesia, at 9.1 years, although it is better than for the US. These last two columns of the table provide an indication of some of new or resurgent health problems which China is facing. These will be considered next.

## 5. Contemporary health problems

### 5.1. Respiratory

The drive for rapid economic growth in the last two decades has brought impressive results. China is now widely regarded as an economic success story, and had the capacity to withstand the worst effects of the Asian Financial Crisis in 1998. But the drive for growth has been at a heavy environmental price as a number of authors have made clear [1,22–24]. This has had a severe knock-on effect on China's health situation. For example, air pollution has become a major problem, and respiratory diseases have increased [1]. Coal is the major fuel, and much of it has a high sulphur content, therefore in many northern cities, as well as the central city of Chongqing which is surrounded by mountains, acid rain poses a severe threat in winter, and it is reckoned that 800,000 tons of SO<sub>2</sub> falls annually on that city, implicated as causing high rates of asthma and lung cancer. By the late-1990s, six of China's major cities—Beijing, Chongqing, Guangzhou, Shang-

hai, Shenyang and Xian—were ranked as among the most polluted in the world, a situation which is increasingly admitted by Chinese politicians. In Beijing and other cities new measures are being put in place to tackle these problems, including a switch to low sulphur coals, liquid petroleum gas, a complete banning of the 'miandi' (small diesel powered minibuses) which cause a high proportion of traffic pollution, and greater restrictions on pollution from industrial sites such as the Shougang steel works, which is to be relocated to a new site two hundred miles away. Nonetheless, the sheer scale of the problem makes it difficult to tackle effectively; city planning, which encourages a spread of urban activities outwards, often contradicts improvements by generating higher traffic levels [25], and by 1999 in China, respiratory diseases were responsible for nearly 14% of deaths in urban areas [16].

But it is not just in the cities that there is a major problem. In rural areas respiratory diseases caused 22% of deaths and is the leading cause of death, whereas it is fourth in the urban rankings [16]. This is because 800 million Chinese use coal in their homes, and it contains a wide range of toxins such as arsenic, lead, mercury and fluorine [26]. In Guizhou province in the south west green peppers are a delicacy, they are dried over coal-fired stoves which impart up to 500 ppm of arsenic to them [27], and at least 3000 cases of chronic arsenic poisoning have been confirmed in that locale. The lack of controls in rural areas means that it will be very difficult to address these problems effectively.

### 5.2. Resurgent diseases

As noted previously, there has been a resurgence in some of the infectious diseases of the pre-PRC era. Liu and Mills [14] show, for instance that rates of immunisation dropped after price charges were introduced, such as a 36% drop in Shandong Province, 1979–mid 1980s. Schistosomiasis prevalence increased from a rate of 540 per 10,000 in 1980 to 788 per 10,000 in 1990. A 2001 study estimated that 865,000 people and 100,250 bovines were infected in the provinces where the disease is endemic [28]. Leprosy rates and TB, too, have increased. Chen et al. [29] show that there are still more than 10% of counties or cities where the criterion for leprosy elimination of less than 1 per 100,000 has not yet been reached. There were an es-

estimated 1–1.5 million additional TB cases remaining infectious during the 1980s, primarily because treatment was not free [14]. Apart from the cost aspect, a major reason for the continuation of many infectious diseases is water pollution. Beach [30] reports that 700 million Chinese are estimated to drink contaminated water, and that over 30 billion tons of urban sewage are discharged into water courses, lakes and seas annually, with 2.7–10% remaining untreated. Many of China's wastewater treatment plants serve at least 1.5 million people per day, compared to 7–8000 in the UK for example [30]. Industrial wastewater also has to be dealt with, with at least 3.8 billion tons of industrial wastewater untreated by 1997 [1]. Although the PRC government is acting to reduce the threat of wastewater pollution from both domestic and industrial sources clearly more must be done, although economic issues often outweigh environmental concerns [30]. Paradoxically, however, it is economic pressures that is largely forcing government action due to worrying economic projections concerning lack of industrial water supply and the impact of poor health on the labour force. But China is spending huge sums on other projects, such as the Sanxia Dam or the north–south water diversion project [1]. The Sanxia dam, in particular, is implicated in threatening to worsen rates of schistosomiasis [31,32], with high rates around reservoirs being a common feature around the globe and local endemic sites being only 40 km downstream or 500 km upstream. Malaria, too, could well increase in such conditions.

### 5.3. Loss of life via 'natural' disasters

With the marked exception of the years following the GLF, when millions died as a result of famine, plus the loss of life of 250,000 in the Tangshan earthquake of 1976, to date the high death tolls of the past have generally been avoided in recent decades. Nonetheless, threats still remain. For example, Tangshan '(Un)fortunately and dangerously, . . . , with its metropolitan population of 1 million, has already been rebuilt on the same site' [33]. The Sanxia Dam noted above might also be susceptible to earthquake, and the potential loss of life would run into the millions due to the resultant floods downstream as well as the huge backwash upstream. Floods across China remain a perennial threat, with loss of life along the Yangtze River in 1998 and 1999, for example possibly run-

ning into the thousands according to foreign sources, far less according to the Chinese authorities. Deforestation, corruption, and human action were all implicated in causing such floods, but climatic change and 'exceptional factors' became the officially recognised culprits in an official report following the 1998 floods along the Yangtze [1], a report questioned by the latter authors. The PRC government has, in general, done well to largely avoid the perils of the past, but this does not mean that these perils have disappeared, rather they are latent and can relatively easily be triggered via human action or government inaction.

### 5.4. Threats via pesticide use

Pesticide use has more than tripled in recent decades, as the communal labour of the Maoist period has been replaced by the individual or family labour of today. In Zhejiang Province, researchers [34] found that the rate of pesticide use in rice production is more than double the national average, and similar to Japan or South Korea rather than other countries in the region. Nor was this use wholly efficient, because diminishing returns set in, and farmers were estimated to be overusing pesticides by more than 40%, reflecting gross overestimates of the threat of loss due to pests. Health impacts reported by the sample included eye effects, headaches, skin problems, liver problems and neurological effects. Of 100 farmers examined, 22 had impaired liver function, while 23 had abnormal levels of key chemicals in their kidneys. At the wider scale, 300–500 deaths per annum are estimated as being due to pesticides, use of which will increase as economic modernisation continues apace [1].

### 5.5. Impact of changing lifestyles and hypertension

The rapid change in lifestyle in China, consequent on the fast pace of economic modernisation, especially in the burgeoning cities, is bringing with it a wide range of stresses. There is evidence for a vast increase in tobacco consumption [35,36] for example, with researchers predicting that 3 million young men could die per annum of smoking-related diseases during the 21st century, and the WHO forecasting 2 million deaths per annum by 2025 [37]. As in some other countries, such as Japan, the situation is not helped via the role of the State in tobacco production, and

a tie-up was announced in 2002 between the major State Owned Enterprise, China National Tobacco Corporation, and the western tobacco giant, Gallaher [38]. There is hence a strong vested interest, due to the income it produces, for the state in playing down the impact of smoking on ill health, with one survey reported by Bradbury stating that 60% of Chinese adults do not know that smoking causes lung cancer, while 96% do not know that it causes heart disease [35,36]. Currently two-thirds of China's young men become smokers before they are 25 years old [39]. Unless these rates show a marked decrease, perhaps highly unlikely due to the strength of the tobacco industry, up to one-third of China's men could die eventually of smoking-related conditions [39]. The respiratory diseases noted above have a strong smoking-related dimension, therefore, and are not just the result of coal burning and related factors.

Nutrition intakes have also shown a marked shift as Western food consumption patterns are adopted and China undergoes the nutrition transition [8]. The first 'fat camp' was opened in Beijing in 1994, reflecting a growing problem of obesity as Western 'junk food' becomes increasingly popular in the cities, where there are a plethora of McDonalds, KFC, New York Pizza and other Chinese variations on the Western theme. A paradox of the Single Child Family Programme introduced in the 1980s has been the emergence of a privileged group of single children, often boys, who are so doted upon and pampered by their parents and grandparents that they are known as the 'little emperors'. Many of these children are overweight, with obesity in young children increasing by over 50% from 1989 to 1997, from 4.2 to 6.4% in the 2–6 years old age range, and in cities from 1.5 to 12.6%. Overweight people increased from 14.6 to 28.9% in that time [40]. Increasing quantities of meat are being consumed, with corresponding higher levels of fat intake—by 1997 60% of urban adults consume over 30% of their energy from fat [41].

Health outcomes of increased smoking prevalence, high fat diets, sedentary lifestyles, increased alcohol consumption and high salt intakes include a large proportion of malnourished or obese people compared to other countries in Asia or Latin America [42], and an increase in diabetes and hypertension [43–45]. Hypertensive patients increased from 30 million in 1960 to 94 million in 1991, and a recent study indicated that

130 million adults—nearly 10% of the population—have blood pressure levels above the normal, contributing in turn to high rates of cardiovascular diseases. What is particularly disturbing is that the increasing rate of hypertension among young people is much higher than among the elderly [45].

Among young people an increase in mental health problems has been reported [46] while the suicide rate is also giving cause for concern [47]. The latter study adjusted official Ministry of Health (MoH) data for estimated unreported deaths and projected these to the corresponding population to arrive at a mean annual suicide rate of 23 per 100,000 and a total of 287,000 suicide deaths per year. Thus, overall, suicide is the leading cause of death in those aged 15–34 years. For rural and urban women aged 15–34 suicide was the leading cause of death, for rural and urban men it was the second leading cause of death (after motor vehicle accidents) [47,48]. There is dispute over the precise scale of suicides, and Phillips et al. contrast their findings with the 2001 WHO study which reports a rate of 14.0 per 100,000 and a 17.2% drop in suicide rates from 1988–1990 to 1996–1998, findings inconsistent with the Western Pacific Region as a whole, and also with a rate previously reported by the WHO of 32.9 per 100,000 for China [47].

## 5.6. HIV/AIDS

Another major health issue, which is partly lifestyle related, is the growing incidence of HIV/AIDS. China during the Maoist years was an austere place in which extra-marital sex, prostitution and drug use was minimal. Since the Open Door Policy was introduced prostitution has shown a marked increase, especially in the cities, and drug-taking has also increased. As highlighted in Table 6, sexually transmitted diseases (STDs) are on the resurgence, having been virtually eradicated by the 1960s [49], and by 1998 were the third most-common group of infectious diseases in China, after dysentery and hepatitis [50]. Officially, in 2001, Gonorrhoea had an incidence rate of 14.62 per 100,000 (compared to 65.15 for viral hepatitis and 39.52 for dysentery), while the Syphilis rate was 4.56 per 100,000 [15]. The AIDS rate was reported as just 0.03.

While the Chinese authorities have been admitting for some time that China had HIV and AIDS cases,

until recently they have played down the number of cases. It was not until 2001 that international experts noted that the authorities were speaking more openly and frankly on this topic, fuelled in part by a scandal of contaminated blood in Henan province [51,52]. By 2002, the official English-language China Daily reported a warning by health officials that around a million people were infected by HIV, a figure that could rise by a factor of 10 by 2010 [53]. International estimates go up to double that figure [54]. Qi Xiaoqi, head of the Department of Disease Control of MoH warned that AIDS was ‘at a very dangerous stage in China on the verge of becoming an epidemic’. Such concerns were prompted by factors such as a UN estimate of 1.5 million HIV cases, and an increase of 58% in HIV and AIDS during 2001, although the rate dropped to 17% to June 2002. AIDS activists are appearing in China, including one Shanghai resident who, under the pseudonym of Jiaming, began a website to publish his diary, following his infection from a prostitute [52]. The website received 2 million hits showing the huge potential interest in this issue in China. Despite the improved government attitude, another activist, Wan Yanhai, was arrested in September 2002 for ‘allegedly revealing state secrets’ [53]. Further, there is gross under-reporting of AIDS cases, in part because in villages people are worried about stigmatisation and being unable to sell their vegetables or find jobs in the towns and cities [53]. Clearly, as with tobacco, there is much to be done to dispel ignorance about this disease, and to assist prevention as well as treatment. Drug addiction in particular, via infected needles, has been suggested as the main cause of the disease in China, as in a number of other countries [55], and the whole issue of drug use requires a more sophisticated policy than the execution of drug dealers currently applied in the PRC.

### 5.7. Severe acute respiratory syndrome (SARS)

The first cases of severe acute respiratory syndrome (SARS) emerged in Hanoi, Vietnam, in late-February 2003 and quickly began to be reported world wide. In late-February China also began reporting SARS, with 305 cases and five deaths [56]. However, it became clear at the end of late April 2003 that Chinese officials had known about atypical cases of pneumonia in southern Guangdong province in November 2002 [56]

and was effectively under-reporting and hiding SARS cases. In April, the deputy health minister acknowledged that the Chinese Ministry of Health was not adequately prepared to cope with the SARS emergency, a view also highlighted by the WHO, who noted, in general, the lack of investment in health care systems [57]. By April 2003, China (excluding Hong Kong) had reported a total of 1807 SARS cases and 79 deaths. However, it is likely that this figure still represents an underestimation of the scale of the problem, with many provinces still not reporting cases [56].

Although it is too early for a full assessment of this ongoing epidemic, what has already become clear from China’s handling of SARS is that a more open and inclusive approach to public health emergencies is required from government officials. Because of the scale of SARS the WHO suggests that it is a problem beyond the control of a single government [56]. Hence, in addition to more openness, partnership is required, with China adopting an open approach to reporting and treating cases, as well as utilising fully the resources of the international community. Although recent government statements suggest this is indeed the situation now, only time will tell how this new policy fares.

### 5.8. Widening inequalities of access to health care

A by-product of rapid economic development is growing disparities at the regional level between China’s ‘gold coast’ and the interior, and also between urban and rural areas, as well as within rural and urban areas [13,58]. The knock-on effect on health is that a ‘medical poverty trap’ is emerging, as in other low-income countries [59], with poor people in poor areas facing particular difficulties, and widening inequity in access to health care is a major social and political issue in China [16,60]. Further, rural areas are suffering from a deteriorating health infrastructure, a lack of personnel, and an increase in the prevalence of some diseases [61]. We have already seen above, the inequities in respiratory diseases, arsenic poisoning and suicide rates between rural and urban areas. The view of China as a dual society (urban–rural) is supported by Attane [62], who argues that peasant families have always been the poor relations of Chinese society, and by Liu et al. [2] who illustrate widening inequalities in health and health care in the 1980s and 1990s. There are also widening gaps

in health care within urban areas, as Gao et al. [63] demonstrate. In these studies, a common factor is the inability to pay for health care, coupled with a lack of an insurance system or alternative means of support for health provision. One response by the authorities is to markedly expand Community Health Services in cities to make medical services both more accessible and more affordable [64]. Liu et al. [65] note the promising signs from an evaluation of urban health insurance reforms which were introduced in 1998. The drive to improve the situation in rural areas will take much longer, however, if indeed it can be adequately tackled at all. Widening inequalities in access to healthcare inevitably lead to widening inequalities in health outcome. As noted, infant mortality has fallen dramatically in China, although major variations exist between urban and rural areas and between the affluent and the poor. In 1987, the infant mortality rate was a huge 96.2 deaths per 1000 births in selected rural areas, whereas in cities the rate averaged 20 per 1000 births [60]—such inequalities persist: Hesketh and Zhu [66] estimate a 10-fold difference in infant mortality between urban and rural poor areas.

## 6. Implications for theory and policy

At the simplest level, it appears that the current health situation in China largely reflects the epidemiological transition model, in which economic development leads to a change from insanitary conditions, high fertility, high infant mortality and a high rate of infectious diseases, towards improved sanitation and water supply, low fertility, low infant mortality and a move away from the ‘diseases of poverty’ towards ‘diseases of affluence’, such as lung cancer and cardiovascular disease. However, while we have demonstrated that this is broadly the case, we also contend that in China state policy, over and above economic development, has played a major role in creating an improved environment for health. For example, the Single Child Family Policy (SCFP) introduced in 1978 and amended in the 1980s [67] has, despite the controversies over its human rights implications, meant that 250–300 million fewer Chinese have been born and this has undoubtedly led to many benefits for the country as a whole, providing more resources for the children who were born. However, we noted above the

situation of the ‘little emperors’, and apart from the new physical and mental health risks to this sector of the population, there is a further knock-on effect on the situation of the elderly in China, with the younger generation proving to be far less willing to look after the elderly than previous generations in China. Powell and Cook [68,69] have considered the empirical and theoretical implications of this for China’s ‘superaging’ population.

Also, above, we have shown that the state’s Dengist policies have led towards a ‘privatisation’ of health care in China, as market forces have been introduced from outside the country. Cornia [70] attributes much of China’s recent successes in health—similarly to such countries as Costa Rica and the East Asian tigers of Singapore, Hong Kong, South Korea and Taiwan—to growing access to global markets, savings and technology. The down side of this, however, is lack of access of the poor, whether in urban or rural areas in China, to such benefits. What we are seeing in China today, therefore, is an increasingly dualistic structure of health, in which there is an upper tier of reasonably prosperous people who have the financial resources to access health care and support systems, contrasting with the lower tier who are dependent on state-funded systems, but these are being increasingly reduced by the state itself in favour of market solutions. Spatially, the latter are concentrated into the poorest parts of cities, often on their periphery and, more especially, within rural areas, especially those which are more remote from the centres of modernisation. Socially, these are the poor, and within this broad group, women, the elderly, disabled and minorities who, as elsewhere, bear the greatest burdens of inequality, and importantly, it is the poor who bear the greatest burden of infectious diseases [9].

It is clear that the health of the Chinese population has improved dramatically over the past 50 years, and China’s socio-economic and public health development trajectory certainly follows the broad pattern of the traditional epidemiological (health) transition model [60]. However, health problems in China are not characterised only by problems of an aging population and increasing chronic diseases of affluence and development. Increasing urban/rural inequities in access to health care are developing [2], with important consequences for public health. Alongside this, rapid (and unplanned) urbanisation has major implications



for the health of the urban population [7]. Infectious diseases still account for a large proportion of deaths of China poorest people [9]. Certain infectious diseases, such as TB, are re-emerging, whilst new infectious disease, including HIV/AIDS, have considerable implications for China's population. As noted, the growing smoking epidemic—with a concomitant increase in premature deaths from lung cancer, heart disease and stroke—has the potential to single-handedly wipe out China's impressive success in increasing life expectancy.

We would argue that the health situation in China reflects a new, late stage, epidemiological transition phase, where the transition from diseases of poverty to diseases of affluence has not reflected smoothly the economic and development transition [5,7]. Consequently, China faces health issues related to an aging and increasingly affluent population, combined with problems caused by rapid urbanisation, emerging and re-emerging infectious diseases and widening inequalities in health and health care. These features of the late stage transition model present considerable challenges for policy, especially as both health care and health experience in China reflect very clear social and also spatial inequalities. Thus, health policy must be designed to target those most at risk: this includes not only the poor in general, but, specifically, the elderly, women (particularly rural women) and the vast population living in rural and remote areas that are poorly served by primary and public health care facilities. Indeed, whilst rural residents account for 70% of the Chinese population, they consume just 30% of the countries medical resources [71]. It is clear from recent Government rhetoric and proposed policy targets that officials acknowledge this widespread disparity in health and health care between urban and rural areas [72]. Such acknowledgements are indeed laudable, but rhetoric must be translated into real policy, backed up by financial support and changes in the delivery and provision of health care in rural areas.

In addition, the current SARS epidemic shows that public health officials, policy makers and politicians in China need to adopt a more open approach to health and health care, including greater engagement with the WHO to ensure that epidemics of infectious diseases are dealt with swiftly and adequately. We argue that health policy in China needs to be made in partnership with external agencies (such as the WHO) and across

government sectors, ensuring that China's health situation improves for its entire people and that the public health infrastructure can respond effectively to crises such as SARS. In this way, China will benefit from outside support and expertise, whilst also contributing experiences that will benefit similarly large and rapidly developing countries.

Much of this study has relied on the official China Statistical Yearbook, although we have complemented these data with other sources where available—including WHO data and other research studies. The validity of some of the official data sources has been questioned [1], and indeed we did not use data available from 1960 because of acknowledged data deficiencies. However, more recently (and certainly since 1980) much more reliable data has become available [73] and much of the official data is internally consistent, allowing trends over time to be analysed. Clearly, there are still issues surrounding the openness with which China treats certain health data and we note this in the case of the (under-)reporting of both HIV/AIDS and SARS cases.

In summary, we argue that health and social care policies need to focus, more closely, on disadvantaged groups (such as the rural poor), and their exclusion from health provision, seeking to ensure that the state responds effectively to the marginalised in Chinese society, not just to the needs of China's ever-expanding and vocal middle class.

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