



# State of Health 2001

The Report of the Director of Medical Services



MINISTRY OF HEALTH  
SINGAPORE

## CONTENTS

2	Foreword	
4	Chapter 1	Health Trends
24	Chapter 2	Disease Prevention and Control Programmes
34	Chapter 3	Health Service Development
48	Chapter 4	Health Services for the Elderly
52	Chapter 5	Health Care Professionals
60	Chapter 6	Professional Training and Standards
66	Chapter 7	Regulation and Quality in Health Care
78	Chapter 8	Medical Research
88	Appendix 1	Infectious Diseases which are Notifiable to the Respective Ministries under the Infectious Diseases Act
89	Appendix 2	Private Hospitals and Medical Clinics Regulation
90	Appendix 3	Research Projects Approved by NMRC
98	Appendix 4	Publications Resulting from Research Programmes and Research Projects, FY2001

### Tables

5	Table 1.1	Key Demographic Statistics, 1957 - 2001
7	Table 1.2	Number of Live-Births, Crude Birth Rates (CBR), Total Fertility Rates (TFR) and Crude Death Rates (CDR), 1957 - 2001
9	Table 1.3	Leading Causes of Death, 1957 and 2001
10	Table 1.4	Age-Standardised Incidence Rates of Five Most Frequent Cancers by Gender, 1968 - 1997
17	Table 1.5	Incidence of $\beta$ -Thalassaemia Major Cases Born in Singapore, 1981 - 2001
18	Table 1.6	Persons Registered with the National Thalassaemia (NTR) by Ethnic Group as at 31 December 2001
18	Table 1.7	Clinical Diagnosis of Cases Screened at the NTR, 1993 - 2001
19	Table 1.8	Leading Congenital Birth Defects, 1994 - 1999
20	Table 1.9	New Cases of Tuberculosis by Resident Status, 1970 - 2001
22	Table 1.10	Profile of HIV Infected Singaporeans and Mode of Transmission, 1985 - 2001
23	Table 1.11	Reported Cases of Acute Hepatitis B Infection, 1990 - 2001
23	Table 1.12	Incidence of STI by Type, 1980 - 2001

29	Table 2.1	Immunisation Coverage for Children Two Years of Age in 1999 - 2001
37	Table 3.1	Waiting Lists for Organ Transplants (As at 31 Dec 2001)
37	Table 3.2	Transplants Done in 2001
39	Table 3.3	Projects Funded under HSDP FY2001
51	Table 4.1	Subsidy by per Capita Income
52	Table 5.1	Number of Registered Healthcare Professionals, 2000 & 2001
53	Table 5.2	Number of Doctors by Gender and Age, 2001
53	Table 5.3	Registered Doctors by Field of Employment, 2001
54	Table 5.4	Doctors to Population Ratio, 1970, 1980, 1990, 2001
54	Table 5.5	Registered Medical Specialists as at Dec 2001
55	Table 5.6	First Division Dentists by Field of Employment
56	Table 5.7	Dentists with Higher Qualifications by Field of Specialty and Employment Sector, 2001
57	Table 5.8	Field of Employment of Pharmacists, 2001
58	Table 5.9	Breakdown of Nurses by Category, 2001
58	Table 5.10	Nurse by Field of Employment, 2001
59	Table 5.11	Post-Basic Nursing Qualifications by Type, 2001
67	Table 7.1	Number of Licensed Health Care Institutions, 1996 - 2001
71	Table 7.2	Registered Acupuncturists, 2001
73	Table 7.3	Number of Approved Clinical Trials* from 1997 to 2001
80	Table 8.1	Distribution of IBG Funding by Institution and Research Programme, FY2001

## Figures

4	Figure 1.1	Population Pyramids, 1957 & 2001 (resident population in '000)
6	Figure 1.2	Life Expectancy at Birth, 1957 -2001
7	Figure 1.3	Infant Mortality, 1957 - 2001
8	Figure 1.4	Maternal Mortality, 1957 - 2001
10	Figure 1.5	Age-Standardised Annual Incidence Rates for All cancers by Gender, 1968 - 1997
11	Figure 1.6	Age-Standardised Incidence Rates of Five Most Frequent Cancers in Females, 1968 - 1997
11	Figure 1.7	Age-Standardised Incidence Rates of Five Most Frequent Cancers in Males, 1968 - 1997
12	Figure 1.8	Age-Standardised Coronary Heart Disease Death Rates by Gender, 1989 - 2001
13	Figure 1.9	Age-Standardised Acute Myocardial Infarction Death Rates by Gender, 1989 - 2001
13	Figure 1.10	Age-Standardised Incidence of Acute Myocardial Infarction Among Singaporeans Aged 20 - 64 Years by Gender, 1989 -2000
14	Figure 1.11	Age-Standardised Stroke Death Rates by Gender, 1989 - 2001
21	Figure 1.12	Rate of HIV Infection Among Singaporeans, 1985 - 2001

# Foreword

The State of Health Report 2001 documents key parameters and trends that reflect the general health of the Singapore population and presents the Ministry's continuing efforts to improve healthcare services and health outcomes, in partnership with medical professionals, healthcare providers and other major stakeholders.

Overall, the health status of the Singapore population is good, and in 2001, we continued to make gains in life expectancy, and improvements in key areas such as stroke mortality and reduced incidence of tuberculosis in the resident population. However, the major chronic, non-communicable diseases such as diabetes, hypertension, coronary artery disease, stroke and common cancers remain our most serious challenges. These conditions are common and have a high potential of causing premature death and/or disabling long-term medical complications, creating a huge burden in human suffering and societal and healthcare costs. In addition, the ever-present threat to our population's health posed by major infectious diseases such as tuberculosis and HIV/AIDS, was heightened in 2001 by the concerns of deliberate spread of infectious agents such as anthrax through acts of bioterrorism.

In response to these challenges, the Ministry continued in 2001, to maintain a strong focus on coordinating national efforts to reduce the incidence and to improve the control and treatment of the major chronic non-communicable diseases with the aim of decreasing the burden of long-term medical complications. Particular attention was paid to the implementation of the various national key disease management plans formulated in the year 2000 in close consultation with medical professionals and major stakeholders.

A complementary area of focus was the Ministry's continuing work on strengthening our framework for clinical quality assurance and our institutional processes for continual quality improvement for better patient outcomes and safety. At the same time, the training of doctors and healthcare professionals has remained a major priority. In 2001, much work was done to refine our system of continuing medical education (CME), in preparation for the introduction of compulsory CME in 2003. A review of the training of nurses and allied healthcare professionals was also carried out.

The Ministry has also continued to actively promote clinical research and to support medical researchers. In 2001, an additional stream of research funding was granted to the 2 public sector healthcare clusters to provide them with a more flexible and responsive form of seed funding to support young clinician-researchers and to help build up their institutional research capabilities and manpower. The cluster research funds complement the substantial competitive research grants available from the National Medical Research Council and A\*STAR's Biomedical Research Council. High quality medical research is important for Singapore, to improve the health of the population and the quality of care provided by our institutions, to lower health care costs and to attain medical excellence. In line with the latter aim, in 2001, the Ministry also committed a new stream of funding to support worthy health services development projects in the public sector.

2001 was another busy but fruitful year for the Ministry. Almost all of the professional initiatives and programmes that were launched or continued during this period, relied heavily on the strong and unstinting support of the professional organisations, as well as doctors and healthcare professionals from both the public and private sector, who gave generously of their time. I would like to take this opportunity to acknowledge their pivotal role in this regard and to commend them for their strong commitment towards high quality medicine, and for their continuing enthusiasm to work with the Ministry of Health to further improve the health of our nation.

**Professor Tan Chorh Chuan**

Director of Medical Services

# Chapter 1 Health Trends

## POPULATION PROFILE

The total population of Singapore, including foreign residents, was 4.13 million as of July 01. The local resident population grew by 1.7% to 3.32 million. Over the past decade, Singapore's resident population grew on average by about 1.7% annually (Figure 1.1).

The ethnic distribution in the resident population remained stable with 76.7% Chinese, 13.9%

Malays and 7.9% Indians. The aging trend in Singapore continued, with the number of elderly aged 65 years and above increasing to 246,500 and comprising 7.4% of the total resident population. The *old dependency ratio* remained high at 10.4 per 100 persons aged 15-64 years compared to 10.2 per 100 persons aged 15-64 years in 2000 (Table 1.1).

**FIGURE 1.1: POPULATION PYRAMIDS, 1957 & 2001**  
(resident population in '000)

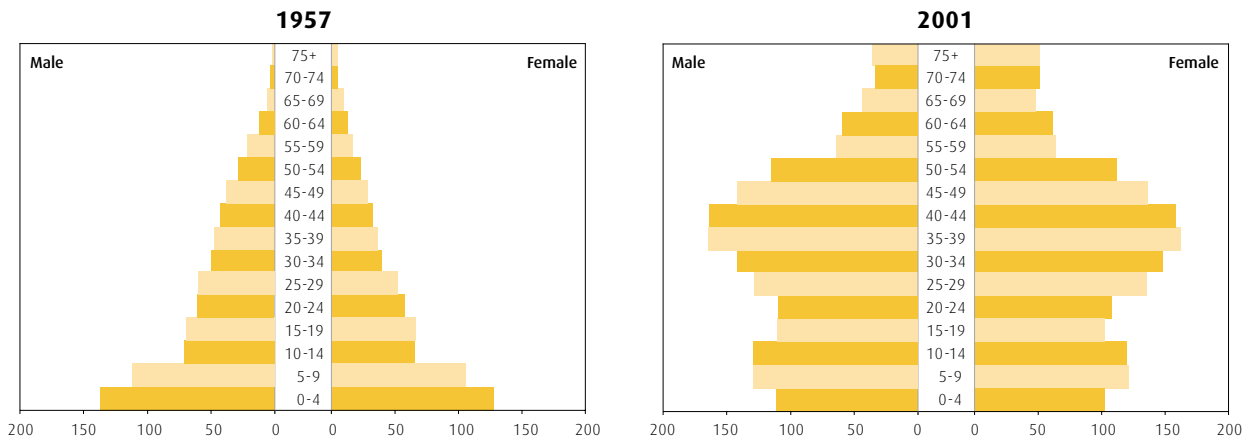


TABLE 1.1: KEY DEMOGRAPHIC STATISTICS, 1957 – 2001

	1957	1970	1980	1990	1999	2000	2001
<b>Resident Population</b> ('000)	1,445.9	2,074.5	2,282.1	2,705.1	3,217.5	3,263.2	3,319.0
<b>Sex Ratio</b> (per 100 females)	111.7	104.9	103.2	102.6	100.6	99.8	99.0
<b>Ethnic Distribution</b> (%)							
Chinese	75.4	76.2	78.3	77.7	76.9	76.8	76.7
Malays	13.6	15.0	14.4	14.1	14.0	13.9	13.9
Indians	9.0	7.0	6.3	7.1	7.7	7.9	7.9
Others	2.0	1.8	1.0	1.1	1.4	1.4	1.5
<b>Age Distribution</b> (%)							
0 – 14	42.8	38.8	27.6	23.2	22.3	21.5	21.4
15 – 64	55.0	57.9	67.5	70.8	70.4	71.2	71.2
65 & over	2.1	3.3	4.9	6.0	7.3	7.3	7.4
<b>Median Age of Population</b> (yrs)	18.8	19.7	24.4	29.8	33.7	34.2	35.0
<b>Dependency Ratio</b> (per 100 persons aged 15-64)							
Total	81.7	72.8	48.2	41.3	42.0	40.4	40.4
Young (<15 yrs)	77.8	67.0	41.0	32.7	31.7	30.1	30.0
Old (65 yrs & above)	3.9	5.8	7.3	8.6	10.4	10.2	10.4

## LIFE EXPECTANCY

The average life expectancy at birth for all Singaporeans in 2001 was 78.4 years. Females have a longer life expectancy at birth of 80.4 years compared with males whose life expectancy at birth was 76.4 years (Figure 1.2).

## FERTILITY TRENDS

Over the last decade, the annual number of births has fluctuated around 48,000 annually. However for 2001, there was a substantial decline in the number of live-births from 46,997 in 2000 to 41,775 in 2001 (Table 1.2). The total fertility rate (TFR) decreased from 1.60 in 2000 to 1.41 in 2001. Among the three major ethnic groups, the TFR for the Chinese was the lowest at 1.21, while that for

the Malays and Indians was 2.45 and 1.50 respectively.

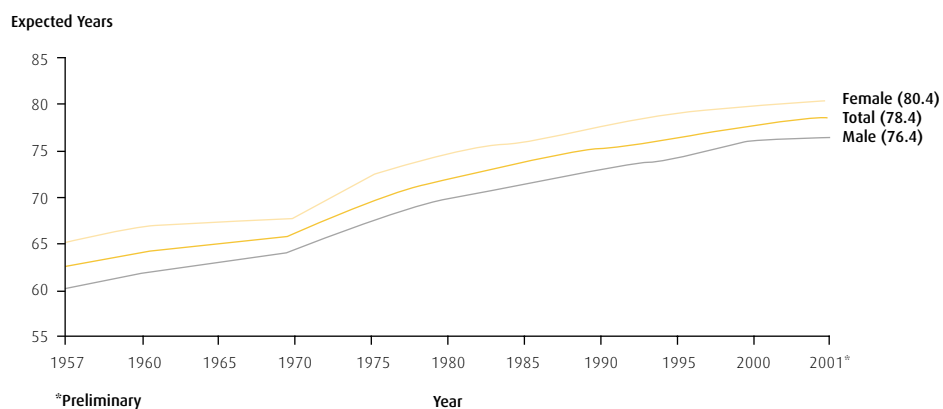
## MORTALITY

The crude death rate was maintained at about 4.5 deaths per 1,000 resident population (Table 1.2).

## INFANT MORTALITY

The infant mortality remained low at 2.2 per 1,000 resident live-births in 2001 (Figure 1.3). Neonatal mortality and perinatal mortality was 1.3 per 1,000 live-births and 3.4 per 1,000 live- and still-births respectively.

**FIGURE 1.2: LIFE EXPECTANCY AT BIRTH, 1957 - 2001**



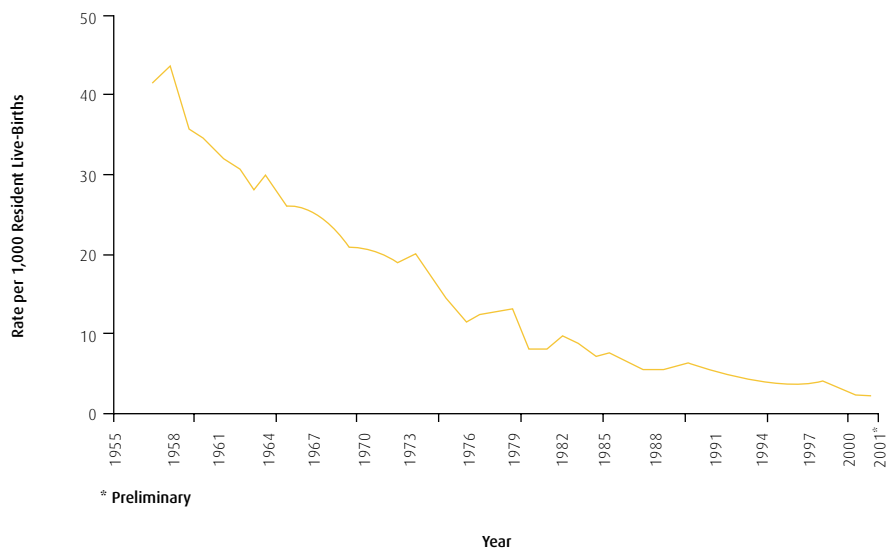


**TABLE 1.2: NUMBER OF LIVE-BIRTHS, CRUDE BIRTH RATES (CBR), TOTAL FERTILITY RATES (TFR) AND CRUDE DEATH RATES (CDR), 1957 - 2001**

	1957	1970	1980	1990	1999	2000	2001*
<b>Total Live-Births</b>	61,757	45,934	41,217	51,142	43,336	46,631	41,775
<b>CBR</b> (per 1,000 population)	42.7	22.1	17.6	18.4	12.8	13.6	11.9
<b>TFR</b> (per woman 15-44 yrs)	6.41	3.07	1.82	1.87	1.47	1.59	1.42
<b>CDR</b> (per 1,000 population)	7.4	5.2	4.9	4.8	4.5	4.5	4.4

\* Preliminary

**FIGURE 1.3: INFANT MORTALITY, 1957 - 2001**



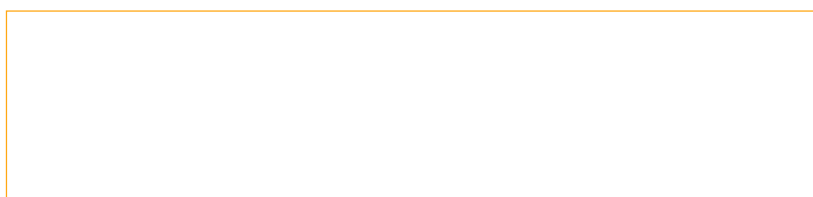
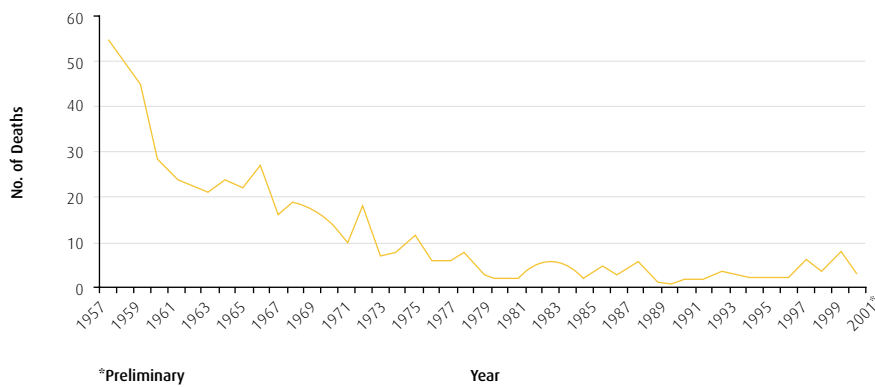
### MATERNAL MORTALITY

There were two cases of maternal deaths in 2001 bringing maternal mortality down from 0.17 per 1,000 live- and still-births in 2000 to 0.05 per 1,000 live- and still-births in 2001. (Figure 1.4).

### LEADING CAUSES OF DEATH

Cancer, heart disease, cerebrovascular disease and pneumonia remained the major causes of deaths in Singapore. Together, these diseases accounted for over 70% of all deaths among Singaporeans in 2001 (Table 1.3).

**FIGURE 1.4: MATERNAL MORTALITY, 1957 -2001**



## MAJOR HEALTH PROBLEMS

### Cancer

Cancer has been the leading cause of death in Singapore since 1991. In 2001, it accounted for 28.2% of all deaths (Table 1.3).

Males have a higher incidence of cancer compared to females, although the gap is narrowing (Figure 1.5). The incidence in males has slowly declined since the early 1980s, while that in females has increased.

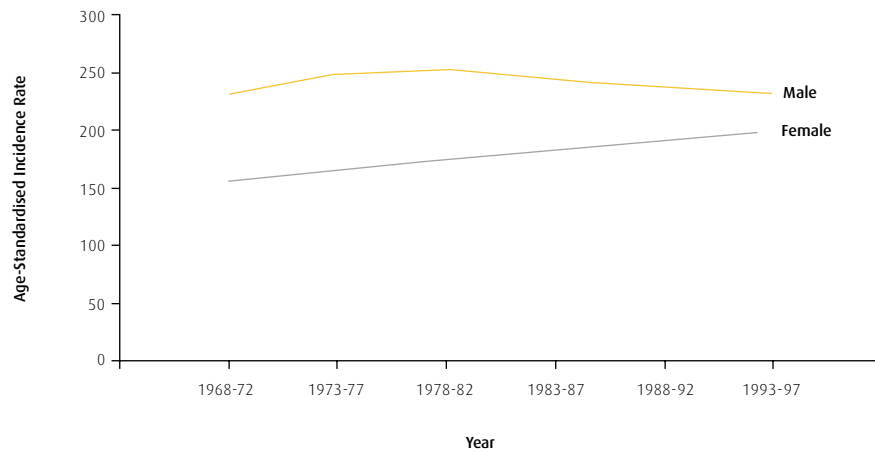
In both males and females, there has been an increasing trend in the incidence of colo-rectal cancer with a doubling of the incidence since the period 1968-72. In addition, breast cancer incidence among the females has more than doubled over the same period (Figures 1.6 & 1.7). Cancers of the stomach, liver, lung and cervix showed a declining trend while the incidence of nasopharyngeal cancer has remained relatively stable.

**TABLE 1.3: 10 LEADING CAUSES OF DEATH, 1957 AND 2001**

1957	% of Total Deaths	2001*	% of Total Deaths
Pneumonia	9.7	Cancer	28.2
Heart diseases	7.7	Ischaemic & other heart diseases	26.3
Cancer	7.2	Pneumonia	10.0
Tuberculosis	7.0	Cerebrovascular disease	9.2
Gastroenteritis	5.5	Accidents, poisoning & violence	6.7
Accidents	5.5	Diabetes mellitus	3.3
Cerebrovascular disease	4.3	Nephritis, nephrotic syndrome & nephrosis	1.7
Birth injuries & Postnatal asphyxia	3.0	Bronchitis, emphysema & asthma	0.8
Nephritis, nephrotic syndrome & nephrosis	2.2	Chronic liver disease & cirrhosis	0.7
Bronchitis, emphysema & asthma	1.7	Tuberculosis	0.7

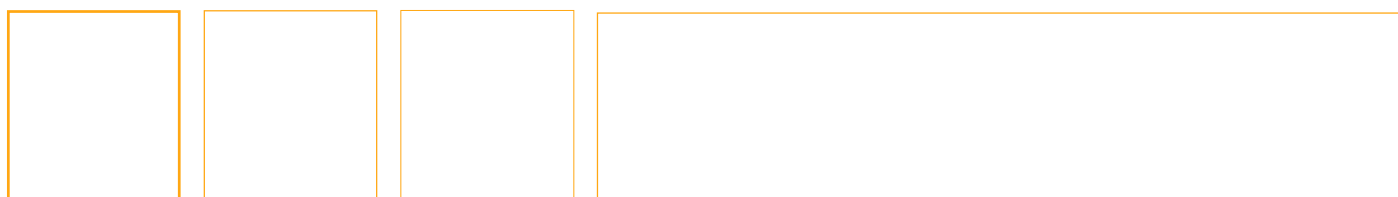
\*Preliminary

**FIGURE 1.5: AGE-STANDARDISED ANNUAL INCIDENCE RATE FOR ALL CANCERS BY GENDER, 1968 - 1997**

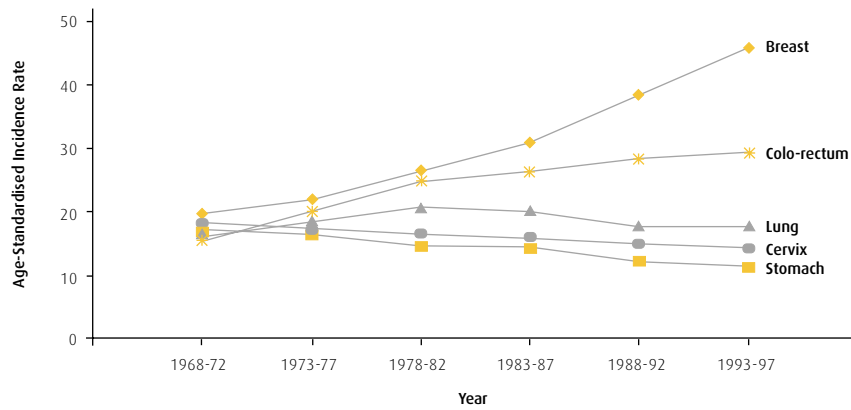


**TABLE 1.4: AGE-STANDARDISED INCIDENCE RATES OF FIVE MOST FREQUENT CANCERS BY GENDER, 1968 - 1997**

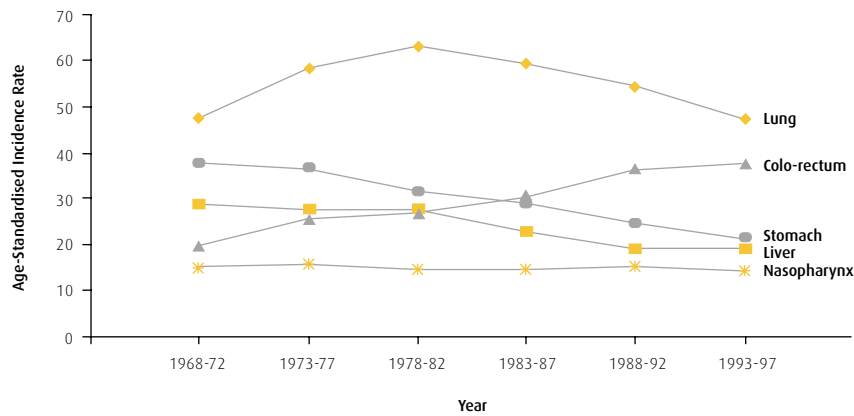
		Per 100,000 population					
Gender	Cancer	1968-72	1973-77	1978-82	1983-87	1988-92	1993-97
<b>Male</b>	Lung	47.6	58.3	63.0	59.4	54.0	47.1
	Stomach	37.7	36.9	31.6	29.1	24.5	21.0
	Liver	28.8	27.6	27.8	22.9	19.0	18.9
	Colo-rectum	19.9	25.5	26.8	30.6	36.4	37.5
	Nasopharynx	14.8	15.5	14.4	14.7	15.4	14.3
<b>Female</b>	Breast	19.9	22.1	26.8	31.0	38.7	46.1
	Cervix	18.1	17.5	16.6	16.1	15.2	14.2
	Stomach	17.4	16.6	14.6	14.4	12.5	11.3
	Lung	16.1	18.6	20.9	20.3	17.8	17.9
	Colo-rectum	15.6	20.1	25.1	26.2	28.5	29.4



**FIGURE 1.6: AGE-STANDARDISED INCIDENCE RATES OF FIVE MOST FREQUENT CANCERS IN FEMALES, 1968-1997**



**FIGURE 1.7: AGE-STANDARDISED INCIDENCE RATES OF FIVE MOST FREQUENT CANCERS IN MALES, 1968-1997**



### Cardiovascular Disease

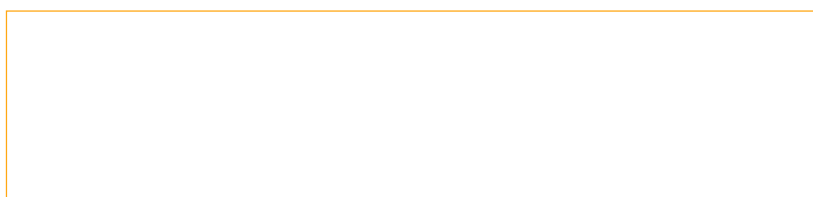
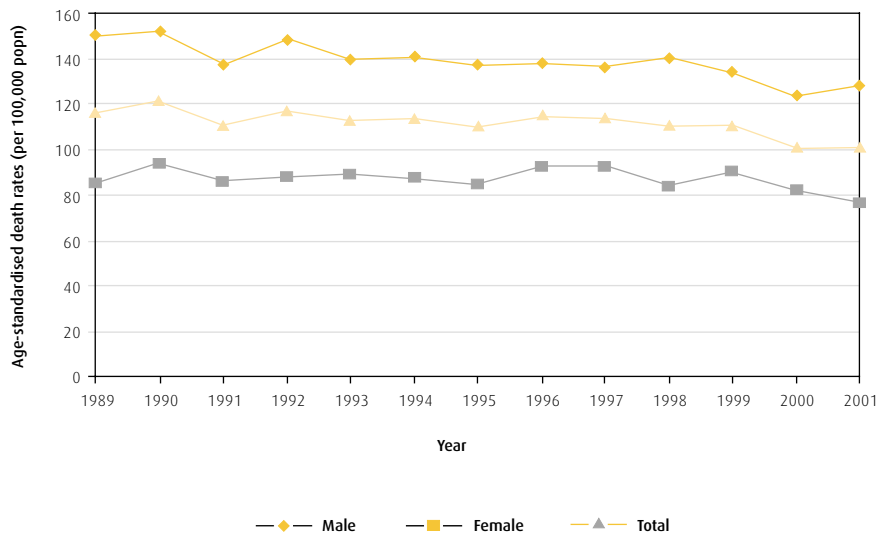
Among the vascular diseases, coronary heart disease and stroke accounted for about one third of all deaths.

The incidence of AMI in adults aged 20-64 years has remained fairly stable over the last decade. In 2000, there was a slight rise in incidence (Figure 1.10). The incidence rate in 2000 was 83 cases per 100,000 Singaporeans. Males have a higher incidence of AMI compared to females.

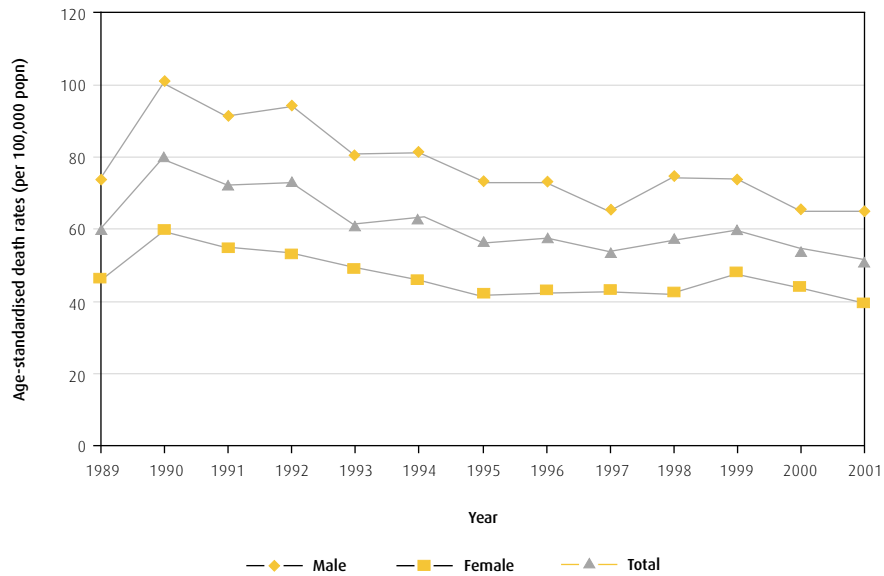
#### Coronary Heart Disease

The death rates for coronary heart disease and acute myocardial infarction (AMI) have showed consistent declines since 1980 (Figures 1.8 & 1.9).

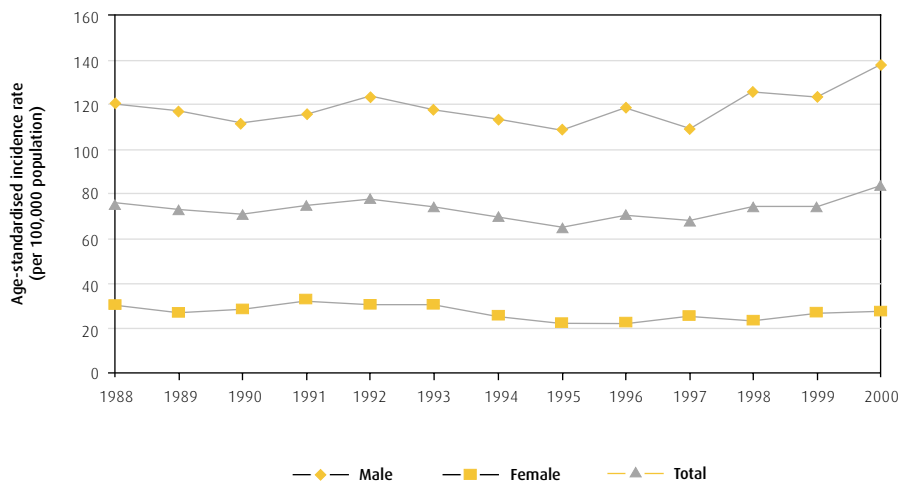
**FIGURE 1.8: AGE-STANDARDISED CORONARY HEART DISEASE DEATH RATES BY GENDER, 1989 - 2001**



**FIGURE 1.9: AGE-STANDARDISED ACUTE MYOCARDIAL INFARCT DEATH RATES BY GENDER, 1989-2001**



**FIGURE 1.10: AGE-STANDARDISED INCIDENCE OF ACUTE MYOCARDIAL INFARCTION AMONG SINGAPOREANS AGED 20-64 YEARS BY GENDER, 1989-2000**



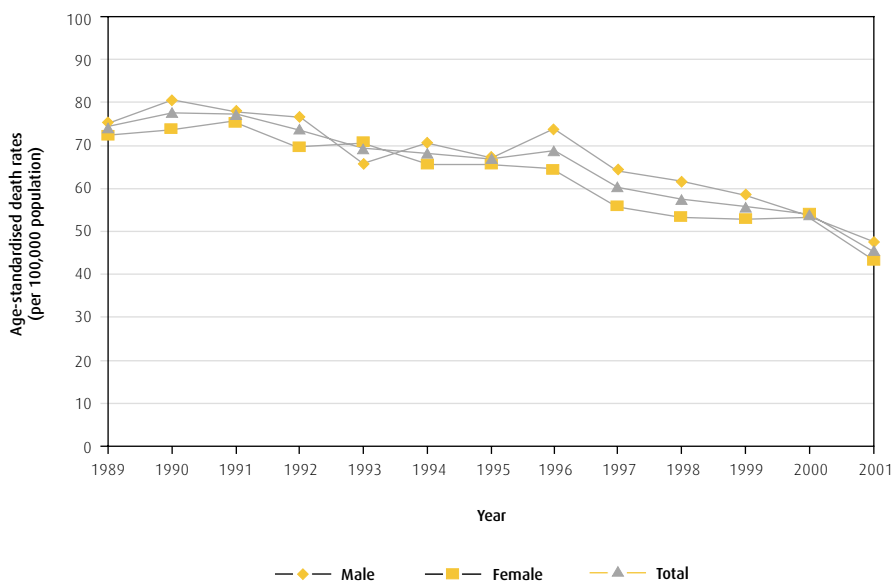
Stroke

Stroke has been among the top leading causes of deaths since 1970 and a major cause of adult-onset disability in Singapore. Despite being the fourth leading cause of death (Table 1.3), there has been a sharp decline in the age-standardised death rate over the past decade, from about 77 deaths per 100,000 in 1991 to 45 per 100,000 in 2001 (Figure 1.11).

**Risk Factors for Cardiovascular Diseases**

The major modifiable risk factors for cardiovascular diseases are diabetes mellitus, hypertension, smoking, physical inactivity, obesity and high blood cholesterol.

**FIGURE 1.11: AGE-STANDARDISED STROKE DEATH RATES BY GENDER, 1989 - 2001**





### Diabetes Mellitus

Diabetes mellitus was the sixth commonest cause of death in 2001. It is the leading cause of end-stage renal disease and blindness in adults. The prevalence of diabetes has markedly increased over the last two decades from 2.5% in 1975 to 4.7% in 1984 to 8.6% in 1992. This appears to have stabilised at about 9.0% in 1998. The prevalence rate is highest among Indians (15.8%), which is twice the rate in Chinese (8.0%). The prevalence of diabetes in Malays is 11.3%.

### Hypertension

The prevalence of hypertension in Singapore rose from 22.2% in 1992 to 27.3% in 1998. More Malays are hypertensive (31.5%), compared to the Chinese (26.9%) and Indians (24.6%). About 70% of all known hypertensives in Singapore have suboptimal blood pressure control of 140/90 mmHg and above.

### Smoking

The prevalence of regular (daily) cigarette smoking in the resident population aged 18-69 years fell from 15% in 1998 to 14% in 2001. Smoking was more common in men (24%) compared to women (4%).

### Physical inactivity

The prevalence of physical inactivity (leisure-time) in 2001 among persons aged 18-69 years rose slightly from 55% in 1998 to 58% in 2001. Encouragingly, the proportion of persons who exercised regularly (at least three times a week) rose from 17% in 1998 to 20% in 2001.

### Obesity

The prevalence of obesity (BMI  $\geq 30$ ) among Singaporeans aged 18-69 years was 6% in 1998. This was similar to the level in 1992 (5%). Another 24% were overweight (BMI 25.0 - 29.9).

### High Blood Cholesterol

The prevalence of high blood cholesterol rose significantly from 19.4% in 1992 to 25.4% in 1998. The mean total cholesterol level increased from 5.3 mmol/l in 1992 to 5.5 mmol/l in 1998. High blood cholesterol is most prevalent among Malays (35.6%), compared with Indians (24.4%) and Chinese (23.9%).

### **Myopia**

Myopia is the leading eye disease in Singapore with a prevalence among the highest in the world. In 2001, 34.4 % of Primary One students were myopic. This increased to 66.0% for Primary Six students and 67.7% for secondary Four students.

### Mental health

The 1998 population survey showed that anxiety disorders had the highest prevalence of 9.3%, followed by depression at 8.6%.

Suicides accounted for 2.2% of all deaths in 2000, 80% of which occurred in the 20-69 year age group. Mortality from suicides has decreased from 11.2 per 100,000 population to 8.7 per 100,000 population in 2000.

### End-stage renal disease

Renal disease has been among the top 10 leading causes of death in Singapore since 1960. In 2001, 1.7% of all deaths were caused by renal disease.

The incidence of patients on dialysis rose from 203 cases per million population in 1999 to 314 cases per million per population. This rise is probably due to an increase in the number of cases of end-stage renal disease caused by diabetes and hypertension and by the aging of the population. 45.5 % of new cases were aged 60 years and above. By ethnicity, the Chinese formed the largest percentage of new cases (77%) followed by the Malays at 19%.

### Osteoporosis

Worldwide, population data on osteoporosis is scarce, as there is no ideal, widely available, inexpensive screening tool for the condition. Data

on the incidence of hip fractures are commonly used as proxies for the incidence of osteoporosis.

In Singapore, hospital admissions for hip fractures have risen steadily in the last decade. There were 2,397 admissions for hip fractures in 2001, 83% of which occurred in the elderly aged 65 and above. Sixty-nine percent of those hospitalized with hip fractures were women.

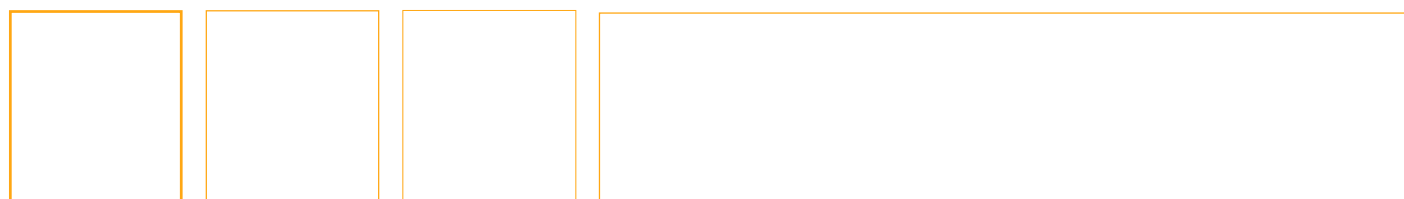
### OTHER NON-COMMUNICABLE DISEASES

Some of the other non-communicable diseases and conditions under surveillance include thalassaemia, haemophilia and congenital birth defects.

### Thalassaemia

Thalassaemia is the commonest preventable genetic disease affecting Singaporeans. The number of babies with thalassaemia major born each year has declined significantly from eight cases in 1981 to an average of only one case annually in the last five years. In 2001, there were no cases of babies born with thalassaemia major (Table 1.5).

About half of all family members of index cases screened at the NTR were normal (Table 1.7).



**TABLE 1.5: INCIDENCE OF  $\beta$ -THALASSAEMIA MAJOR CASES BORN IN SINGAPORE, 1981-2001**

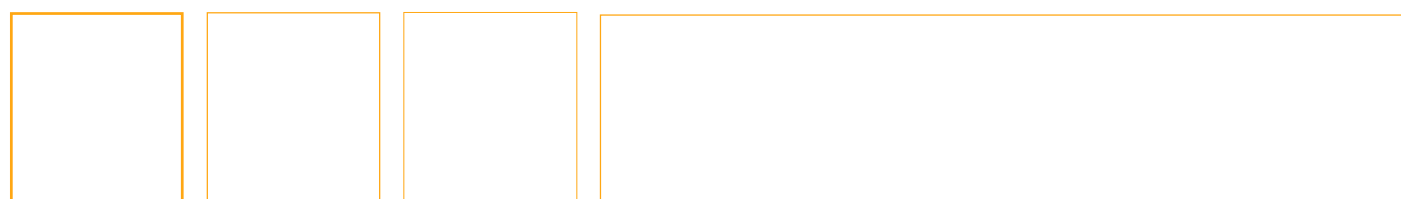
Year	Number of live births	Number of $\beta$ -Thalassaemia Majors born	Incidence rate (Per 1,000 live births)
1981	42,250	8	0.19
1982	42,654	4	0.09
1983	40,585	4	0.10
1984	41,556	2	0.05
1985	42,484	4	0.09
1986	38,379	3	0.08
1987	43,616	6	0.14
1988	52,957	3	0.06
1989	47,669	0	0.00
1990	51,142	3	0.06
1991	49,114	2	0.04
1992	49,402	1	0.02
1993	50,225	3	0.06
1994	49,554	2	0.04
1995	48,635	2	0.04
1996	48,557	2	0.04
1997	47,371	0	0.00
1998	43,664	1	0.02
1999	43,336	1	0.02
2000	46,997	1	0.02
2001	41,451	0	0.00

**TABLE 1.6: PERSONS REGISTERED WITH THE NATIONAL THALASSAEMIA REGISTRY (NTR)  
BY ETHNIC GROUP AS AT 31 DECEMBER 2001**

Clinical Category	Chinese	Malay	Indian	Others	Total
β-thalassaemia major	53	17	3	2	75
β-thalassaemia minor	5,673	1,048	314	180	7,215
α-thalassaemia carrier	4,346	308	91	76	4,821
α/β thalassaemia carrier	88	3	1	2	94
HbE- thalassaemia	8	47	2	3	60
HbE trait	119	1,164	20	113	1,416
HbH Disease	220	18	1	8	247
Others	31	8	4	1	44
<b>Total</b>	<b>14,597</b>	<b>3,343</b>	<b>613</b>	<b>502</b>	<b>19,055</b>

**TABLE 1.7: CLINICAL DIAGNOSIS OF CASES SCREENED AT THE NTR, 1993 -2001**

Clinical Diagnosis	1993	1995	1999	2000	2001
β-thalassaemia minor	192	368	150	233	180
α-thalassaemia + HbH	1	62	242	376	381
HbE & HbE Thalassaemia	9	9	52	29	46
Others	6	25	14	24	25
Normal	251	484	489	778	796
<b>Total</b>	<b>459</b>	<b>948</b>	<b>947</b>	<b>1,440</b>	<b>1,428</b>



## Haemophilia

In 2001, there were seven new cases registered with the National Haemophilia Registry (NHR) bringing the total number of registered persons with the NHR to 259. Of the persons registered with NHR, 184 had Haemophilia A, 23 had Haemophilia B and 52 had Von Willebrand's Disease as of 2001. In 2001, seven out of the 13 persons screened at NHR, were found to be carriers of Haemophilia A. None were carriers of Haemophilia B. This brings the total number of haemophilic carriers detected at NHR to 51.

## Congenital Birth Defects

The commonest birth defects in Singapore are those affecting the heart (Table 1.8). In 1999, more than 50% of all congenital birth defects were due to heart anomalies.

**TABLE 1.8: LEADING CONGENITAL BIRTH DEFECTS, 1994 - 1999**

	<b>(% of total defects in live and stillbirths)</b>					
	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Heart Anomalies	335 (29)	336 (41)	342 (44)	322 (47)	421 (55)	362 (52)
Musculoskeletal Anomalies (including limb anomalies)	181 (16)	229 (28)	215 (28)	150 (22)	173 (23)	162 (23)
Chromosomal Anomalies	93 (8)	108 (13)	66 (9)	76 (11)	84 (11)	77 (11)
Cleft Palate and Cleft Lip	84 (7)	75 (9)	75 (10)	91 (13)	75 (10)	56 (8)
Others	25 (2)	22 (3)	24 (3)	21 (3)	28 (4)	17 (2)

## COMMUNICABLE DISEASES

### Tuberculosis (TB)

In 2001, 2,118 new cases of TB were reported (Table 1.9). Incidence among non-residents declined from 31.1% in 2000 to 30.4% in 2001. Among residents, incidence of TB has fallen from 106 cases per 100,000 population in 1980 to 44.4 cases per 100,000 population in 2001.

TB continued to be a disease of older males. Almost 40% of new resident cases in 2001, were males aged 50 years and above. The incidence rate among children (below 15 years) remained low at below 5 per 100,000 children. TB incidence among Malays was highest (55.6 per 100,000 population) followed by the Chinese (43.2 per 100,000) and the lowest in Indians (34.6 per 100,000).

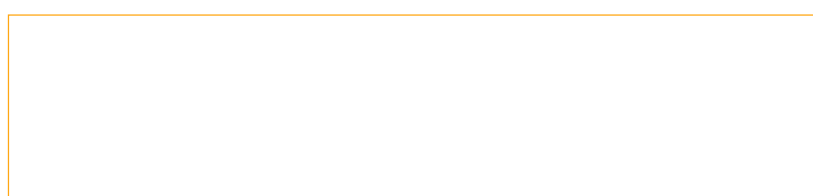
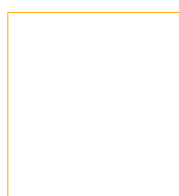
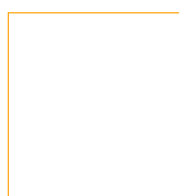
The majority (87%) of the new cases among residents had pulmonary TB. Among those with extra-pulmonary TB, the pleura was the commonest site for males and lymph nodes for females. The number of single and multiple drug-resistant TB cases remained low at 3.4% and 1.6% respectively.

### Human Immunodeficiency Virus (HIV) & Acquired Immunodeficiency Syndrome (AIDS)

The number of reported cases of HIV/AIDS increased from 226 in 2000 to 237 in 2001 (Figure 1.12). As at 31 December 2001, there was a

**TABLE 1.9: NEW CASES OF TUBERCULOSIS BY RESIDENTIAL STATUS, 1970 - 2001**

Residential status	Number of new TB cases notified					
	1970	1980	1990	1999	2000	2001
Residents	}	2,417	1,366	1,543	1,518	1,474
Non-residents		293	225	876	686	644
<b>Total</b>		2,710	1,591	2,419	2,204	2,118



cumulative total number of 1,599 reported cases of HIV infections among Singaporeans of which 628 were asymptomatic carriers, 381 had AIDS and 590 had died.

The majority (97%) of cases in 2001 contracted the disease through sexual contact. In the early years of the epidemic (1985 – 1990), homosexual transmission was the most common mode of transmission, accounting for 50% of cases. Since 1991, heterosexual transmission has become the most common mode of transmission, accounting for 52% of cases in 1991 and increasing to 81% in 2001 (Table 1.10).

There were 1,398 males compared to 201 females, giving a male to female ratio of 7 : 1. In the first few years of the epidemic, the majority (80%) of cases were singles. However, in recent years, there has been a gradual shift with more married Singaporeans reported (14% in 1991 to 32% in 2001). The shift is seen mainly among the males.

Singaporeans aged 20-49 years accounted for 81% of those infected with HIV. In 2001, two paediatric cases of HIV infection were reported. This brings the total number of paediatric HIV infection to 15 since the first case was reported in 1991.

**FIGURE 1.12 : RATE OF HIV INFECTION AMONG SINGAPOREANS, 1985-2001**

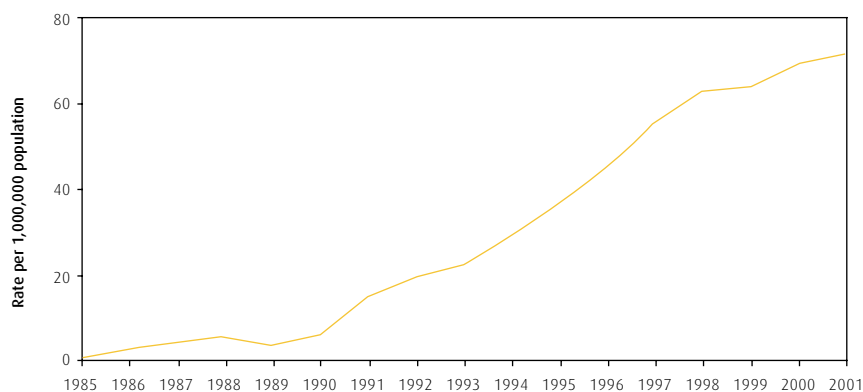


TABLE 1.10 : PROFILE OF HIV INFECTED SINGAPOREANS AND MODE OF TRANSMISSION, 1985-2001

	1985-1990	1991-1996	1997	1998	1999	2000	2001	Total
<b>Gender</b>								
Male	59	447	157	167	171	193	204	1,398
Female	2	50	16	32	35	33	33	201
<b>Age at Diagnosis</b>								
0 - 9	0	1	4	4	3	1	2	15
10 - 19	3	3	2	2	0	1	1	12
20 - 29	29	137	35	37	35	31	27	331
30 - 39	24	215	73	73	86	72	67	610
40 - 49	3	84	37	46	50	74	68	362
50 - 59	2	34	12	14	17	29	38	146
60+	0	23	10	23	15	18	34	123
<b>Ethnic Group</b>								
Chinese	39	420	147	166	174	192	202	1,340
Malays	8	40	10	9	14	15	18	114
Indians	12	19	10	12	8	13	10	84
Others	2	18	6	12	10	6	7	61
<b>Marital Status</b>								
Single	48	327	103	99	102	115	114	90
Married	12	129	56	75	76	79	77	504
Divorced	1	32	12	16	21	24	32	138
Widowed	0	9	2	9	7	8	14	49
<b>Mode of Transmission</b>								
<b>Sexual Orientation</b>								
Heterosexual	16	354	135	163	154	194	191	1,207
Homosexual	31	73	12	12	29	12	22	191
Bisexual	12	54	15	19	14	16	16	146
Intravenous Drug Use	1	10	5	1	6	3	6	32
Blood Transfusion	1	0	2	0	0	0	0	3
Renal Transplant Overseas	0	5	0	0	0	0	0	5
Perinatal(mother to child)	0	1	4	4	3	1	2	15



## Hepatitis B

The number of reported acute hepatitis B infection has been decreasing since 1990. The number of reported cases reached a low of 80 in 2001 – a 30% decrease from 2000 (Table 1.11). The incidence rate correspondingly decreased from 2.9 per 100,000 population in 2000 to 1.9 per 100,000 population in 2001.

gonorrhoea. The incidence of non-gonococcal urethritis and syphilis continued to decline.

The ratio of STI incidence between males to females was 3.4:1. The age-specific STI rates were highest among the 20-29 age group for females and the 20-39 age group for males.

## Sexually Transmitted Infections

The incidence of sexually transmitted infections (STIs) continued to decline from 1,013 per 100,000 population in 1980 to 156 per 100,000 population in 2000 (Table 1.12). Year 2001 saw a 4% increase in incidence of STI (162 per 100,000 population). This increase was due to a rise in incidence of

**TABLE 1.11: REPORTED CASES OF ACUTE HEPATITIS B INFECTION, 1990 - 2001**

Year	Number
1990	244
1999	140
2000	117
2001	80

**TABLE 1.12: INCIDENCE OF STI BY TYPE, 1980-2001 (per 100,000 population)**

Year	Gonorrhoea	Non-gonococcal Urethritis	Syphilis	Others	Total
1980	629	89	45	249	1,013
1990	123	45	27	36	230
1999	45	31	29	58	162
2000	37	41	24	54	156
2001	51	37	23	51	162

# Chapter 2 Disease Prevention and Control Programmes

## CONTROL PROGRAMMES FOR NON-COMMUNICABLE DISEASES

Singapore has seen tremendous socio-economic progress in the last three decades. This has translated into improved standards of living and environmental conditions leading to a decrease in incidence of infectious diseases. Over the same period, non-communicable diseases such as cancer, heart diseases and stroke have become leading causes of death. Public health programmes focusing on non-communicable diseases like cancer, cardiovascular diseases and diabetes have assumed greater importance.

This has led to the development of specific disease control programmes for cancer and cardiovascular diseases. In addition, control programmes for end-stage renal disease, myopia and major mental disorders like depression, anxiety disorders and schizophrenia have been developed. This is due to the very high prevalence of myopia in Singapore and the significant morbidity that end-stage renal disease and major mental disorders can result in. Each disease control programme employs a comprehensive strategy encompassing primary, secondary and tertiary prevention components.

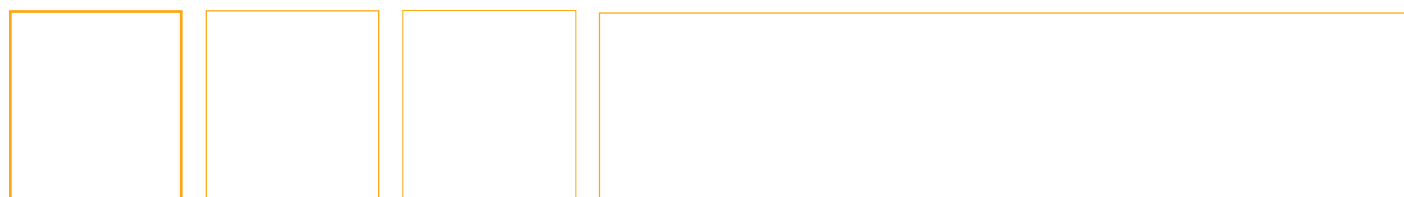
### Cancer

The Ministry aims to reduce premature deaths from all cancers by 10% from 124 deaths per 100,000 population aged 35-64 years in 1997

to 112 deaths per 100,000 in 2010. Two cancers have been specially targeted for control - breast and cervical cancer.

### Breast Cancer

Breast cancer is the commonest cancer among women in Singapore. The National Breast Cancer Screening Programme, or BreastScreen Singapore, aims to provide all women aged 40 to 64 years subsidised screening mammography in polyclinics around the country. The target of the programme is to reduce the breast cancer mortality rate by 10% from the projected rate in 2010. When BreastScreen Singapore is implemented in Jan 02, women aged 50 to 64 years will receive personal invitations to attend screening mammography. This will be extended to women aged 40 to 49 years at a later stage. Other components of the breast cancer control programme focus on raising public awareness on the disease and the importance of early detection. The Breast-Self Examination (BSE) is one prevention strategy focused on teaching and encouraging women of all ages through General Practitioners(GPs) and community outreach programmes to engage in BSE.



### Cervical Cancer

Cervical cancer is the fourth commonest cancer among women. The key control strategy for cervical cancer is early detection through screening. Preliminary planning for the National Cervical Cancer Screening Programme for implementation in 2002 was carried out. The control programme will include a publicity campaign focused on increasing awareness on the early symptoms of cervical cancer and the benefits of early detection through screening as well as treatment.

### **Coronary Heart Disease**

The Ministry aims to reduce premature mortality from coronary heart disease (CHD) in those aged 35-64 years by 30% from 67 deaths per 100,000 in 1997 to 47 deaths per 100,000 by the year 2010.

Key strategies to prevent and control CHD centre on reducing the prevalence of major risk factors for the disease, early detection of diabetes mellitus, hypertension and hyperlipidaemia through screening, optimising control through effective treatment, and implementation of clinical practice guidelines for CHD and its risk factors. Ongoing primary preventive measures focus on effecting a change in behavioral risk factors such as a lack of exercise, a diet high in cholesterol and fats, and smoking. The National Healthy Lifestyle Programme is an ongoing key preventive strategy

that includes a review of health policies to provide an environment which is supportive of a healthy lifestyle. The campaign is also centred on promoting healthy lifestyles in schools and workplaces.

The Check Your Health programme is a community screening programme launched in Jul 00 to screen Singaporeans aged 55 years or older for diabetes, hypertension and hyperlipidaemia. The programme was extended to persons aged 50 to 54 years in Apr 01. As of Dec 01, 40,000 people have been screened through the Check Your Health programme. Among the 40,000 people screened, over 60% had not participated in any health screening before, 48% were detected with high blood pressure, 13% with high blood glucose and 54% with high blood cholesterol. Persons with screening results indicative of high blood pressure, high blood glucose or high blood cholesterol are advised to see a doctor for confirmation and treatment.

The Comprehensive Chronic Care Programme (CCCP) was launched in Oct 00 as a pilot programme to improve the management of the three common cardiovascular risk factors: diabetes, hypertension and high blood cholesterol. The pilot programme continued in selected polyclinics in 2001. The CCCP will be expanded to cover all CHD risk factors when the programme becomes established.

Another key strategy is optimal management of CHD and its risk factors through the development of clinical practice guidelines (CPG). The CPG on lipids was launched in Nov 01, following CPGs on diabetes launched in 1999 and hypertension launched in 2000. CPG on smoking will be launched in 2002.

### Stroke

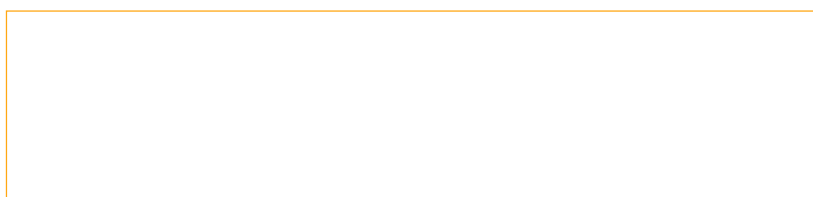
The National Stroke Control Programme was launched in the later part of 2001. The key strategies for the programme include controlling risk factors for stroke such as hypertension, diabetes, smoking and hyperlipidaemia through the ongoing National Healthy Lifestyle and Check Your Health programmes. The focus of the National Healthy Lifestyle Campaign (NHLC) 2001 was on stroke prevention. With the theme "Keep Fit. Fight Stroke", the Campaign aimed to encourage Singaporeans to adopt healthy lifestyle practices to reduce their risk of stroke. Special emphasis on lowering salt intake and other healthier food choices were also promoted through the media.

The CCCP described earlier for the control of CHD is another strategy to control the risk factors for stroke. To educate the public on the early recognition of signs and symptoms of stroke and correcting misconceptions on the disease, a series of media programmes on TV, radio and magazine publications presented information and education messages on the disease.

At the tertiary prevention level, the key strategy involves setting up dedicated multi-disciplinary Stroke teams in all acute general hospitals. Stroke units have already been set up in the Singapore General Hospital and National Neuroscience Institute.

### Myopia

Singapore has one of the highest prevalence of myopia among schoolchildren in the world. Nearly 30% of 7-year old schoolchildren have myopia with the figure rising to over 60% in 12 year olds. Control measures for myopia have thus focused on early detection and on promoting good eye care habits at a young age. The Health Promotion Board launched the National Myopia Prevention Programme in Aug 01. The programme aims to prevent and reduce myopia progression as well as to delay the onset of myopia in children. The programme's tagline, "Fight Myopia. Give Your Eyes A Break," summarises the main public education message of this programme – that our eyes need a rest after 30 to 40 minutes of continuous near work, such as reading, using the computer and so on. In Sep 01, guidelines for schools on the promotion of vision care were implemented. Vision screening in child-care centres and kindergartens was implemented in Oct 01.



## Mental Health

The major mental health conditions seen in Singapore are depression, anxiety disorders and schizophrenia. Two nationwide prevention and control programmes were initiated in 2000 - the National Mental Health Programme and the Early Psychosis Intervention Programme (EPIP). The National Mental Health Programme includes strategies to increase mental health awareness and promote good mental health in the population. A 'Mind Your Mind' (MYM) Programme, spearheaded by the Institute of Mental Health together with the Health Promotion Board, was launched in 2001. The programme aims to promote mental wellness and raise awareness of the importance of early detection and treatment of the three major mental disorders, namely depression, anxiety disorders and schizophrenia. The MYM Programme targets the general public, children, adolescents, adults and the elderly. The focus for 2001 was on stress management. Mass media education was conducted throughout the year through television, newspaper advertorials, radio and magazines. Other public education activities include public forums, carnivals, exhibitions and workshops.

Training primary health care physicians was another crucial strategy which was adopted. It aimed at improving the ability of primary healthcare professionals and educationists to recognise mental disorders such as anxiety and depression so that affected individuals can be diagnosed and treated early. This initiative has also been extended to other healthcare providers and carers in community-based services and educationists such as teachers and lecturers.

The Early Psychosis Intervention Programme (EPIP) is a comprehensive and integrated treatment programme involving a multi-disciplinary team of psychiatrists, psychologists, nurses, social workers, physiotherapists and occupational therapists, that aims to reduce chronic disability among schizophrenic patients. Strategies employed by the EPIP programme include increasing public awareness of early psychosis and the importance of early treatment, training of primary care physicians and EPIP teams; establishment of satellite specialist clinics and, the development of CPGs.

## End stage renal disease

Key initiatives to prevent progression to end stage renal disease (ESRD) at the primary preventive stage include control of diabetes and hypertension through the CCCP programme and shared care arrangements between the restructured hospitals and private General Practitioners (GPs). Good clinical management of patients with established chronic renal disease is paramount in preventing or delaying progression to end-stage renal disease. To complement the CPGs on diabetes and hypertension which were launched earlier, CPG on glomerulonephritis was launched in Sep 01. Plans are also underway to support the setting up of renal retardation clinics in the Singapore General Hospital and the National University Hospital in the first quarter of 2002.

## **SURVEILLANCE, EPIDEMIOLOGY AND CONTROL OF MAJOR COMMUNICABLE DISEASES**

Infectious diseases in Singapore are monitored through a well-established system of disease surveillance under the ambit of the Infectious Diseases Act (IDA). There are currently 27 infectious diseases that are notifiable under the IDA. An important component of this surveillance is the prompt notification of infectious diseases. From 1 Sep 01, the Ministry required all notifications of infectious disease to be submitted by fax to the relevant authorities within specified time limits, so that appropriate public health control measures can be instituted immediately to limit the spread of the infectious disease. To further facilitate prompt and efficient infectious disease notifications, MOH has developed a web-based Electronic Notification System (ENS) to be launched in 2002. This system will allow speedier submissions of infectious disease notifications on-line by medical practitioners and laboratory personnel.

The prompt notification of infectious diseases must be coupled with the prompt institution of public health control measures during disease outbreaks. This led to the launch of the MOH Med Alert system in Apr 01. This system sends out urgent circulars to medical practitioners through email and fax. Plans are underway to include Short Messaging System (SMS) alerts in addition to circulars sent via email or fax in 2002 as a means of alerting doctors to disease outbreaks.

## **National Childhood Immunisation Programme**

The National Childhood Immunisation Programme offers vaccination against tuberculosis, hepatitis B, diphtheria, pertussis, tetanus, poliomyelitis, measles, mumps and rubella. Immunisation against diphtheria and measles are compulsory by law. Immunisation of infants and pre-school children are carried out at government restructured polyclinics and private medical practitioner clinics. As shown in Table 2.1, immunisation coverage remains high for almost all immunisations. Notification of immunisations to the Central Immunisation Registry (CIR) is required by law. The CIR issues reminder letters to parents whose children have missed any of the childhood immunisations.

## **Poliomyelitis**

29 Oct 00 marked a significant milestone in the poliomyelitis eradication efforts of Singapore: the Western Pacific Region, of which Singapore is a member, was certified by the World Health Organisation (WHO) to be free of poliomyelitis. After the Americas, this is the second region in the world to have achieved polio-free status.

The high level of vigilance against poliomyelitis will continue to be maintained through a comprehensive system of mandatory notification and epidemiological surveillance.

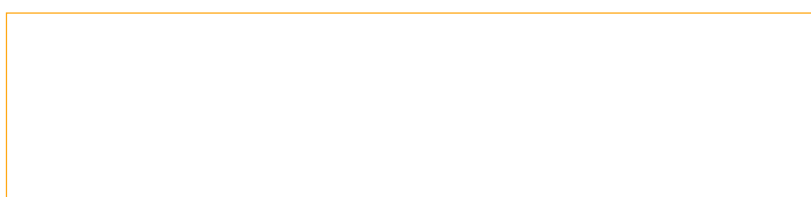
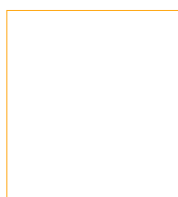


TABLE 2.1: IMMUNISATION COVERAGE FOR CHILDREN TWO YEARS OF AGE IN 1999- 2001

Immunisation Type (Primary)	1999 (%)	2000 (%)	2001*
BCG	96	98	98
DPT/DT	91	93	94
Polio (Sabin)	90	93	94
Measles / MMR	89	89	91
Hepatitis B	89	92	94

\* Preliminary

### Tuberculosis

Singapore has a comprehensive Tuberculosis (TB) Control Programme, which includes treatment of TB cases, directly observed therapy (DOTS), early detection (case finding), chemoprophylaxis for infected contacts, and prevention (BCG vaccination). The TB Control Programme was further strengthened in Apr 97 with the implementation of the Singapore TB Elimination Programme (STEP) with the aim of eliminating the disease in fifteen years time. Since STEP was implemented in 1997, there has been a 12% decline in the incidence of TB in Singapore between 1999 and 2001.

BCG vaccination has been given to all newborns in Singapore since 1957. In addition, a second BCG vaccination was given to children at 12 years or 16 years depending on their reaction to the

Mantoux skin test. BCG vaccination at birth has been shown to be highly effective in preventing the serious forms of childhood TB such as TB meningitis and disseminated TB. However, despite numerous studies done worldwide over the years, there was no scientific evidence to show that repeat BCG vaccination is effective in protecting against TB. Based on the lack of evidence to support the effectiveness of repeat BCG vaccination, WHO does not recommend repeat BCG vaccination.

Following this and from the recommendation of the Ministry's advisory committees, namely the International Advisory Panel to the Singapore Tuberculosis Elimination Programme (STEP), the STEP Committee and the Expert Committee on Immunisation, the Ministry reviewed the practice of repeat BCG vaccination and decided to

discontinue the practice. As of 1 Jul 01, only newborns will continue to receive BCG vaccination at birth.

### Hepatitis B

The key component of the hepatitis B control programme in Singapore is immunisation to prevent the susceptible population from being infected. To protect infants and young children at an early age, hepatitis B vaccination was integrated into the Childhood Immunisation Programme in 1987.

Beginning in 2001 a four-year Hepatitis B immunisation programme for students born before 1987 and were not covered under the Childhood Immunisation Programme was started. All Secondary Three pupils, second year Junior College students and third year students from centralised institutes were targeted. In addition, in 2001, the immunisation programme was offered to all polytechnic, Institute of Technical Education (ITE) and university students. Adults are also encouraged to be vaccinated if they do not have immunity against the disease.

Ongoing health education is carried out through printed materials and the mass media to increase public awareness on the effects of the disease, its mode of transmission and effectiveness of vaccination. Healthcare establishments are also

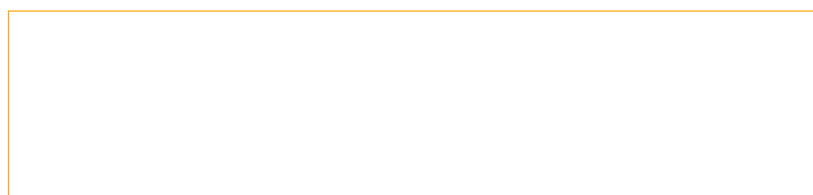
encouraged to adhere to infection control guidelines in the healthcare setting to prevent transmission of the disease.

### HIV and AIDS

The key to the control of HIV infection and AIDS in Singapore is prevention through health education. The main message for the public is to remain faithful to one's spouse and to avoid casual sex and sex with prostitutes. For high-risk groups, health education programmes focus on prevention of AIDS through the proper use of condoms.

### Sexually Transmitted Infections (STI)

The Department of STD Control of the National Skin Centre is responsible for administering the National STD Control Programme. The main components of the STD Control Programme are early diagnosis, adequate treatment, contact tracing and health education. Special health education programmes are conducted for high-risk groups.





## Bioterrorism

The threat of emerging and re-emerging biological agents have become very real in light of the post September 11 incidences of deliberate anthrax release in the US. These recent events have highlighted the importance of having in place comprehensive contingency plans in the event of bioterrorism. In response of this, the Ministry has taken several active steps to upgrade our preparedness against bioterrorist acts.

## HEALTH PROMOTION

### Formation of the Health Promotion Board

The Ministry of Health places great emphasis on health promotion and preventive health services as key strategies to reduce illness and improve the health of Singaporeans.

The health of children in Singapore is good. The National Childhood Immunisation Programme has resulted in the elimination of severe infectious diseases such as diphtheria and poliomyelitis. The comprehensive School Health Programme of health screening, immunisation, dental care and health education has contributed to the children's good health. The major health problems among children are myopia and obesity.

Among adults and the elderly, chronic non-communicable diseases such as coronary heart disease, stroke and cancer are the main causes of morbidity and mortality. Behavioural risk factors

such as a sedentary lifestyle, unhealthy diets, obesity, smoking and stress have been linked to these diseases. These modifiable risk factors can be reduced through the adoption of healthy lifestyle practices.

The Health Promotion Board (HPB) was set up as a statutory board on 1 Apr 01 to provide greater focus on these major health problems and to spearhead health education, promotion and prevention programmes, and create a supportive environment to address these and other health problems.

### MAJOR NATIONAL PUBLIC HEALTH PROGRAMMES UNDER THE HPB

#### National Healthy Lifestyle Programme

The National Healthy Lifestyle Programme was launched in 1992 to encourage healthy living among Singaporeans, create a supportive social and physical environment and foster community participation in these efforts. The National Healthy Lifestyle Campaign (NHLC) 2001 focused on stroke prevention. With the theme "Keep Fit. Fight Stroke", the Campaign aimed to encourage Singaporeans to adopt healthy lifestyle practices to reduce their risk of stroke.

### The National Smoking Control Programme

The National Smoking Control Programme (NSCP) was launched in 1986 to reduce the prevalence of smoking in Singapore. Strategies to combat smoking include public education, smoking cessation services, legislative measures and tobacco taxation. The National Smoking Control Campaign in 2001 continued with the previous two years' use of "scare tactics". The campaign focused on the harmful effects of tar in cigarettes and the amount of tar that can accumulate in a smoker's lungs.

### Nutrition Programmes

Since the implementation of the "You can ask for..." programme in 1994, 136 hawker centres, 42 food courts and 239 restaurants have joined in the national effort to promote healthy eating. Consumers can ask for more vegetables, less oil and fat, less sauces and gravy, or less sugar and syrup when making their food orders at these outlets. In 2001, this programme was extended to schools.

The Nutrition Labeling Programme was started in 1997 to provide consumers with various forms of

nutrition information at the point-of-purchase. As at the end of 2001, over 500 products carry the recommended labels. From Oct 01, the HPB has taken over the administration of the Healthier Choice Symbol from the Singapore National Heart Association. In 2001, 377 food companies applied for the Symbol and were given approval to carry the Symbol.

### Workplace Health Promotion

The workplace remains one of the key settings for adult health promotion as a significant proportion of our population is in the workforce. An Intersectoral Management Committee on Workplace Health Promotion was formed in 2001 to collaborate with relevant national agencies to promote workplace health. The joint efforts have resulted in several achievements including incorporating an employee health component into the Singapore Quality Award assessment criteria and a more coordinated approach to marketing and promoting workplace health to the private sector.



### Prevention and Control of Obesity in School Children

The School Health Service (SHS) works closely with the Ministry of Education in the Trim And Fit (TAF) programme. The aim of TAF programme is to reduce obesity and improve physical fitness among school children in Singapore. It focuses on a balance of appropriate physical activity and proper dietary intake. TAF sessions for overweight children consist of an exercise programme and counseling on proper nutrition. Teachers monitor the children's weight regularly. Physical activity takes the form of games and exercises during recess or outside curriculum time. Parents of overweight children are invited to support the programme through seminars and meetings. Besides physical activities, overweight children are given nutrition counseling, including choice of low calorie food in school canteens. School canteen vendors are also advised on healthier methods of cooking. More fruit and vegetables are encouraged. The TAF Programme has been successful in reducing the obesity rate in school children from 14% in 1992 to 10% in 2001.

### Oral Health

The School Dental Service (SDS) provides a comprehensive dental health care programme which includes scaling, polishing, fillings, extractions, fissure sealants, and education on oral hygiene to school children. The objective is to prevent the onset and spread of oral diseases, to promote good oral health and also to treat oral problems. SDS is working with the Ministry of Education to extend the school dental care programme to secondary schools with the aim of setting up dental clinics in secondary schools. For secondary schools without a dental clinic, mobile dental units will be provided.

# Chapter 3 Health Service Development

## NATIONAL DISEASE REGISTRIES

In early 2001, MOH embarked on setting up National Disease Registries (NDR) for major diseases. These Registries are managed centrally by the National Disease Registry Office (NDRO). The aim is to collect information for health planning and to support National Disease Management Plans, as well as to provide information for clinical service management and development in hospitals, and for medical research.

Each NDR functions as a discrete database and is overseen by its own Registry Committee. National Disease Registry Committees for Cancer, Heart disease, Myopia, Kidney disease, Stroke and Diabetes comprising medical professionals, researchers and epidemiologists have been appointed. The Disease Registries will operate under a stringent framework that would safeguard data privacy and ensure medical confidentiality.

## Singapore Cancer Registry

The Singapore Cancer Registry, which was first established in 1968 as a research project in the Department of Pathology at NUS, was transferred to MOH in March this year. The disease and treatment components of the Registry have been expanded. The new registry will be fully operational in 2002.

## Singapore Cardiac Registry

The Singapore Cardiac Databank (SCDB), which was established in 1999, contains information from the previous Singapore Myocardial Infarct Registry. With the establishment of the Singapore Cardiac Registry, part of the data from SCDB will be transferred to it. The relevant data set for the Registry has been finalized in 2001 and the electronic transfer of Information from SCDB to NDRO will be initiated in early 2002.

## Singapore Renal Registry

The Singapore Renal Registry, which was established in SGH in 1993 through funding from the National Kidney Foundation, was transferred to MOH in April 2001. Besides the dialysis and



transplant data, the registry will also be collecting data on biopsy-proven glomerulonephritis (GN). This is in line with the MOH's National Disease Management Plan to reduce the progression of renal diseases in patients at risk of developing End Stage Renal Disease (ESRD). The Registry will be piloted at the Renal Disease Retardation Clinics which will be set up in SGH and NUH in early 2002.

### Singapore Myopia Registry

The Singapore Myopia Registry is being set up with the main objectives of determining the incidence, prevalence and severity of myopia in pre-school, primary and secondary school children, and the longitudinal monitoring of progression in those with myopia. The dataset to be collected has been confirmed. Additional outcome related data will also be collected from various hospitals.

### Singapore Stroke Registry

The dataset has been confirmed and pilot testing was started in 2001. The Registry will be operational by 2002.

## MANAGEMENT OF LEVELS OF MEDICAL CAPABILITIES

To help manage the pace and direction of health service capability and capacity development in the public health care system, the Ministry has established a new framework which is summarised in the 'Manual on Levels of Medical Capabilities for the Public Health Care Institutions'.

For each discipline, medical services were designated as Level 1 or Level 2 services based on the following principles:

- (i) Level 1- The types and levels of medical services which all acute hospitals receiving acute admissions must provide so that they are able to deal effectively with the common medical and surgical problems presenting to them.
- (ii) Level 2 – Medical services which go beyond Level 1 services for the management of more complex cases, those with multiple problems or complications, and those requiring specialised interventions e.g. high-dose chemotherapy.

For each discipline, institutions were designated as Level 1 (or Level 1 with special designated level 2 services) or Level 2 centres.

The Manual will form the basis of specification of services for the Service Agreement between MOH and the Clusters. MOH will conduct an annual

review of the designated Levels of Medical Capabilities for each discipline in the various institutions. The Clusters or institutions wishing to introduce new technologies or services can also apply for a change of designation for any of the disciplines at any time.

### CLINICAL PRACTICE GUIDELINES

MOH remains committed to setting high standards of clinical practice through the development of clinical practice guidelines (CPGs) based on the best available scientific evidence. These CPGs are produced by Ministry-appointed expert workgroups comprising top clinicians from the Academy of Medicine, National Committees, College of Family Physicians and other professional societies.

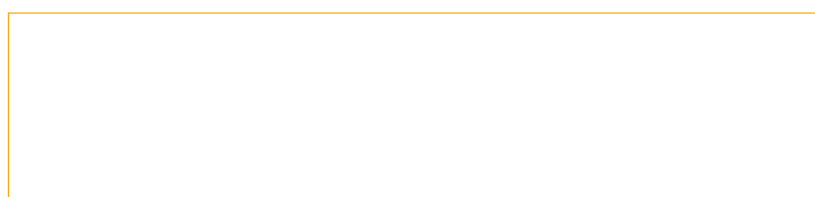
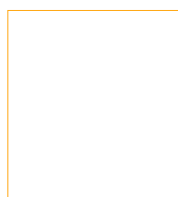
The MOH guidelines contain graded recommendations to help doctors to deliver appropriate healthcare. Audit parameters are also included in the CPGs to help doctors and institutions monitor the standard of clinical practice.

Eight clinical practice guidelines listed below were published and distributed to all registered medical practitioners in 2001:

- Guidelines on Management of Pre-Term Labour
- Guidelines on Laser Refractive Surgery
- Guidelines on Dementia
- Guidelines on Glomerulonephritis
- Guidelines on Lipids
- Guidelines on Management of Asthma
- Guidelines on Osteoporosis
- Guidelines on Use of Antibiotics in Paediatric Care

Symposia to officially launch some of the more important CPGs were also held, e.g. Guidelines on Lipids and Management of Asthma.

The Ministry has developed a master plan for the development of CPGs for the next three years.



The development of nursing CPGs has taken a structured approach. With the support from the various hospitals and institutions, a group of nurses were trained in the development of CPGs. They formed several workgroups to examine evidence and develop CPGs in the following areas: prevention of infections related to peripheral intravenous devices, oral care, urinary continence care, venous leg ulcer, prevention of infections related to central venous devices in children, and breastfeeding of full-term babies. A multidisciplinary team comprising a doctor, pharmacist, physiotherapist, occupational therapist and some nurses was also formed to develop CPGs on the prevention of falls in institutions, since falls are problems with root causes that may not be within the control of nurses.

The nursing CPGs on "Prediction and Prevention of Pressure Ulcers in Adults" and "Nursing Management of Pressure Ulcers in Adult" were disseminated to nurses in 2001.

The CPGs may be downloaded from <http://www.gov.sg/moh/pub/cpg/cpg.htm>.

### ADMINISTRATION OF THE HUMAN ORGAN TRANSPLANT ACT (HOTA)

The Ministry's Organ Transplant Unit (OTU) maintains the computerised registers of people who have opted out of kidney donation and Muslims who have pledged to donate their kidneys. In 2001, there were 531 kidney donor objectors and 496 Muslim kidney pledgers, compared to 666 kidney donor objectors and 1,752 Muslim kidney pledgers in 2000.

To increase the supply of organs for transplantation, the Ministry will be considering the feasibility of amending HOTA in 2002. Extensive public consultation will be held before a decision will be made on the amendment.

**TABLE 3.1 - WAITING LISTS FOR ORGAN TRANSPLANTS (AS AT 31 DEC 2001)**

Organ	Number of people on waiting list
Kidney	650
Bone Marrow	27
Cornea	26
Liver	25
Heart	5

The OTU also maintains a register of people who have pledged their organs under the Medical Therapy, Education and Research Act. With the launch of the Multi-Organ Donation Drive in Oct 99, the number of organ pledgers rose from 286 in 1998 to 3,462 in 1999 to 3,943 in 2000. In 2001, there were 3,428 people who made a pledge of organ donation.

**TABLE 3.2 – TRANSPLANTS DONE IN 2001**

Organ	Number of transplants done
Cornea	177
<u>Kidney</u>	
Cadaveric*	46
Living-related	46
Bone marrow	57
<u>Liver</u>	
Cadaveric	7
Living-related	3
Heart	2
Lung	1

\*18 kidneys were donated through HOTA, while 28 kidneys were through MTERA

### ADVANCE MEDICAL DIRECTIVE

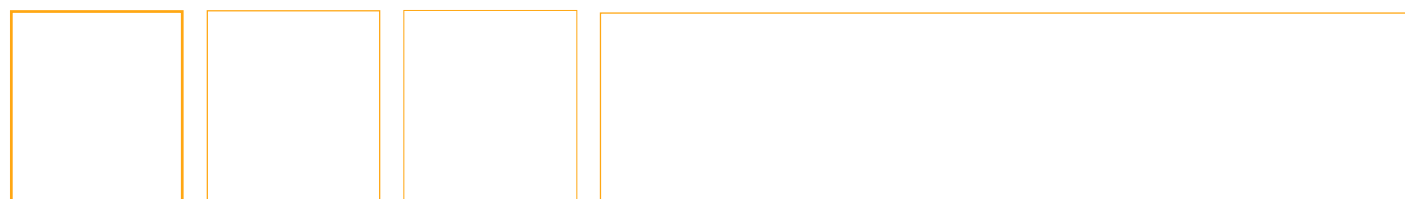
The Advance Medical Directive Act (1996) makes legal provision for any person of sound mind who has attained the aged of 21 years to register his or her wish in advance, that he or she will not be subjected to extraordinary life-sustaining treatment in the event that he or she is suffering from a terminal illness and is unconscious or incapable of expressing rational judgement.

453 Advance Medical Directives (AMDs) were registered in 2001, making a total of 1,630 AMDs since the implementation of the Act.

### TECHNOLOGY ASSESSMENT

In building up its capability in health technology assessment (HTA), the Ministry is forming networks with international HTA centres and will be establishing a database of HTA reports.

In 2001, several new medical technologies and therapies were evaluated, including Hand-Assisted Live Donor Nephrectomy for harvesting donor kidneys, faecal occult blood test kits for the preliminary screening of colorectal cancer, and role of acupuncture in stroke management.





## HEALTH SERVICE DEVELOPMENT PROGRAMME

The Health Service Development Programme (HSDP) was established with the objective of

developing new medical capabilities and health services through the funding of three categories of projects on a pilot basis:

**TABLE 3.3 – PROJECTS FUNDED UNDER HSDP FY2001**

S/N	Name of project
1	Early Psychosis Intervention Programme (EPIP)
2	Child Development Programme
3	Renal Disease Retardation Programme
4	(a) Newborn Hearing Screening Programme (b) Cochlear Implant Programme
5	Optimal Intervention in High Burden Asthma Patients in SOC
6	Liver Dialysis in Liver Failure
7	Development of Molecular Pathology Services
8	Respiratory Failure: Improving Outcome by Non-invasive Ventilation
9	Computer-Assisted Image Guided Endoscopic Sinus Surgery
10	Lower Extremity Amputation Prevention (LEAP) for Life Programme
11	Development of Cardiac and Cardiovascular MRI
12	Reducing Blindness in the Elderly through Comprehensive Eye Screening Programme
13	Community Addiction Management Programme (CAMP)
14	3T MRI In Evaluation of Stroke (3TIES)
15	Tissue Culture Programme for the treatment of extensive burn injuries
16	The Cell and Immunotherapy Programme - Refinement, Augmentation and Expansion
17	Cost-effective Cancer Chemoprevention
18	Radiofrequency Ablation of Liver Tumours in Inoperable Disease or Adjuvant Local Therapy in Multi-focal Diseases
19	Medivision – Advanced Surgical Navigation Support System
20	Screening and Early Intervention for Obstructive Sleep Apnoea Hypoventilation Syndrome and other Co-morbidities in Morbidly Obese Schoolchildren
21	Mechanical Heart Devices for Heart Failure
22	Endovascular Stenting of Aortic Aneurysms
23	Bilateral Deep Brain Stimulation Surgery for Medically Intractable Advanced Parkinson's Disease

- (i) New cutting-edge medical technology, which require a period of evaluation;
- (ii) Advanced and costly treatments, which might have substantial adverse effects and should be offered on a subsidised basis only to patients who have a likelihood of benefiting from them; and
- (iii) Major augmentations of existing management capability for key diseases.

In FY 2001, twenty-three projects were approved for funding under HSDP. (Table 3.3)

### Cross-Cluster Projects

#### Early Psychosis Intervention Programme

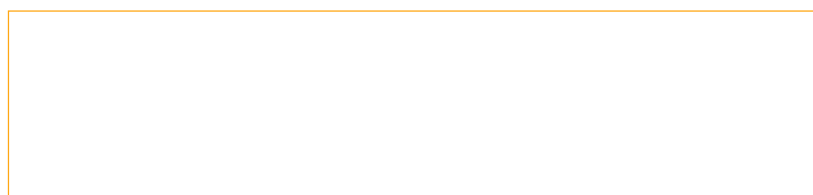
Schizophrenia is the most severe of mental disorders that affects individuals in late adolescence or early adulthood. It is estimated that the prevalence of schizophrenia in Singapore is 0.75 per 1,000 population. The Early Psychosis Intervention Programme (EPIP) is a multidisciplinary, comprehensive and integrated treatment programme for schizophrenics. It includes an extensive education programme for health professionals and the public. The programme, which involves institutions in both clusters, aims to reduce delays in diagnosis of schizophrenia and improve the clinical and functional outcomes of schizophrenics.

#### Child Development Programme

Every year, there are about 800 to 1,200 new cases of children with developmental problems requiring specialised medical care. The Child Development Programme (CDP) is a comprehensive programme involving detailed developmental screening and diagnosis, as well as early intervention of children with developmental and behavioural problems. The CDP will adopt a holistic approach in the management of these children through collaboration with various partners in the educational, social and community services in Singapore. To ensure accessibility, Child Development Units for interventional therapy under the CDP will be set up within the community. These units will be managed by health professionals from KKH and NUH.

#### Renal Disease Retardation Programme

The Renal Disease Retardation Programme aims to reduce the number of people developing end-stage renal failure and requiring renal dialysis. The programme is offered at SGH and NUH and targets people at high risk of developing end-stage renal failure e.g. diabetics and hypertensives. It adopts various measures to retard the progression of renal failure including the institution of angiotensin-receptor blockers.



### Newborn Hearing Screening Programme

The incidence of hearing loss is 3-4 per 1,000 newborns. As the critical period of auditory plasticity for the brain to develop higher centers essential for speech is in the first three years of life, children born with profound hearing loss who are not diagnosed and treated early enough will never acquire normal speech. The Newborn Hearing Screening Programme, which provides objective hearing screening for all newborns at KKH and infants seen at the polyclinics, aims to detect hearing loss early for appropriate intervention to allow the children to be successfully integrated into society.

### Cochlear Implant Programme

About 1 in 1,000 children are born profoundly deaf. Despite the best available hearing aids, many of these children are unable to hear well enough to acquire good speech and therefore, they require cochlear implants for their speech development. The Cochlear Implant Programme, which provides subsidies for the expensive cochlear implants for eligible children treated at SGH, NUH, KKH and TTSH aims to enable profoundly deaf children acquire adequate speech for mainstream education and successful integration into society.

### Optimal Intervention in High Burden Asthma Patients in SOC

This comprehensive programme, which augments the clinical management of asthmatics, aims at reducing the disease burden of asthma. The programme has a primary care component involving the polyclinics and a hospital component involving the acute hospitals. Whilst the primary care component focuses on public and patient education on asthma, the hospital component focuses on the intensive clinical management of high-burden asthma patients.

### **NHG Projects**

#### Liver Dialysis in Liver Failure

Liver dialysis is a novel intervention aimed at providing short-term support for patients with liver failure. It is used either as a bridge to liver transplant or to increase the likelihood for spontaneous recovery of liver function. The Liver Dialysis Programme, which is offered at NUH, aims to determine the mechanisms of clinically beneficial actions and to delineate the clinical utility of liver dialysis as part of the therapeutic strategy for liver failure patients where mortality is usually very high.

Development of Molecular Pathology Services

Molecular diagnosis applied to cytopathology and histopathology specimens of solid tumors is an important and rapidly growing field. It is complementary to conventional histomorphological and immunohistological analyses. The HSDP project in NUH will develop molecular assays for solid tumours, lymphomas and leukemias that need to be implemented for routine diagnosis, in order to achieve earlier and more accurate detection of these cancers.

Respiratory Failure: Improving Outcome by Non-invasive Ventilation

This HSDP project involves the administration of non-invasive ventilation via face mask as a first - line therapy for patients with acute respiratory failure at NUH. The project aims to reduce the incidence of intubations, hospital acquired pneumonia, as well as mortality and costs associated with severe exacerbations of chronic obstructive pulmonary disease and pneumonia in patients who fail extubation.

Computer-assisted Image Guided Endoscopic Sinus Surgery

The project involves the use of an image guidance system in endoscopic sinus surgeries. With the system, CT scans of a patient's sinuses can be

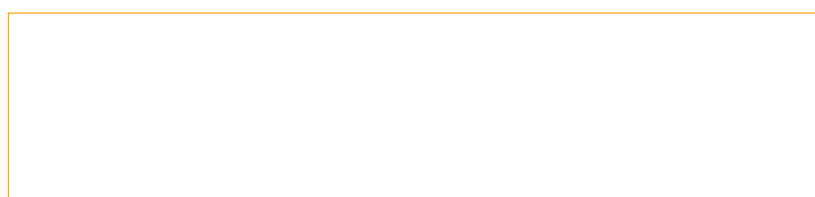
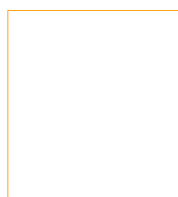
projected onto a computer controlled monitor during surgery and the position of instruments in the sinuses can be checked continuously throughout the surgery. The TTSH project aims to improve surgical accuracy and reduce surgical complications in endoscopic sinus surgeries.

Lower Extremity Amputation Prevention (LEAP) For Life Programme

At least two people in Singapore lose their leg to diabetic foot gangrene a day. Major lower extremity amputation can render the amputee significant disability and pose a tremendous social and economic burden on the society. The LEAP programme at TTSH detects and treats limb-threatening peripheral arterial disease in high-risk patients. In addition, it monitors the vascular status of the remaining limb of unilateral amputees, aggressively treats non-healing wounds and prevents progression in asymptomatic disease through vascular rehabilitation programme.

Development of Cardiac and Cardiovascular MRI

The project will develop new cardiac imaging capabilities in NUH for non-invasive robust assessment of cardiac structural, functional and vascular abnormalities in a single examination, as



well as the development of non-invasive vascular angiography. Cardiac and vascular patients will benefit from the non-invasive comprehensive high-quality services for cardiovascular assessment using MRI and MR angiography.

#### Reducing Blindness in the Elderly through Comprehensive Eye Screening Programme

Glaucoma is the leading cause of blindness in Singapore. Cataracts and refractive errors are also common problems affecting the vision of the elderly. This project provides systematic eye screening for the elderly aged 65 years and above at the NHG Polyclinics, and aims for the early detection and appropriate intervention of glaucoma, cataract and refractive errors so as to prevent blindness and improve their quality of life.

#### Community Addiction Management Programme

The Community Addiction Management Programme (CAMP) is established to provide outpatient treatment for individuals suffering from addictive disorders including alcoholism, drug dependence, sex addiction, pathological gambling and compulsive internet use. The multi-disciplinary team at IMH that manages CAMP works closely with partners like the family service centers and

subordinate courts to ensure a holistic approach to the management of patients.

#### 3T MRI in Evaluation of Stroke

Stroke is the third leading cause of death in Singapore. Other neurological diseases like epilepsy are also common and can cause much disability. In this project, the 3T MRI will be applied for the diagnosis of stroke, epilepsy and other neurological diseases in NNI. With the application of 3T MRI, the management capability of neurological diseases, especially in the clinical diagnosis and patient selection for specific therapy, will be augmented. This will therefore contribute to the reduction in morbidity and mortality from these diseases.

### SingHealth Projects

#### Tissue Culture Programme for the Treatment of Extensive Burn Injuries

Skin is the largest and most extensive organ in the body. It protects the body against the external environment. In burns patients, survival is markedly improved if burn eschar is extensively excised and the wounds covered with the patient's own skin or cultured keratinocytes. The Tissue Culture Programme at SGH will establish a skin bank and utilise tissue cultures for severely burnt patients.

The Cell and Immunotherapy Programme – Refinement, Augmentation and Expansion

In recent years, cell and immunotherapy has established itself as an important treatment modality for cancers, organ failures and autoimmune diseases. It provides hope to patients who are suffering from conditions unresponsive to conventional therapies. This programme offered at SGH aims to develop three exciting and important areas of cell and immunotherapy: non-myeloablative stem cell transplants, novel treatment of severe graft-versus-host disease with monoclonal antibodies and new immunosuppressants, and autologous stem cell transplants for autoimmune disorders.

Cost-effective Cancer Chemoprevention

With cancer screening, many benign conditions (e.g. fibrocystic breast disease, colonic polyposis) with a high risk of developing into cancers are being detected. The specialised clinical service at NCC provides risk assessment and counseling for patients with such conditions. Where appropriate, chemoprophylaxis is instituted to prevent the occurrence of cancer.

Radiofrequency Ablation of Liver Tumours in Inoperable Disease or Adjuvant Local Therapy in Multifocal Diseases

The project involving NCC and SGH will evaluate the use of radiofrequency ablation in the treatment of inoperable hepatocellular carcinomas and liver metastases unresponsive to chemotherapy. Radiofrequency ablation is a new technique involving a cutting-edge technology that shows promise in becoming an established modality of treatment.

Medivision – Advanced Orthopaedic Surgery Navigation Support System

With the utilisation of the Medivision surgical navigation system in orthopaedic surgery in SGH, real-time visualization of anatomy will be accurate and the surgery will be more precise and safe. Hence, the project aims to reduce surgical complications and shorten a patient's hospitalisation stay.

Screening and Early Intervention for Obstructive Sleep Apnoea Hypoventilation Syndrome and other Co-morbidities in Morbidly Obese Schoolchildren

Approximately 5% of school children are morbidly obese. Obese children are at risk of obstructive sleep apnoea hypoventilation syndrome (OSAHS).



This HSDP project aims at the early diagnosis and intervention of OSAHS in morbidly obese school children and the reduction of morbidity and health care costs associated with undiagnosed OSAHS. The comprehensive programme at KKH includes OSAHS screening and interventions comprising weight management, tonsillectomy and adenoidectomy, continuous positive pressure ventilation, and medical management of associated co-morbidities.

#### Mechanical Heart Devices for Heart Failure

Heart transplantation remains the accepted therapeutic modality for selected end-stage heart failure patients. Implantable mechanical heart devices have been shown to be safe and effective as bridges to cardiac transplant, until a suitable heart donor becomes available. There is also evidence to show that these devices are effective in providing mechanical support for myocardial recovery and long term cardiac support. The HSDP project provides subsidies for the expensive mechanical heart devices for suitable patients in NHC, NUH and KKH.

#### Endovascular Stenting of Aortic Aneurysms

An estimated 50% of patients with untreated aortic aneurysm will die of rupture within 5 years. Although open surgical repair of aortic aneurysm is a proven effective technique, it is associated with high morbidity. The less invasive endovascular stenting can reduce the perioperative risks associated with open surgery, but few patients can afford the expensive stent grafts. This HSDP project will provide subsidies for aortic stent grafts for eligible patients in SGH and TTSH.

#### Bilateral Deep Brain Stimulation Surgery for Medically Intractable Advanced Parkinson's Disease

In the treatment of Parkinson's Disease, long term usage of drugs can lead to disabling side-effects such as involuntary movements. Implantation of stimulators in the brain can correct imbalances in the brain cells due to dopamine deficiency. This project involves the insertion of metal stimulators into certain parts of the brains of patients in NNI and SGH with advanced Parkinson's Disease who have experienced severe side-effects from their medications. The project aims to significantly improve the lives of patients who have become disabled because of Parkinson's Disease.

## OFFICE OF CHIEF DENTAL OFFICER

The Office of the Chief Dental Officer sited in MOH headquarters, was established on 1 Jul 01. The Chief Dental Officer acts as the chief advisor to MOH on dental professional matters, which includes the following:

- (i) Dental professional policy
- (ii) Dental regulation
- (iii) Dental service
- (iv) Dental technology
- (v) Dental manpower planning and development
- (vi) Dental practice

In the year 2001, a Task Force and several Committees, as listed below, were set up to look at various issues pertaining to dentistry.

- (i) The National Oral Health Strategy Task Force
- (ii) The Dental Manpower Development Committee
- (iii) The Dental Disease Prevention and Control Committee
- (iv) The Dental Quality Assurance Committee

The Committees' recommendations would not only serve to improve the level of dental care provided for the population but also to advance the practice of dentistry in Singapore.

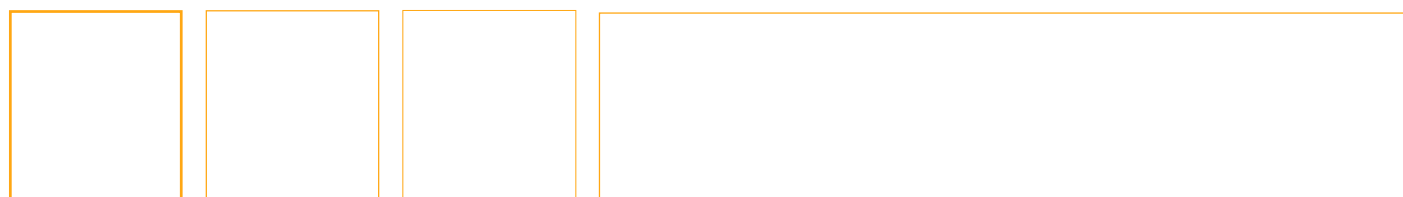
Several initiatives have been planned and will be implemented over the next few years. Surveys will be conducted to determine if there are enough general dental practitioners, dental specialists and dental support staff to serve the population. Based on the survey results, the necessary recommendations will be made to address the situation.

Programmes for the reduction of periodontal diseases in the Singapore population will be introduced. These programmes will be reviewed periodically to see if they are effective in reducing periodontal diseases in the population.

A dental quality assurance framework will be put in place to provide the public with a high level of dental care and service.

## OFFICE OF CHIEF PHARMACIST

With the restructuring of MOH, the drug registration and evaluation functions of the National Pharmaceutical Administration were absorbed by the newly set up statutory board, Health Sciences Authority (HSA) on 1 Apr 01, while the professional duties of the Chief Pharmacist remained with the Ministry. The Chief Pharmacist Office was sited in Ministry of Health headquarters on 1 Jul 01.





The Chief Pharmacist acts as the chief advisor to MOH on all pharmaceutical professional matters, which includes:-

- (i) Pharmaceutical policies
- (ii) Development of pharmaceutical services
- (iii) Pharmacist manpower planning and development
- (iv) Pharmacists' clinical practice and standards
- (v) Planning for emergency medical and surgical supplies
- (vi) Registration of Pharmacists
- (vii) Regulation of Pharmacists
- (viii) Forging international relationships with Chief Pharmacist Offices, overseas.

In 2001, the Chief Pharmacist Office developed a system for the production of common patient information leaflets to be used by institutions in the public sector. These leaflets will be distributed to patients at the point of dispensing together with medication counseling and will help in improving their compliance to prescribed medicines. Information on the management of side-effects, drug interactions and the storage of prescribed medicines would be made available through these leaflets.

The Chief Pharmacist Office has completed the revision of the Pharmacists Registration Act and its Regulations and it will be submitted for approval by the Cabinet in FY2002.

To keep up with the advance in medical sciences, the Chief Pharmacist Office has set up various committees to study and make recommendations on the following:- clinical pharmacy services, pharmacists' norms, pharmacist specialisation, role of pharmacists in elderly care, improvement of community pharmacy services and upgrading of pharmacy services in institutions.

Several initiatives have been planned to develop the pharmacy profession in Singapore and to increase and upgrade pharmaceutical services provided to the public. These initiatives include:

- (i) Implementation of compulsory continuing education for practising pharmacists.
- (ii) Introduction of specialist pharmacists by identifying appropriate specialist courses to be conducted at the local universities and other training centres.
- (iii) Identification of appropriate clinical pharmacy services to be provided by the institutions.

# Chapter 4 Health Services for the Elderly

With the increase in the elderly population in Singapore from 7% in 1999 to 19% by the year 2030, the healthcare services for the elderly have to be geared up to meet the expected increase in demand for the future. The Ministry is committed to provide adequate, accessible, appropriate and quality services for the elderly in Singapore, from the acute hospital setting, to step down services for those requiring extended care. This is to enable the elderly to live independently in their own homes with the support of quality community services.

## SEAMLESS QUALITY SERVICES FOR THE ELDERLY

All nursing homes run by private and voluntary welfare organisations (VWO) and community hospitals were subjected to audit checks by the Licensing and Accreditation Branch of MOH. This is to ensure that the minimum requirements for service provision were met. The community hospitals and a majority of VWO nursing homes receive funding from the Ministry. To improve the standards of these services, MOH had introduced a number of initiatives.

## Framework for Integrated Health Services for the Elderly

In Apr 01, the Framework for Integrated Health Services for the Elderly was implemented. The main thrust of this initiative was to provide seamless and good quality step down care for the elderly. Under this Framework, three community hospitals and four nursing homes were appointed as 'approved' providers to offer expanded scope of services to include day rehabilitation, home medical and home nursing services. These 'approved' providers were affiliated to the geriatric departments of regional hospitals within their zones. These departments were tasked to provide professional leadership and assist in enhancing the standards of care of the three community hospitals and the four nursing homes within their zones.

The 'approved' providers were given additional funding to provide (or outsource) expanded services and enable them to buy professional services from regional hospitals to provide the higher standards of care required. Over time, this Framework will expand to include more nursing homes.



### **Audit of Standards in 'Approved' Nursing Homes and Community Hospitals**

Data collection and audit checks of the 'approved' nursing homes and community hospitals within the Framework were done at the end of 2001, so that they meet the required standards. Using the integrated framework as a model, audit exercises will gradually be introduced in a phased manner to more funded VWO nursing homes.

### **Development of Guidebooks**

As a guide for provision of minimum care standards, the Inter-Ministerial Committee on Health Care for the Elderly recommended that MOH make guidebooks available to providers of long term care and that benchmarks on the standards of care be established. Guidebooks on Nursing Homes, Home Medical and Home Nursing Services were developed and would be made available to service providers. Two other guidebooks on Dementia Day Care Centres and Day Rehabilitation Centres will be produced.

### **Review Committees for Psychiatric and Psycho-geriatric Step Down Facilities and Community Hospitals**

The Review Committee on the Provision of Psychiatric and Psychogeriatric Step-Down Facilities was set up in May 00 to review and make recommendations on the national provision of step-down facilities for psychiatric and

psychogeriatric patients. The Committee deliberated on issues like promotion of mental health, staff norms and the projected requirements of step-down facilities for psychiatric and psychogeriatric patients.

The Review Committee for Community Hospitals was set up in Aug 00 to review and recommend the role and service provision of community hospitals. Issues such as admission and discharge criteria, planning norm for national requirement, staff and space norms, and quality indicators for community hospitals were set out by the Review Committee.

### **Infection Control Training Programme**

The Infection Control Training Programme, organised by MOH with the Communicable Disease Centre (CDC), was aimed at raising the standard of nursing care related to infection control in step-down facilities and community based services. The training programme included talks and hands-on practical sessions. It provided basic information on infection control, including standard precautions. The Programme commenced in May 01. Participants of the programme comprised nursing officers, registered nurses, enrolled nurses and nursing aides from community hospitals, VWO and private nursing homes, hospices and hospice home care providers.

## ACCESSIBLE AND APPROPRIATE SERVICES

### Integrated Care Services

With the closure of the Care Liaison Service (CLS) in 2000, the Integrated Care Service (ICS) was set up as a joint cluster service in May 01 to take over the role of the CLS in co-ordinating nursing home placement services for the two clusters. The role of ICS will be expanded in future to include co-ordinating placement of the elderly in appropriate step down services such as community hospitals, day rehabilitation centres, home medical and home nursing services.

### Workgroup on Guidelines on Assessment and Referral to Rehabilitation Services

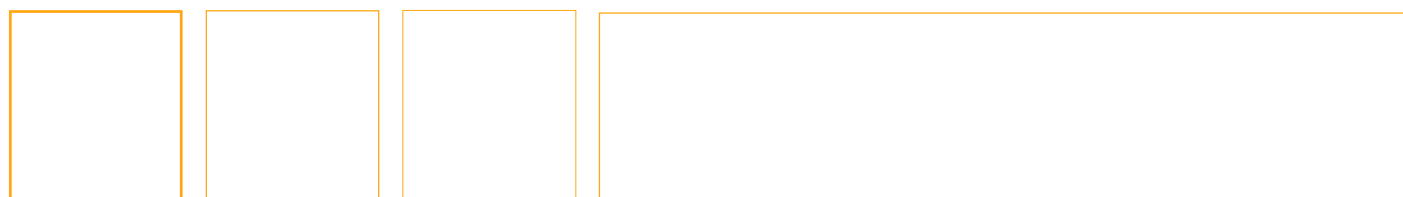
A Workgroup looking into appropriate rehabilitation services for the elderly who require rehabilitation care for improvement in their functioning level after the onset of an illness was set up. The main task of the Workgroup is to draw up guidelines for assessment and appropriate referral to the different levels of rehabilitation services. These guidelines will be made available to doctors and care co-ordinators at acute hospitals.

### Making Information on Eldercare Services Available

A brochure on "Continuing Care After Hospitalisation" was produced to provide information to professionals and the public on the range of step down facilities available in Singapore. The facilities include community hospitals, nursing homes, day rehabilitation centres, day care centres for dementia, home medical and home nursing services and the contact numbers of Integrated Care Service. The brochures were distributed to the Community Development Councils (CDCs), Community Centres, polyclinics and other relevant institutions. In line with the development information technology, a user friendly MOH internet website providing information on health services for the elderly is also being developed.

### More Services for the Elderly

Three new nursing homes and expansion of an existing nursing home were completed by end 2001, increasing the number of VWO beds for the elderly from 3,632 to 4,403. Two new community hospitals (Ren Ci and Bright Vision) were still under construction and they would be due for completion in 2002. The increase in community hospital and nursing home beds will cater to the demand for such services as the ageing population increases.



## FINANCING ELDERLY SERVICES

### ElderCare Fund

With a rapidly aging population and a shrinking tax base due to a proportionately smaller working population, Singaporeans will find it more difficult to pay for the health care needs of the elderly population in future. An ElderCare Fund was set up in Apr 00 to finance the operating subsidy to elderly care facilities and services run by VWOs. Currently, subsidies to nursing homes are paid directly out of the government's annual budget. In future, operating subsidies will be fully financed by the interest income of the ElderCare fund. By putting aside funds now, our future subsidies to the elderly will be secured without having to fall back on tax increases. \$750 million capital sum has been injected so far and the Government targets to provide \$2.5 billion to the fund by 2010.

### Means Testing and 3-Tier Subsidy for Nursing Homes

The means testing and 3-tier subsidy framework, implemented in VWO nursing homes since Jul 00, was reviewed in year 2001. To extend the subsidy to more Singaporeans, the income cut-off was raised from \$700 to \$1,000. The subsidy rate was revised as shown (Table 4.1):

**Table 4.1: Subsidy by Per Capita Income**

Before Review	After Review	Subsidy Rate
Per capital Household Income		
Less than \$300	Less than \$300	75%
\$301 to \$500	\$301 to \$700	50%
\$501 to \$700	\$701 to \$1,000	25%
>\$700	>\$1,000	0%

The revised means testing was implemented in the VWO nursing homes on 1 Jul 01. It was also introduced at other VWO step-down care services such as hospices and day rehabilitation centres in Oct 01 and will be extended to other step-down facilities in the near future.

### ElderShield

ElderShield, an affordable severe disability insurance scheme, will be introduced to allow the elderly with severe disabilities to claim insurance payouts to defray medical/care expenses of long term care. It will be an opt-out scheme, where premiums will be paid through the policyholder's Medisave account. It will have features of risk pooling, pre-funded premiums, lifetime coverage and cash payout and will be implemented in 2002.

## Chapter 5 Health Care Professionals

In Singapore, the respective Professional Boards regulate the practice of doctors, dentists, pharmacists, nurses and midwives. The number of registered health care professionals in Singapore continued to increase in 2001. (Table 5.1).

### DOCTORS

As at Dec 01, 5,922 doctors registered with the Singapore Medical Council (SMC) (Table 5.1).

This was an increase of 345 compared to year 2000. About 47.2% of registered doctors worked in the public sector while 49.4 % of them are with the private sector (Table 5.3). The doctor-to-population ratio (based on the number of doctors with full and conditional registration) was 1:700 as compared to 1:720 in 2000. In the same year, 1,933 doctors registered as specialists under SMC's Register of Specialists (Table 5.5), compared to 1,819 in 2000.

**Table 5.1 - Number of Registered Healthcare Professionals 2000 & 2001**

Health Personnel	2000	2001
<b>Doctors</b>	<b>5,577</b>	<b>5,922</b>
Public Sector	2,586	2,794
Private Sector	2,809	2,925
Not in Active Medical Practice	182	203
<b>Dentists</b>	<b>1,028</b>	<b>1,087</b>
Public Sector	193	209
Private Sector	755	775
Not in Active Medical Practice	80	103
<b>Pharmacists</b>	<b>1,098</b>	<b>1,141</b>
Public Sector	238	297
Private Sector	638	619
Not in Active Medical Practice	222	225
<b>Nurses and Midwives</b>	<b>16,611</b>	<b>17,398</b>
Public Sector	8,927	9,297
Private Sector	4,166	4,224
Not in Active Medical Practice	3,518	3,877

Table 5.2 - Number of Doctors by Gender and Age, 2001

Age (Years)	Male	Female	Total
Below 30	573	304	877
30 - 39	1,518	693	2,211
40 - 49	858	463	1,321
50 - 59	621	215	836
60 - 69	372	94	466
70 & above	161	50	211
<b>All Age Groups</b>	<b>4,103</b>	<b>1,819</b>	<b>5,922</b>

Table 5.3 - Registered Doctors by Field of Employment, 2001

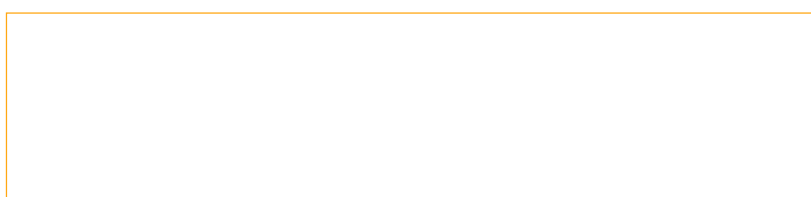
	No.	%
<b>Public Sector</b>	<b>2,794</b>	<b>47.2</b>
Government Service	265	4.5
Restructured Hospitals/Institutions	2,360	39.8
National University of Singapore	169	2.9
<b>Private Sector</b>	<b>2,925</b>	<b>49.4</b>
Individual Practice	1,347	22.7
Group Practice	1,123	19.0
Locum	272	4.6
Employed by Private Hospitals/Corporations	183	3.1
<b>Working in Non-Medical Fields</b>	<b>14</b>	<b>0.2</b>
<b>Not Working</b>	<b>189</b>	<b>3.2</b>
<b>Total</b>	<b>5,922</b>	<b>100.0</b>

**Table 5.4 - Doctors to Population Ratio, 1970, 1980, 1990, 2001**

<b>1970</b>	1 : 1,520
<b>1980</b>	1 : 1,220
<b>1990</b>	1 : 850
<b>2001</b>	1 : 700

**Table 5.5 - Registered Medical Specialists as at Dec 2001**

	2001		2001		2001
<b>Total</b>	<b>1,933</b>	Hand Surgery	7	Paediatric Med	170
Anaesthesiology	173	Infectious Diseases	13	Paediatric Surgery	11
Cardiology	72	Internal Medicine	46	Pathology	70
Cardiothoracic Surgery	23	Medical Oncology	27	Plastic Surgery	26
Dermatology	47	Neurology	37	Psychiatry	93
Diagnostic Radiology	97	Neurosurgery	23	Public Health Med	67
Emergency Med	24	Nuclear Med	6	Rehab Med	11
Endocrinology	34	O&G	233	Renal Med	24
Gastroenterology	46	Occupational Med	29	Respiratory Med	46
General Surgery	128	Ophthalmology	90	Rheumatology	14
Geriatric Med	22	Orthopaedic Surgery	92	Therapeutic Radiology	17
Haematology	24	Otorhinolaryngology	58	Urology	33





## DENTISTS

1,087 First Division\* dentists registered with the Singapore Dental Council at the end of 2001. This was an increase of 59 compared with the previous year. During the year, 19.2% of the First Division dentists practised in the public sector and 71.3% in the private sector (Table 5.6). The dentist-to-population ratio was 1 : 3,908. Of the

First Division dentists, 21.6% had post-graduate dental qualifications (Table 5.7).

*\*Dentists registered in the First Division of the Register are those who hold a degree or diploma in dentistry granted by a college or university in Singapore, or by any other foreign university or body recognised by the Singapore Dental Council.*

**TABLE 5.6 - FIRST DIVISION DENTISTS BY FIELD OF EMPLOYMENT, 2001**

Field of Employment	No.	%
<b>Public Sector</b>	<b>209</b>	<b>19.2</b>
Government Service	4	0.3
Restructured Hospitals/Institutions	165	15.2
National University of Singapore	27	2.5
Statutory Board	13	1.2
<b>Private Sector</b>	<b>775</b>	<b>71.3</b>
Individual Practice	303	27.9
Group Practice	431	39.6
Locum	39	3.6
Employed by Private Hospitals/Corporations	2	0.2
<b>Working in non-Dental Fields</b>	<b>2</b>	<b>0.2</b>
<b>Not Working</b>	<b>101</b>	<b>9.3</b>
<b>Total</b>	<b>1,087</b>	<b>100.0</b>

**TABLE 5.7 - DENTISTS WITH HIGHER QUALIFICATIONS BY FIELD OF SPECIALITY AND EMPLOYMENT SECTOR, 2001**

Field of Speciality	Public Sector	Private Sector	Not Practising	Total
Prosthodontics	18	40	4	62
Orthodontics	10	42	1	53
Oral Surgery	13	21	2	36
Periodontics	8	20	2	30
Endodontics	4	14	-	18
Paedodontics	5	7	1	13
Dental Public Health	-	5	1	6
Others	3	13	1	17
<b>Total</b>	<b>61</b>	<b>162</b>	<b>12</b>	<b>235</b>

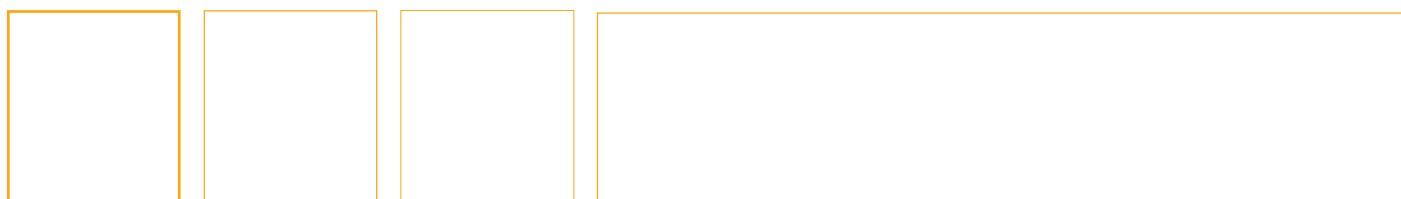


TABLE 5.8 - FIELD OF EMPLOYMENT OF PHARMACISTS, 2001

Field of Employment	No.	%
<b>Public Sector</b>	<b>297</b>	<b>26.0</b>
Restructured Hospitals	238	20.8
Government Institutions	5	0.4
University	19	1.7
Statutory Boards	35	3.1
<b>Private Sector</b>	<b>619</b>	<b>54.3</b>
Research	49	4.3
Hospital	38	3.3
Wholesale	154	13.5
Retail	140	12.3
Wholesale & Retail	31	2.7
Manufacturing	32	2.8
Marketing	54	4.7
Locum	36	3.2
Others	85	7.5
<b>Working in Non-Pharmaceutical Fields</b>	<b>78</b>	<b>6.8</b>
<b>Not Working</b>	<b>147</b>	<b>12.9</b>
<b>Total</b>	<b>1,141</b>	<b>100.0</b>

Source : SMC

## PHARMACISTS

At the end of 2001, 1141 pharmacists registered with the Singapore Pharmacy Board, which is an increase of 43 pharmacists over the previous year. During the year, 916 (80.3%) pharmacists worked in pharmaceutical related fields, 78 (6.8%) worked in non pharmaceutical fields. The majority of pharmacists were employed in the private sector (Table 5.8).

## NURSES

17,398 nurses were registered with the Singapore Nursing Board in 2001. This was an increase of 787 nurses over the previous year. The registrants included registered nurses, enrolled nurses and registered midwives (Table 5.9). About 53.4% of nurses were practising in the public sector and 24.3% in the private sector (Table 5.10). Among the nurses, 6,190 of them had post-basic qualifications (Table 5.11).

**TABLE 5.10: NURSE BY FIELD OF EMPLOYMENT, 2001**

Field of Employment	No.	%
<b>Public Sector</b>	<b>9,297</b>	<b>53.4</b>
Government Service		0.0
Govt Restructured Hospitals		0.0
Statutory Boards		0.0
<b>Private Sector</b>	<b>4224</b>	<b>24.3</b>
Private Hospitals		0.0
Private Clinic		0.0
Nursing Homes		0.0
Nursing Agencies		0.0
Industrial Nursing		0.0
Others		0.0
<b>Non-Nursing Work</b>	<b>666</b>	<b>3.8</b>
<b>Not Working</b>	<b>3,211</b>	<b>18.5</b>
<b>Total</b>	<b>17,398</b>	<b>100.0</b>

**TABLE 5.9: BREAKDOWN OF NURSES BY CATEGORY, 2001**

Category	No.	%
Registered Nurses	12,828	73.7
Enrolled Nurses	4155	23.9
Registered Midwives	415	2.4
<b>Total</b>	<b>17,398</b>	<b>100.0</b>

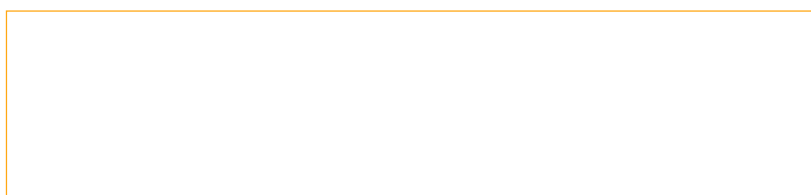


TABLE 5.11: POST-BASIC NURSING QUALIFICATIONS BY TYPE, 2001

Type of Post-Basic Qualification	No.*	%
Community health	252	4.1
Critical Care	562	9.1
Dermatology	8	0.1
Gerontology	149	2.4
Medical/ Surgical	30	0.5
Midwifery / Obstetric	1,884	30.4
Midwifery / Paediatric / Community Health	236	3.8
Neuroscience	81	1.3
Nursing Administration	143	2.3
Nursing Education	44	0.7
Occupational Health	39	0.6
Oncology	120	1.9
Operating Theatre	542	8.8
Ophthalmology	79	1.3
Ophthalmology & Orthorhinolaryngology	4	0.1
Orthopaedic/ Spinal Injuries & Rehabilitation	109	1.8
Orthorhinolaryngology	19	0.3
Paediatric/ Neonatology	304	4.9
Plastic & Reconstructive surgery	35	0.6
Psychiatric/ Mental Health	415	6.7
Renal/ Urology	76	1.2
Thoracic/ TB	50	0.8
Trauma/ Emergency	74	1.2
Others	935	15.1
<b>Total</b>	<b>6,190</b>	<b>100.0</b>

\*Refer to the number of certificates held by nurses (A nurse may have more than one certificate)

## Chapter 6 Professional Training and Standards

The Professional Standards and Development Division (PSD) of MOH is responsible for maintaining high professional standards among medical, nursing, dental and paramedical professionals practising in Singapore. To achieve this, PSD works closely with professional bodies, academic institutions and regulatory/ licensing boards to develop frameworks for registration and comprehensive training for these professionals. PSD also works with these partners to promote a framework of continuing professional development so that all doctors and health care professionals continue to stay abreast with current medical knowledge and practice.

### WELL-TRAINED DOCTORS AT EACH LEVEL OF THE HEALTH CARE SYSTEM

In 2000, MOH initiated a systematic review of the existing training system for doctors. This was to enhance the comprehensiveness of the training for all medical professionals in the entire spectrum of medical practice, i.e. house officers (HO), medical officers, basic and advanced specialist trainees, specialists and family physicians. The aim was to further strengthen and upgrade the system so that there would be well-trained doctors at all levels of our health care system.

### House Officers' (HO) Training

Graduates from the National University of Singapore Faculty of Medicine and other recognised overseas medical schools undergo one year of housemanship (internship) training in public sector hospitals.

An SMC Education Committee was set up in 1998 to set directions and make recommendations to the Council on matters concerning undergraduate medical education, HO training and continuing medical education. A review of the accreditation of HO training posts was subsequently done, which led to an Implementation Committee being formed. The Committee reviews applications from clinical departments for the accreditation of HO training. Site inspections at the respective hospitals were carried out. The inspection teams, each chaired by a Committee member, conducted interviews with clinical supervisors and HOs to get their feedback on the training currently provided for HOs. The Committee's report was submitted to the SMC in Jan 01 and the accreditation of HO training posts was implemented from May 01, when HOs began to undergo training only in institutions and departments with accredited HO training posts. The Education Committee also produced a training logbook and handbook detailing the training objectives for all HOs. This would be used to assess the adequacy of the HO's training at each posting.



## Medical Specialist Training

### Specialists Accreditation Board

PSD serves as the secretariat to the Specialists Accreditation Board (SAB), which is responsible for the overall performance of the specialist training system. The Board determines the qualifications, experience, training programmes and other conditions required for accreditation and registration of specialists under the Medical Registration Act. It also grants specialist accreditation to persons who meet these requirements. 144 specialists were accredited in 2001. The SAB website is accessible at [http:// www.moh.gov.sg/moh/sab](http://www.moh.gov.sg/moh/sab)

### Joint Committee on Specialist Training

In order to strengthen basic and advanced specialist training, the Joint Committee on Specialist Training (JCST) was appointed by SAB in Aug 00 to set professional standards for specialist training and establish mechanisms for assuring the quality of specialist training in Singapore. The JCST, comprising the Graduate School of Medical Studies (GSMS) and the Academy of Medicine(AM), oversees all the 35 Specialist Training Committees (STCs) and provides them with professional guidance and secretariat support.

Accreditation of specialist training centres is ongoing and the JCST has drawn up guidelines for accrediting hospitals and institutions to provide basic and advanced training in various specialities. Site visits for accreditation of specialist training centres started in Sep 01 and are scheduled to be completed by mid-2002.

### Specialist Training Committees

The Specialist Training Committees are responsible for the selection of basic specialist and advanced specialist trainees. They conduct exit evaluations for advanced trainees based on criteria given by the JCST. In 2001, 151 basic and 114 advanced specialist trainees were appointed by the JCST.

A review of all Basic and Advanced specialist training programmes has been completed. Each STC has drawn up a structured training programme for both basic and advanced training for their specialty that clearly defines the training objectives that each trainee is expected to achieve by the end of both basic and advanced periods of specialist training.

The roles and responsibilities of the various parties involved in specialist training, comprising the SAB, the JCST, the STCs and the employer organisations like SingHealth and NHG, have been compiled into a set of guidelines. This set of guidelines was agreed upon and circulated to all stakeholders in Aug 01. A copy of the guidelines is also available on the SAB web-site at <http://www.moh.gov.sg/moh/sab> for the reference of medical officers and trainees.

### Family Physicians' Training

Family physicians provide 80% of the primary health care services in Singapore. In addition to first line acute care and chronic care, family physicians play important roles in the implementation of Singapore's national disease control programmes. They are also crucial and influential sources of health information for patients and their families.

The requisite skills and knowledge for independent practice as a competent and effective family physician have been defined by the College of Family Physicians, Singapore (CFPS) and the Family Medicine (FM) Training Committee.

A system of professional accountability for the family medicine training system has been established, involving the following parties:

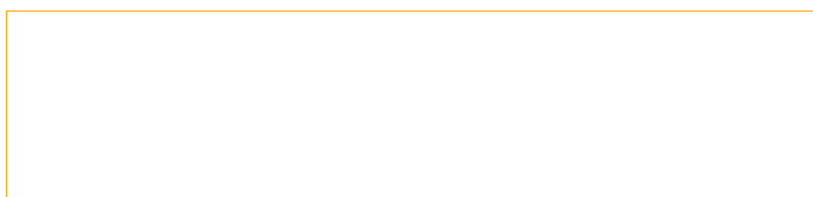
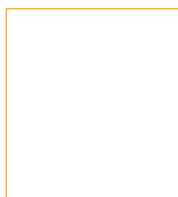
- (i) *FM Training Committee*: Sets training and practice standards and is accountable to the JCST
- (ii) *Graduate School of Medical Studies*: Conducts the GDFM Examination and awards the Diploma
- (iii) *CFPS*: Provides clinical knowledge and skills instruction
- (iv) *Cluster Polyclinics*: Provides clinical postings in general practice

PSD will continue to work with the relevant stakeholders to achieve buy-in and enhance the quality of the family medicine training system as well as monitor the number of doctors with GDFM and Masters in Family Medicine qualifications.

### Continuing Medical Education for All Doctors

Continuing Medical Education (CME) is a key mechanism through which medical practitioners maintain the currency of their professional knowledge and stay abreast of latest developments in medical science and technology.

In 2000, SMC established its Online CME System to facilitate the application process for CME providers seeking to accredit their programmes for CME points. The system also provided doctors with an online CME calendar for easy reference as well





as a convenient electronic account for logging and tracking their own CME activities.

In 2001, under the direction of the SMC CME Co-ordinating Committee, AM and CFPS completed their definition of core and non-core CME syllabi for specialists and GPs respectively. These included lists of recommended scientific meetings and journals specific to each specialty or for general practice. With effect from 2002, 25% of each doctor's CME points must come from participation in core activities as defined by these lists.

For the year 2001, 49.5% of doctors in Singapore documented the minimum requirement of 25 or more CME points.

Compulsory CME would be implemented from 1 Jan 2003 and it would be linked to renewal of all practising certificates (PCs) issued from 1 Jan 2005 onwards. The CME qualifying period would be the two calendar years preceding the year in which the PC was due for renewal.

Doctors would be required to obtain a minimum of 50 CME points within the 2-year qualifying period, of which 20% (10 points) must come from core CME activities. Doctors who fail to meet these minimum requirements would not have their PCs renewed and would have to apply for reinstatement after completing a reinstatement module (RM) to make up for their shortfall in CME points. The format, content and delivery of this module would be worked out by the relevant professional bodies (i.e. CFPS for the GPs and AM for the specialists).

The SMC Online CME System can be accessed at <http://www.smc-cme.gov.sg>

## TRAINING OF NURSES

### Registered Nurses

The School of Health Sciences, Nanyang Polytechnic (NYP) offers a nursing course that allows graduates to register with the Singapore Nursing Board. Graduates of the three-year NYP Diploma in Nursing are licensed to practise as Registered Nurses (RNs). In order to meet the national nursing manpower requirements, NYP had an intake of students for the course in Jan 2001, in addition to its annual intake in July.

RNs are sponsored for the NYP Advanced Diploma in Nursing courses for upgrading of their professional clinical role. These courses are in the following nursing specialty: emergency, community health, critical care, gerontology, medical-surgical, mental health, midwifery, nephro-urology, neuroscience, oncology, operating theatre, ophthalmic, orthopaedic and paediatric nursing.

Opportunities are also available for RNs to pursue the 2-year part-time Bachelor of Health Science (Nursing) Degree conducted by the University of Sydney and the Singapore Institute of Management.

## Nurse Specialists

The complexity of healthcare requires RNs in the clinical track to be prepared at the advanced practice or specialist level. With the mastery of specialised knowledge and skills as well as increased recognition accorded to the advanced practice status within the career structure, RNs could derive greater job satisfaction. This would motivate RNs to remain in direct patient-care positions.

The educational preparation of advanced practice nurses will be at the postgraduate level, which is similar to what is being practised in the US, Canada, UK, Australia and New Zealand.

The Ministry will explore the feasibility of conducting a Master of Clinical Nursing with the Graduate School of Medical Studies, National University of Singapore.

A Nurse Specialist Steering Committee was formed to determine the role, scope of practice, qualifications, experience, and the educational preparation required for the credentialing and registration of nurse specialists. The Nurses Specialist Register will be established in 2002.

## Enrolled Nurses

The Institute of Technical Education (ITE) offers a nursing course that allows graduates to register with the Singapore Nursing Board. The first group

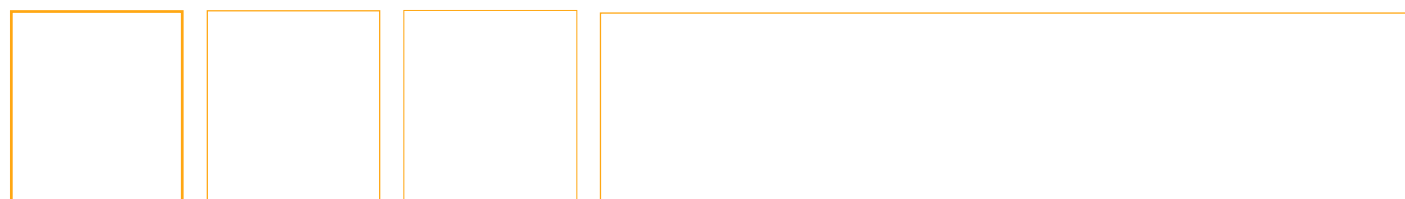
of ITE nursing students successfully completed the two-year National Certificate in Nursing course in Dec 2001. They were licensed to practise as Enrolled Nurses. Outstanding Enrolled Nurses have the opportunity to undergo the Certificate in Bridging Studies conducted by NYP. 40 Enrolled Nurses have completed the Certificate in Bridging Studies and are pursuing the Diploma in Nursing course at NYP.

ITE responded to an increased number of applications for the National Certificate in Nursing course by increasing the number of student intake from 64 to more than 70 students in each of the two cohorts of students in 2001.

## Continuing Nursing Education

Continuing nursing education (CNE) is vital for nurses to keep abreast of developments in nursing and medical science for application in practice. Hospitals and healthcare institutions conducted many clinical skill courses to help nurses maintain their professional competence. Some hospitals and institutions monitor CNE participation and have incorporated this in the annual staff appraisal system.

From 2001, SNB will be issuing annual practising certificates to nurses. Nurses who have lapsed practice for 5 years or more will have to attend a



Return-to-Nursing training programme. Currently, nurses and midwives who apply for renewal of their annual practising certificate are not required to participate in CNE.

A computerised CNE system was developed by SNB in 2001 and would be commissioned in 2002. This system has the infrastructure for course organisers to submit to SNB programmes for the accreditation and attendance of participants for the award of CNE points. The CNE events calendar will be available on-line. Nurses and midwives can register for courses, view their earned CNE points and record their points for CNE participation on-line. With the implementation of the CNE system, SNB will be able to monitor the CNE participation rate of nurses and midwives.

### Accreditation of Nursing Courses and Institutions

With the implementation of the Nurses and Midwives Act 1999, SNB assumed the expanded function of accrediting courses and institutions which provide qualifications in nursing and midwifery in addition to those required for the nurses' registration and enrolment.

### ALLIED HEALTHCARE PROFESSIONALS

The Allied Healthcare (AHC) professionals are key members of the healthcare teams in Singapore's hospitals, clinics and step-down care facilities. Their contributions are critical because of their involvement in the management of patients, especially those with chronic conditions.

To attract more young people into careers in physiotherapy, occupational therapy, diagnostic radiography and radiation therapy, a new Allied Health scholarship was introduced by the Ministry in Apr 2002. This scholarship will be administered by the National Healthcare Group (NHG) and the Singapore Health Services (SingHealth). Recipients of this scholarship will pursue a degree programme in the chosen field of study. They will begin with a 3-year diploma course at NYP, after which their final year of study will be completed at the University of Sydney, subject to the University's progression criteria. This new scholarship will complement the opportunities that are currently in place for professional upgrading of the diploma-trained AHC professionals.

The Ministry has also set up various workgroups and committees to review the job scope, career structure and professional development of AHC professionals.

# Chapter 7 Regulation and Quality in Health Care

The Ministry of Health looks into the safety, appropriateness and effectiveness of public health care services and products through the functions of its Health Regulation Division (HRD), and the Health Sciences Authority (HSA).

The HRD ensures high standards of patient care in health care providers through regulatory activities including the licensing and accreditation of health care establishments, and the institution of quality improvement programmes. The Division also oversees the practice of traditional and complementary medicine in Singapore. More information on HRD can be obtained from <http://www.gov.sg/moh>

Formed on 1 Apr 01, the HSA is a statutory board comprising 8 specialised centres which together ensure the safety and efficacy of all health-related products available in Singapore, and provide specialised scientific, investigative and analytical expertise to support the functions of public and private organisations. More information on HSA can be obtained from <http://www.hsa.gov.sg>.

## LICENSING OF HOSPITALS AND CLINICS

(<http://www.gov.sg/moh/l&a>)

Under the Private Hospitals and Medical Clinics (PHMC) Act, health care institutions must be licensed before they are allowed to operate. As of 31 Dec 01, 26 hospitals, 2,625 medical and dental clinics, 73 clinical and X-ray laboratories, and 53 nursing homes were licensed in Singapore (Table 7.1).

HRD also administers the Termination of Pregnancy (TOP) and Voluntary Sterilisation (VS) Acts, which set out the requirements for termination of pregnancy and voluntary sterilisation, respectively, for institutions and medical practitioners providing such services.

HRD conducts regular inspections on health care institutions to ensure that acceptable standards are met in terms of facilities and equipment, infection control activities, financial counselling, and qualifications and adequacy of staff, etc. In 2001, 1,168 inspections were conducted. Starting from 2001, HRD officers use personal digital assistants (PDAs) for inspections to replace manual checklists.

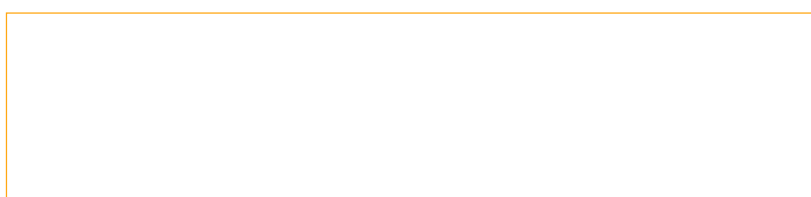
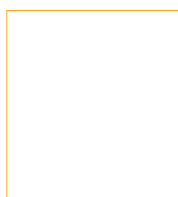


Table 7.1: Number Of Licensed Health care Institutions, 1996-2001

Type of License / Permit / Certificates	No. of Health care Institutions					
	1996	1997	1998	1999	2000	2001
<b>Hospitals</b>						
Restructured Hospitals	7	6	6	9	12	11
Private Hospitals	14	13	14	15	15	15
<b>Nursing Homes</b>						
Commercial	23	24	24	27	26	27
Voluntary	24	25	25	25	24	26
<b>Clinical &amp; X-ray Laboratories</b>						
Clinical Laboratories	49	48	43	39	39	45
X-ray Laboratories	24	24	27	26	29	28
<b>Clinics</b>						
Medical Clinics	1,566	1,626	1,680	1,743	1,878	1,914
Dental Clinics	402	412	426	440	486	672
Joint Medical and Dental Clinics	34	40	46	41	40	39
<b>Total</b>	2,143	2,218	2,291	2,365	2,549	2,777

Corrective actions were taken against health care institutions which failed to comply with the statutory requirements under the relevant Acts. In 2001, HRD issued warning letters to 6 clinics and 2 nursing homes for contravention of the PHMC Act and Regulations, and to another 3 hospitals and 6 medical clinics for contravention of the Advertising Guidelines. A nursing home and 2 medical clinics were fined for failing to comply with the Ministry's directive, and operating before a license was issued, respectively. One medical clinic had its operation suspended for 6 months, and was also prohibited from performing abortions.

Clinical laboratories intending to perform HIV testing, Malarial Parasite testing, ABO Blood Group and Rhesus (D) Type Testing and Acid Fast Bacillus (AFB) (Smear) testing are required to seek approval before they are allowed to perform these tests. These laboratories are also required to participate in respective Proficiency Testing Programmes. As of 31 Dec 01, 23 laboratories were accredited to perform HIV testing, 50 for Malarial Parasite testing, 28 for ABO Blood Group and Rhesus (D) Type testing, and 21 for AFB (Smear) testing.

### Guidelines for Special Care Services

Hospitals and medical clinics are required to seek approval before they are allowed to provide the specialised or special care services listed in the Second and Third Schedules of the PHMC Act, respectively (Appendix 2). In 2001, the Ministry issued guidelines on endoscopy, neonatal intensive care unit, renal dialysis and assisted reproduction services to all health care institutions providing these services.

## QUALITY ASSURANCE IN HEALTH CARE INSTITUTIONS

### National Medical Audit Programme

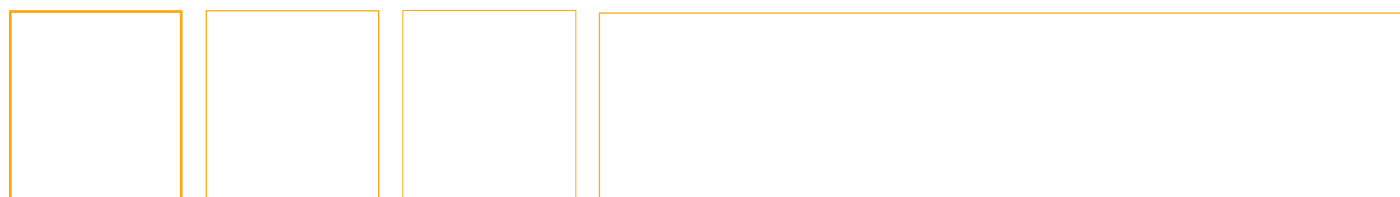
HRD monitors and maintains the standards of patient care mainly through the National Medical Audit Programme (NMAP) which provides a comprehensive framework by which the quality of patient care is measured and evaluated. The components of the programme are as follows:

### Ensuring Effective Monitoring of Clinical Quality

#### Quality indicator monitoring

All acute care hospitals participate in the Quality Indicator Project (QIP), an international clinical quality programme which allows for comparative benchmarking of hospitals against peer institutions internationally. The hospitals are expected to monitor their clinical performance indicator results, identify possible problems in the care delivery system, study the causes of variation and look for opportunities to improve the quality of clinical services. HRD co-ordinates the system and reviews the results at the national level. Information on the International QIP is available at <http://www.qiproject.org>.

In the year 2001, a second quality indicator programme, the Specialty-Specific Clinical Indicator (SSCI) Programme, was initiated in the hospitals. The SSCIs are adapted from the care evaluation programme of the Australian Council of Health care Standards (<http://www.achs.org.au>) and tailored for use locally. A set of 32 specialty indicators will complement the 8 hospital-wide indicators monitored under the QIP. The SSCI programme is being implemented in 3 phases, starting in Jul 01 with 11 indicators for the following specialties: cardiology, ophthalmology, ENT, general surgery, neurology, neurosurgery, O&G, orthopaedics, paediatrics, respiratory medicine and urology.



### Clinical Audit

In 2001, HRD conducted a clinical audit to assess the provision of care for stroke patients in the public hospitals. This is the first of a series of clinical audits targeting key diseases that are the focus of national disease management plans. The audit evaluated the structure and process of acute stroke care provision in five public hospitals established the existing clinical standards of stroke practice and determined the degree of practice variability among the hospitals. The findings of the audit are being used by the hospitals to drive quality improvement in stroke care provision.

### **Ensuring Effective and Comprehensive Institutional Clinical Quality Programmes**

In 2001, HRD initiated the review of guidelines on infection control and sentinel event reporting and review. The revised guidelines will allow hospitals to detect system deficiencies within the relevant clinical services and effect timely changes for improvement.

### **Enhancing the Effectiveness of HRD in Assuring Clinical Quality**

HRD has been networking with international health professional bodies and authorities to study the current best practices in the field of clinical quality improvement. These links will also enable the Ministry to tap on the relevant expertise needed to develop an effective and responsive system for health care regulation and quality.

### **AMENDMENTS TO THE PHMC REGULATIONS**

The PHMC Regulations were amended in Sep 01. Some of the key amendments are intended to:

- Ensure standards and quality of laboratory tests by mandating that these be performed only in licensed laboratories or recognised accredited foreign laboratories, and also that medical clinics providing laboratory or radiological services meet those accreditation standards set for clinical/x-ray laboratories.
- Enhance the requirements on Quality Assurance Programme by spelling out more explicitly the role and responsibility of the Quality Assurance Committee, and the components of the Quality Assurance Programme.

## REGULATION OF TRADITIONAL AND COMPLEMENTARY MEDICINE

(<http://www.gov.sg/moh/mohiss/tcm/tcmrpt.html>)

Various Complementary and Alternative Medicines (CAM) are available locally, including Traditional Chinese Medicine (TCM) which is more established and popular than the other therapies like reflexology, aromatherapy, homeopathy, chiropractic and osteopathy. There are close to 200 non-TCM CAM establishments registered with the Registry of Companies and Businesses (RCB), with an estimated 2,500 of such practitioners. MOH aims to progressively regulate the practice of CAMs. The first stage of the regulation plan involves the registration of acupuncturists, followed by TCM physicians and then herbal dispensers. Under the TCM Practitioners Act 2000, which came into effect on 7 Feb 01, all acupuncturists practising in Singapore must be registered with the TCM Practitioners Board, the regulatory body overseeing the registration and professional conduct of TCM practitioners.

Passing the Common Acupuncture Qualifying Examination (CAQE) is a mandatory requirement for registration. However, citizens and permanent residents of Singapore who were already practising acupuncture in Singapore at the time the TCM Practitioners Act 2000 came into effect were considered for various exemptions from CAQE under a transitional registration framework based on their qualifications and practise experience. About 1,600 acupuncturists applied for registration. Under the framework, about 63% of them were fully exempted from CAQE. About 22% of the applicants who had relatively less qualifications and experience were partially exempted and were registered only after they had passed an acupuncture appraisal examination. About 7% were required to undergo the Acupuncture Upgrading Training Course and sit for the CAQE thereafter. The remaining 8% of the applicants were unsuccessful. As of 31 Dec 01, there were 1,448 registered acupuncturists in Singapore (see Table 7.2).





Table 7.2: Registered Acupuncturists, 2001

	Female	Male	Total	%
<b>Age</b>				
Below 30	7	6	13	0.9
30-39	112	101	213	14.7
40-49	233	290	523	36.1
50-59	150	342	492	34.0
60-69	38	137	175	12.1
70 & above	10	22	32	2.2
<b>Work Status</b>				
Full time	283	519	802	55.4
Part time	211	316	527	36.4
Working in non-TCM field	0	3	3	0.2
Not working	56	60	116	8.0
<b>Registration Status</b>				
Full registration	449	717	1,166	80.5
Provisional registration	97	177	274	18.9
Conditional registration	4	4	8	0.6
<b>Total</b>	<b>550</b>	<b>898</b>	<b>1,448</b>	<b>100.0</b>

### Training Course for Chinese Medicinal Materials Herbal Dispensers

To prepare for the eventual registration of CMM herbal dispensers after the registration of acupuncturists and TCM physicians, MOH worked with the TCM Practitioners Board and the Singapore TCM Organisations Committee (STOC), the umbrella body representing the main local TCM trade associations, to formulate a training course to upgrade the professional standard of CMM herbal dispensers.

TCM experts from People's Republic of China were invited in Dec 01 to advise MOH on the structure, contents, curriculum and the actual implementation of the training course.

### REGULATION OF DRUGS AND HEALTH-RELATED PRODUCTS

The Centre for Pharmaceutical Administration (CPA) is an arm of HSA responsible for ensuring the safety of the use of drugs and health-related products such as Chinese proprietary medicines, cosmetic products and health supplements in Singapore. CPA conducts surveillance, investigation and enforcement to ensure that the regulated products, premises and professionals comply with the legal requirements of the Medicines Act, the Poisons Act, the Sale of Drugs Act, the Medicines (Advertisement and Sale) Act and the Misuse of Drugs Regulations.

### Western Medicinal Products

319 new western medicinal products were licensed for use locally, and 1,746 of such product licenses were renewed. The sale of the cholesterol lowering drug Lipobay®, which contains the active drug "cerivastatin" was suspended following the worldwide withdrawal of the drug by the manufacturer. The withdrawal of this drug was prompted by the high incidence of rhabdomyolysis, a potentially fatal muscular side effect, especially in patients taking another cholesterol lowering drug gemfibrozil.

Of the 1,080 samples of registered western medicines tested in 2001, 11 (1.0%) failed to meet the quality specifications. The corresponding figure for the previous year was 0.7%.

The guidelines for declassification of medicinal products, and for recording and tracking of blood derived products, were reviewed. The framework for regulating health and dietary supplements was being developed to monitor the quality and safety of this group of products, which is increasingly being used by Singaporeans.



## Drug Safety and Adverse Drug Reaction Monitoring

For the year 2001, 551 adverse drug reaction (ADR) cases were reported – a record number indicating good response of health care professionals to the reporting system. Of which, about 20% were serious ADR. Specific classes of drugs with potential safety concerns, including cox-2 inhibitors; amphetamine like anorectics, statins, serotonin re-uptake inhibitors and bupropion, were evaluated to determine their risk profile. To facilitate the dissemination of information on drug safety to health care professionals, an electronic channel of communication with health care professionals is being developed.

## Clinical Trials

The number of clinical trials conducted in Singapore has been increasing steadily over the past few years (see Table 7.3).

The regulatory framework for clinical trials was being reviewed to improve accountability, streamline the review procedures and optimise the use of resources.

The clinical trials framework was also being reviewed to improve the efficiency of the approval process and the protection of trial subjects.

**Table 7.3: Number of Approved Clinical Trials\* from 1997 to 2001**

Phase	Year					Total
	1997	1998	1999	2000	2001	
I	3	2	11	21	19	56
II	7	12	16	44	50	129
III	10	49	57	63	68	247
IV	22	36	30	29	28	145
Total	42	99	114	157	165	577

\* number of sites involved in clinical trials.

## Chinese Proprietary Medicines

The control of Chinese Proprietary Medicines (CPM) under the Medicines Act was implemented in phases over 3 years, with the first phase of control on tablets and capsules introduced in Sep 1999. This was extended to cover liquid preparations in Sep 2000 and all other dosage forms in Sep 01. Henceforth all CPM products are subject to the evaluation of safety and quality, and must meet full labelling requirements before they are allowed for local sale. In addition, all importers, wholesalers, local manufacturers and re-packers of CPM must be licensed to operate. As of 31 Dec 01, 8,855 CPM products had been approved. Of the 360 samples of CPM tested in 2001, 16 (4.4%) failed to meet the quality specifications. The corresponding figure for the previous year was 6.6%.

A comprehensive database on CPM products and their dealers has been established to facilitate both product recall and enforcement of regulation. The surveillance and enforcement had prevented attempts to import several CPM products adulterated with sildenafil, the active ingredient of Viagra®, into Singapore.

### Cosmetic Products

In 2001, 8,972 cosmetic product licenses and 99 import licenses were issued. 49 applications were rejected due to presence of prohibited substances including some colour additives and excipients. 2,620 cosmetic product licenses and 176 cosmetic import licenses were also renewed.

The classification of hair-dyes was revised to make hair-dyes containing diamines, which were previously 'Pharmacy-Only' preparations, available in general retail stores. The guidelines for cosmetic products with bovine-derived ingredients were reviewed and tightened to minimise the risk associated with Bovine Spongiform Encephalopathy (BSE).

### Pharmaceutical Manufacturers and other Premises

Manufacturers and assemblers of pharmaceutical, CPMs and cosmetics products are licensed, and their premises are regularly inspected for high standards of manufacturing practices. In 2001, 14 western medicinal products manufacturers/assemblers were licensed, and another 14 for CPM and 2 for cosmetic products manufacturers/assemblers.

During the year, the following licenses and certificates, among others, were also processed and issued:

- 54 Wholesale Dealer's Licenses for medicinal products
- 100 Wholesale Dealer's Licenses for CPMs
- 41 Wholesale Dealer's Licenses for Controlled Drugs
- 199 Retail Pharmacy Certificates

In addition, 287 Certificates of Pharmaceutical Product were issued to facilitate the registration or export of pharmaceutical products overseas.



### Surveillance and Enforcement

A number of public complaints and feedback were investigated during the year. The important cases included those involving the sale of counterfeit Viagra(R), CPMs and health supplements adulterated with sildenafil, the active ingredient of Viagra(R). Other cases involved youth enhancing formulas, health supplements with unsubstantiated medical claims and the illegal import of medicines, especially midazolam.

The surveillance and investigations carried out in 2001 resulted in the compounding of 107 cases, the majority of which (70 cases) involved medicinal products. In addition, 15 cases were successfully prosecuted in court by HSA's lay prosecutors.

### Tobacco Products and Retailers

HSA's CPA administers the Smoking (Control of Advertisements and Sale of Tobacco) Act which has provisions for the regulation of the use of tobacco by youths under 18 years old, packaging and advertising of tobacco products, contents of cigarettes, and licensing of tobacco retailers.

As of Dec 01 the number of tobacco retail licensees totalled 7,620. During surveillance of retail outlets, 37 retailers were caught selling cigarettes without valid licenses and enforcement action was subsequently taken against the offenders. The enforcement laws against underage-smokers was intensified with increased surveillance carried out after office hours. Of the 1,608 underage youths caught for smoking or possession of cigarettes, 796 were compounded and 92 were prosecuted in court. About 99% of cigarettes sold locally have tar and nicotine content within legal limit.

### EVALUATION OF FOOD, COSMETICS AND DRUGS

The Centre for Analytical Science (CAS) was established in Apr 01 under HSA. It provides analytical services for the quality and safety of food, cosmetics and drugs, the protection of the environment, cigarette testing, industrial health, and the testing of tariff items. It is recognised as a WHO Collaborating Centre for monitoring of food contaminants and drug quality assurance. It is also accredited by the Singapore Accreditation Council under the Singapore Laboratory Accreditation Scheme.

## EVALUATION OF NEW DRUGS

The Centre for Drug Evaluation (CDE) was established in 1998 with the aim to encourage the pharmaceutical industry to set up R&D bases in Singapore, thereby developing the nation into a country of origin for new and innovative drugs. The CDE also complements the role of CPA in the evaluation of new therapeutic substances for safety and efficacy before they are registered for use in the local market. In 2001, CDE received 9 new drug applications for evaluation, bringing the total number of products evaluated to 18.

The 3 expert panels of CDE for pharmacy/chemistry, pharmacotoxicology and clinical evaluations together comprise 180 scientists and clinicians from local universities, hospitals and research institutes.

## REGULATION OF NEW MEDICAL DEVICES

The Centre for Medical Device Regulation (CMDR) administers the regulation of various medical devices in Singapore for their safety, quality and efficacy. CMDR has been working with the industry in developing a regulatory framework for medical devices, ready for implementation by 2003.

CMDR administers the Contact Lens Practitioners Act which requires contact lens practitioners in Singapore be registered and to have their practice regulated. In 2001, there were 409 licensed contact lens practitioners.

## REGULATION OF THE USE OF RADIATION

The Centre for Radiation Protection (CRP) is the national regulatory authority for the safe use of ionising and non-ionising radiation in Singapore. It administers the Radiation Protection Act and its subsidiary regulations through a system of licensing and inspection. Licenses are issued for the import, export, possession and use of irradiating apparatus and radioactive materials, and for the transport of radioactive materials. In 2001, 19,366 licenses were issued.

Premises using irradiating apparatus or radioactive materials are inspected regularly for their compliance with legal requirements. In tandem with the nation-wide promotion on breast screening by MOH, CRP implemented quality control (QC) tests in 2001 on mammography x-ray machines and educating end users of these machines on QC procedures.



## ENSURING THE QUALITY OF BLOOD PRODUCTS

The Centre for Transfusion Medicine (CTM) introduced Nucleic Acid Testing (NAT), ( the current state of art screening for Hepatitis C and HIV) since Oct 00 which has improved the safety of our blood products. CTM is currently developing a national blood transfusion guideline to reduce inappropriate blood transfusions. CTM is also looking into the development of a national haemovigilance system to detect complications related to blood transfusion.

In 2001, CTM worked closely with WHO to host the workshop on the WHO blood bank quality management project, which was attended by more than 30 representatives from different countries. CTM also started the preparation for Singapore to host the WHO first blood bank Quality Management Training (QMT) course for the Western Pacific region in Apr 02.

## FORENSIC MEDICINE AND SCIENCE

The Centre for Forensic Medicine (CFM) supports the police and Coroner for the investigation of death under the Criminal Procedure Code. Post-mortem examinations are conducted to determine the cause of death in sudden, unnatural and violent circumstances. CFM also provides consultation on medico-legal examination of the living such as alcoholic intoxication, child abuse and sexual offences.

The Centre for Forensic Science (CFS) provides a wide-range of forensic science services to law enforcement agencies, government ministries, private organisations and individuals for criminal investigations and civil disputes. In Jun 01, CFS was re-accredited in the disciplines of controlled substances, toxicology, trace evidence, serology, DNA, firearms/toolmarks and questioned documents by the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB), an international benchmark accreditation scheme.

# Chapter 8 Medical Research

## NATIONAL MEDICAL RESEARCH COUNCIL

(<http://www.nmrc.gov.sg>)

The mission of the National Medical Research Council (NMRC) is to improve the health of Singaporeans through promoting and funding medical research in Singapore.

### Council Members and Structure

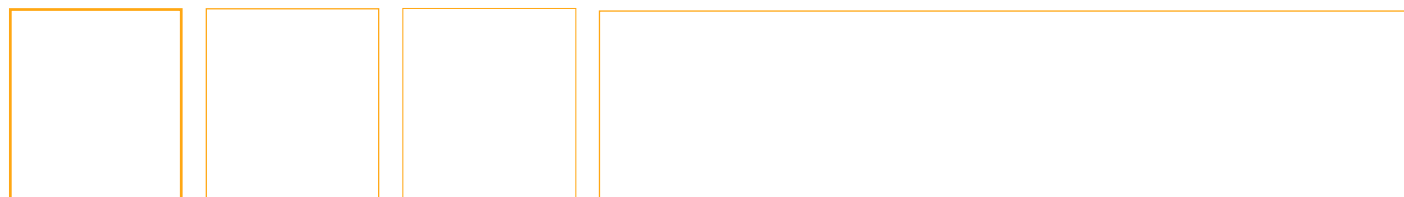
The current Council was appointed by the Minister for Health on 3 Feb 2000 for a 3-year term. The Council is chaired by Prof Lim Yean Leng, Director, National Heart Centre. It comprises local and overseas medical experts and representatives from the universities and leading medical and scientific institutions in Singapore such as the National University of Singapore (NUS), Nanyang Technological University (NTU), Agency for Science, Technology and Research (A\*STAR), Genome Institute of Singapore (GIS), Lilly-NUS Centre for Clinical Pharmacology, National Cancer Centre (NCC), National Neuroscience Institute (NNI) and Kent Ridge Digital Laboratories.

A Research Committee (RC) was subsequently appointed by the Council in June 2000 to provide scientific inputs to assist the Council in making funding decisions, in particular to support the peer review of research grant applications and the evaluation of other grant applications including

those for the NMRC-Singapore Totalisator Board (STB) Medical Research Fellowship/Scientist Award and institutional block grant. The RC also makes recommendations to the Council on policy matters regarding medical research in Singapore. It comprises experts from universities, restructured hospitals and national specialty centers and institutions and is authorized to approve research grants up to \$250,000 each. Beyond this figure, the Council's approval will have to be sought.

The Council's peer review have to process for research grant applications was further enhanced with the setting up of 10 Peer Review Subcommittees in FY 2001. The Peer Review Subcommittees are organized by field of research as follows:

- (i) Immunology/Microbiology,
- (ii) Pathology/Inflammation/Oncology/Nuclear Medicine,
- (iii) Biochemistry/Cell Biology,
- (iv) Epidemiology/Health Sciences/Public Health & Health Services,
- (v) Peripheral, Central, Sensory & Cellular Nervous System/Mental Health,
- (vi) Genetics/Paediatrics/Reproduction,
- (vii) Cardiovascular/Respiratory,





- (viii) Renal/Endocrine/Pharmacology,
- (ix) GIT/Liver/Nutrition,
- (x) Dentistry/Surgery.

Each Subcommittee is chaired by a member of the RC and consists of leading researchers in their respective research field.

Fellowship Subcommittee was also set up to assist the Council in the evaluation of applications for the NMRC-STB Medical Research Fellowship/Scientist Award.

### Funding Amounts

In FY 2001, the expenditures for research projects and programmes were \$14.580m and \$37.167m respectively. The expenditure for protected time was \$3.041m. The Singapore Totalisator Board (STB) co-sponsors medical research by generously funding 25% of NMRC's research needs, up to a ceiling of \$5m a year. In addition, the STB provides up to \$2m a year for medical research fellowships and medical research scientist awards for doctors and scientists to carry out medical research projects in their area of interest as well as in disease areas that are of priority in Singapore. 15 awards were given out in FY2001, amounting to \$1.971m.

### Research Project Applications

The NMRC has received 1,517 research grant applications since FY1994. In FY2001, 232 applications were received from 3 funding exercises and 117 were approved as at 31 Mar 02. The list of projects approved in FY2001 is in Appendix 3. The list of research publications in FY2001 resulting from research projects and programmes is in Appendix 4.

### Deliverables of the NMRC

The progress and outcome of research projects and programmes are monitored by means of progress reports submitted on a yearly basis and final reports submitted upon the completion of the project. Since FY2000, indicators were also established to assist the Council in monitoring and evaluating the progress and outcome of NMRC-funded research projects and programmes. The parameters monitored include the following:

- (i) The volume of research activities, as measured by the number of research projects funded and completed, the number of presentations and publications and the number of patents filed and awarded.

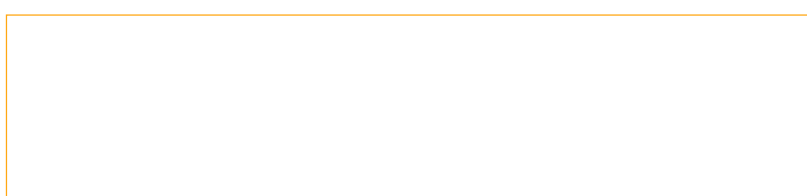
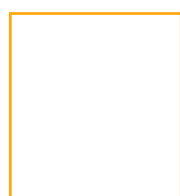
- (ii) The quality of research, as determined by the number of publications in top 20% of journals, and the number of external awards for research and other types of international recognition.
- (iii) The development of research manpower, as determined by the quantum of funding for the research fellowships/scientist awards, the protected time scheme; academic outputs achieved from the funding, i.e. PhD, MSc students trained or PhDs/Post-doctoral positions employed under the various funding activities.
- (iv) The development of collaborative research activities between local researchers, as measured by the number of research outputs from local inter-institutional research collaborations.
- (v) The development of research infrastructure, as measured by the number of research facilities developed through NMRC funding and the number of research groups using these research infrastructures.
- (vi) The commercialisation of research outputs, as measured by the number of patents out-licensed or developed commercially and the number of spin-off companies resulted from NMRC funded research.

### Institutional Block Grants and Research Programmes

The Council provides funding through Institutional Block Grants (IBG) to restructured hospitals and public research institutions to support core research manpower and facilities, as well as research programmes. The IBG funding also enhances collaborations between institutions and different research teams. Table 8.1 shows the distribution of IBG funding in FY2001 by institution and research programme.

**Table 8.1 Distribution of IBG Funding by Institution and Research Programme, FY2001**

Institution/Programme	Amount (\$)
CTERU	2,800,000
IMH	200,000
KKH	100,000
NCC	9,816,800
NHC	800,000
NNI	3,500,000
NUMI	4,740,000
NUS Block Vote	200,000
SERI	4,000,000
SGH-DCR	1,800,000
SGH-DES	368,000
TTSH-CRU	520,000
Hepatitis Research	250,000
National Birth Defects Registry	250,000
NNI-TTSH Animal Facilities	265,000
Nursing Research Committee	90,000
Singapore Cardiac Data Bank	1,000,000



### National Cancer Centre (NCC)

(<http://www.ncc.com.sg>)

With the objective of fostering and supporting cancer research that aim to benefit clinical care and strengthen Singapore's biomedical industry, NCC continued its efforts in improving cancer prevention, detection and management. This in turn contributed to the ultimate goal of achieving excellence in healthcare in Singapore.

The NCC received an amount of \$9.8m through IBG funding in FY2001 to support its core research activities. In addition, another 12 research projects were approved through Individual Research Grants totaling \$3.5m in FY2001.

As of 31 Mar 02, there were 123 ongoing projects and 21 ongoing clinical trails in NCC. The research projects and programmes have resulted in 81 publications and presented 40 papers at international conferences. Six patents were filed in FY2001.

### National Heart Centre (NHC)

(<http://www.nhc.com.sg/research1.htm>)

Research activities at NHC include projects on prevention of coronary heart diseases including identification of risk factors, and early diagnosis and drug therapies to combat coronary heart

diseases, as well as studies to address the quality of life of patients who suffer from coronary heart diseases.

On-going research at NHC include the following:

- (i) Asia Pacific Myocardial Infarction Trial (APAMIT)- Pilot Study
- (ii) Characterization of Alpha 1-adrenoceptor subtypes in human coronary artery bypass grafts
- (iii) Development of platelet inhibitors for the treatment of coronary heart disease
- (iv) Inter-Heart - A Global study of risk factors in acute myocardial infarction
- (v) Genetic effects of apo(a) and apoE in coronary heart disease (CHD) in Singapore populations.

In addition, about 10 clinical trials were on-going and they involved new drugs, new therapeutic devices and alternative treatment to coronary heart diseases. Among these ongoing trials in FY 2001, APAMIT and INTER-HEART were funded under the above NMRC IBG grant. Other research projects at NHC involve the investigation on genetic polymorphism of atherosclerosis, anti-proliferative drugs and gene therapy, stem cell research for repair of damaged myocardium and the prevention of restenosis.

National Neuroscience Institution (NNI)

(<http://www.nni.com.sg/services/research.htm>)

The Epidemiology and Clinical Research Unit was set up in NNI in FY2001 to support clinical trials and other clinical research activities at the NNI. Through the funding support from the NMRC, research laboratories for the research scientists and NNI-TTSH Animal Research Laboratory (ARL) were set up. The Animal Research Laboratory (ARL) aim to develop a Small Animal Research Facility to cater to the needs of TTSH and NNI. The Facility is scheduled to operate in early Apr 02.

As of 31 Mar 02, 17 NMRC-funded projects were on-going at NNI and 2 were completed. In addition, 7 clinical trials and 4 other projects funded by other external sources were being conducted.

National University Medical Institutes (NUMI)

(<http://numi.nus.edu.sg>)

The National University Medical Institutes (NUMI) focused its efforts on the development of research programmes in cancer and cardiovascular diseases, as well as the development of centralised research facilities and services to support the research carried out by researchers primarily from the Faculty of Medicine, NUS.

The NUMI provides a range of research services such as confocal microscopy, DNA sequencing, flow cytometry, *in situ* hybridization, transgenic and knockout facilities, as well as supporting services such as biostatistical consultancy, laboratory supplies, media preparation and medical communication workshops.

There were 8 ongoing research projects funded by NMRC in NUMI as of 31 Mar 02. 29 publications had resulted from the research projects.



Singapore Eye Research Institution (SERI)

(<http://www.shec.com.sg/education/seri.htm>)

The Singapore Eye Research Institute conducts and coordinates clinical and laboratory-based research in ophthalmology and the vision sciences at national and international levels. Its main aim is to improve the vision of the people at risk and reduce the impact of sight-threatening disorders of particular relevance in Singapore and Asia.

With international and commercial collaborations, researchers at SERI also undertake research to develop new ophthalmic technologies and products with commercial impact. In FY2001, SERI doctors and scientists published new findings on the development of myopia in schoolchildren, with the identification of excessive near work as an environmental risk factor, and tested novel ocular drug delivery systems for cataract surgery and corneal transplant rejection.

Other published work included new findings and treatments for Asian glaucoma, new important findings on retinal microvascular changes in stroke patients, and studies on the etiology and prevalence of pterygium, a common Asian corneal and ocular surface disorder. SERI doctors and scientists published 56 scientific publications in FY2001.

Clinical Trials and Epidemiology Research Unit (CTERU)

(<http://www.cteru.gov.sg>)

CTERU serves as a national clinical trial centre that provides clinicians and scientists with the necessary expertise and infrastructure in the conduct of multicentre clinical trials, epidemiological studies and systematic reviews to meet international standards for design, conduct, analysis and reporting. It also conducts training courses in the area of clinical and epidemiologic research methodology, statistical analysis and use of software, evidence-based medicine and clinical practice guideline development.

In FY 2001, eleven new clinical trials started with patient recruitments and 30 studies were ongoing in FY2001. There were 14 papers presented at local and international conferences and 14 publications were resulted in FY2001.

Department of Clinical Research (DCR),  
Singapore General Hospital (SGH)

([http://www.sgh.com.sg/clinical\\_specialties/clinical\\_research\\_ambul.html](http://www.sgh.com.sg/clinical_specialties/clinical_research_ambul.html))

Major activities in the Department of Clinical Research (DCR) in FY2001 included the setting up of DCR's Neurobiology Laboratory and Multiple Myeloma Research Laboratory, where new facilities such as electrophysiology and behavioural equipment, as well as basic equipment for proteomics analysis were made available to researchers in the hospital.

The DCR continued to serve as a core research facility in SGH. It awarded 33 small research grants in FY2001 and held regular seminars and journal club presentations, as well as participated in laboratory training workshops.

Main research areas in the department were neurodegeneration and neuroregeneration studies, stem cells, multiple myeloma, progesterone receptor gene therapy and its molecular mechanisms, gene expression and translation and molecular genetics. There were 15 publications resulting from the DCR research projects in FY2001.

Department of Experimental Surgery (DES),  
Singapore General Hospital (SGH)

([http://www.sgh.com.sg/research/registry/re\\_main\\_experi.html](http://www.sgh.com.sg/research/registry/re_main_experi.html))

In line with the government's life sciences initiative and to meet the increasing demand for research facilities in the cluster, the Department of Experimental Surgery embarked on a programme to improve and expand existing facilities to support animal research. The department assessed whether the improved facilities met the physical requirements and complied with best international standards. This is to facilitate their efforts in achieving accreditation with **AAALAC** (Association for Assessment and Accreditation of Laboratory Animal Care International).

A joint DES-SERI primate facility was also set up in the SGH campus to meet the research needs of DES and SERI. In addition, a cadaveric repository was set up for cadaveric research. This would allow planned collection of cadaveric material and minimise wastage in cadaveric materials.

In FY 2001, the department conducted 31 research projects and 21 surgical skills training workshop courses. The department also hosted training courses in collaboration with local hospitals and institutions such as SERI, NCC, NHC, NUH, NUMI, and NTU and overseas collaborators which included the Royal College of Surgeons, Edinburgh; the AO Center, Switzerland and the British Orthopaedic Association.



### Other Research Programmes

Other research programmes funded by the NMRC were in the areas of nursing research, hepatitis research and mental health research. In addition, NMRC funded national disease registries such as the Singapore Cardiac Data Bank and the National Birth Defects Registry.

### Protected Time Scheme

The guidelines and application forms of the Protected Time Scheme were revised in FY2001 to streamline the administration of the scheme. The funding of protected time is project-based and is only open to principal investigators of NMRC-funded research projects. The expenditure on protected time amounted to \$3.041m in FY2001.

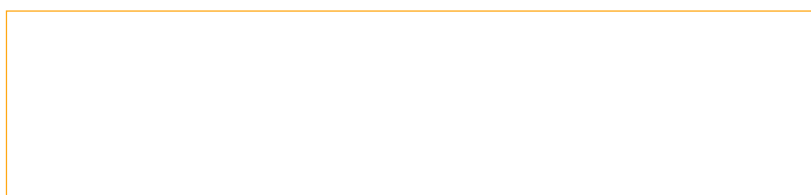
### NMRC-STB Medical Research Fellowship/Scientist Award

The NMRC-Singapore Totalisator Board (STB) Medical Research Fellowship is fully sponsored by the STB to enable doctors and scientists to carry out medical research in their area of interest. The award also allows those who are interested in pursuing a career in research to obtain postgraduate research degrees from reputable overseas universities and research institutes.

A Fellowship Sub-committee was set up in FY2001 to evaluate applications for the Fellowship/Scientist Award and make funding recommendations to the Council. Fifteen awards were given away in FY 2001 which comprised 12 fellowships and 3 scientist awards. The projects undertaken are listed as follows:

- (i) The relationship of angiogenic factors and the hypoxic stimulus on dendritic cell function and development in tumours
- (ii) The comparison of patients, treatments and outcomes within the GUSTO trials
- (iii) The genetic basis of primary angle closure glaucoma
- (iv) The biomechanical behaviour of the patella and patella implants in total knee arthroplasty

- (v) Arterial calcification examination (ACE) trial and the National ESRD clinical performance Measures Project
- (vi) Near infrared Raman spectroscopic analysis of tissues in the head and neck. To study the potential of this technique as a means of obtaining an "optical biopsy" of tissues in the head and neck including the larynx, nasopharynx and thyroid gland.
- (vii) DNA microchip array genome-wide analysis in disease and risk evaluation for childhood acute lymphoblastic leukaemia
- (viii) Metals and prion diseases
- (ix) Production of a panel of FISH probes along the Y chromosome to determine Y structural anomalies in male infertility
- (x) Neuropsychological & electrophysiological responses in neurological disease
- (xi) Cartilage regeneration by tissue engineering approach
- (xii) Matrix metalloproteinases and their inhibitors in the nervous system
- (xiii) Sensitivity and specificity of serum procalcitonin and cerebrospinal fluid cytokines: tumor necrosis factor-alpha, interleukin-1b and interleukin-8 in the primary evaluation of patients with bacterial versus non-bacterial meningitis
- (xiv) Protein interactions in tyrosine kinase signaling and metazoan development
- (xv) Tumour immunotherapy: Hypoxia regulated peptides as immune targets





### Overseas Visitors

Professor Warwick Anderson, Chairman of the Research Committee of National Health and Medical Research Committee (NHMRC), Australia stopped over in Singapore on 26 and 27 June on-route to Melbourne from Paris. During the 2-day visit, besides discussions with Chairman and staff of the NMRC, Prof. Andersen met with Mr Philip Yeo, Chairman, Economic Development Board (EDB), Prof Louis Lim, Executive Director, Biomedical Research Council and the officers of EDB and Agency of Science, Technology and Research (A\*STAR). The main purpose of his visit was to explore opportunities in developing links and collaborations in health and medical research, biotechnology, peer review and research strategies between Singapore and Australia.

Mr M Edhie Sulaksono, senior research scientist of National Institute of Health Research & Development, Ministry of Health, Indonesia visited the NMRC office as part of his programme under the SEAMIC Travel Research Fellowship. During his visit, Mr Sulaksono met Chairman, NMRC and had a presentation by the Secretariat staff on the functions and operation of the NMRC, including the Peer Review and Project Management databases.

### NMRC Secretariat

The Secretariat continued to support the Council in FY2001. It embarked on initiatives to streamline the administrative processes, to enhance the project management as well as to strengthen the accountability framework of NMRC-funded projects and programmes. Recruitment of staff to meet its full establishment and the sourcing of a new office space to house the Secretariat were also underway.

### CLUSTER RESEARCH FUND

In FY2001, the Ministry established the Cluster Research Fund (CRF) to directly provide each cluster with a research grant, to allow them to have some autonomy in setting the direction of the research efforts of their institutions. Under the CRF, \$5 million was allocated to each cluster.

The objectives of the CRF are:-

- (i) to develop clinical research capabilities, e.g. provide funding support for young or first-time investigators who may have difficulty obtaining funds through NMRC, and
- (ii) to support research which contribute directly to improving patient care, e.g. provide funding for the employment of statisticians to support patient-focused clinical research.

# Appendix 1 Infectious Diseases Which Are Notifiable To The Respective Ministries Under The Infectious Diseases Act

## Ministry of Health

*Notifiable within 72 hours of diagnosis*

- AIDS/HIV
- Chancroid
- Genital herpes
- Gonorrhoea
- Leprosy
- Non-gonococcal Urethritis
- Syphilis
- Tuberculosis

## Ministry of the Environment

*Notifiable within 24 hours of diagnosis*

- Cholera
- Dengue Fever/  
Dengue Haemorrhagic Fever
- Encephalitis
- Hand, Foot and Mouth Disease
- Legionellosis
- Malaria
- Nipah Virus Infection
- Paratyphoid
- Plague
- Typhoid
- Yellow fever

*Notifiable within 72 hours of diagnosis*

- Chickenpox
- Diphtheria
- Hepatitis, viral
- Measles
- Mumps
- Poliomyelitis
- Rubella

## Appendix 2 Private Hospitals And Medical Clinics Regulation

### SECOND SCHEDULE

#### SPECIALISED PROCEDURES OR SERVICES IN PRIVATE HOSPITALS

1. Blood and blood product collection, processing, storage, distribution and transfusion services (including Autologous blood transfusion)
2. Assisted reproduction services
3. Neonatal intensive care unit
4. Nuclear medicine, imaging and assay services
5. Renal dialysis
6. Sperm banking
7. Radiation oncology
8. Tissue banking

### THIRD SCHEDULE

#### SPECIAL CARE SERVICES IN MEDICAL CLINICS

1. Blood and blood product collection, processing, storage, distribution and transfusion services (including Autologous blood transfusion)
2. Ambulatory surgery (including minimally invasive surgery and laparoscopy)
3. Endoscopy
4. Assisted reproduction services
5. Lithotripsy
6. Renal dialysis
7. Special cardiac investigation
8. Specialised diagnostic radiology

## Appendix 3 Research Projects Approved by NMRC

Project No	Project Title	Amount	PI	Dept	Inst
F2/S037/NHC/ 013/2001	Genetic effects of apo(a) and apoE in coronary heart disease (CHD) in Singapore populations	\$198,000.00	Xiong Zhuo Wei		NHC
NMRC/0507/2001	The use of p27 and other molecular markers in predicting survival in colorectal cancer	\$135,000.00	Cheah Peh Yean	Colorectal Surgery	SGH
NMRC/0508/2001	Using tissue engineering to produce biologically active bone allografts for orthopaedic surgery and oral and maxillo-facial surgery	\$173,900.00	Nather Aziz	Orthopaedic Surgery	NUS
NMRC/0509/2001	Studies of progesterone receptor (PR)-gene therapy in PR-negative breast cancer	\$226,000.00	Lin Valerie	DCR	SGH
NMRC/0510/2001	A single-centre observational study to evaluate trends in resource utilisation and cost on patients with acute myocardial infarction	\$89,100.00	Mak Koon Hou	Cardiology	NHC
NMRC/0511/2001	Ethnic differences in polymorphisms in candidate genes associated with asthma severity	\$63,850.00	Tan Wan Cheng	Medicine	NUS
NMRC/0512/2001	Prevalence of germline mutations in the hMLH1 and hMSH2 genes in Singaporean colorectal cancer patients suspected clinically to have hereditary non-polyposis colorectal cancer and correlation with clinical and family history & tumor microsatellite status	\$178,300.00	Lee Soo Chin	Med Oncology	NUH
NMRC/0513/2001	Clinical manifestations of food allergy - a double blind, placebo controlled food challenge study	\$171,400.00	Yeoh Kian Hian	Otolaryngology	NUH
NMRC/0514/2001	Angiotensin peptides and arteriovenous graft-induced neointimal hyperplasia and stenosis	\$75,000.00	Sim Meng Kwoon	Pharmacology	NUS
NMRC/0515/2001	Detection of disease-specific epitopes in pityriasis rosea, pityriasis lichenoides chronica, urticaria and mycosis fungoides using a screening phage displayed random peptide library	\$115,000.00	Goon Teik Jin Anthony	Dermatology	NSC
NMRC/0516/2001	Nasopharyngeal carcinoma: 3D imaging for staging and treatment planning	\$196,400.00	Chong Fook Hin Vincent	Diagnostic Radiology	SGH
NMRC/0517/2001	Short stay chest pain evaluation and treatment unit (CPETU) project - ACTION (Acute chest pain treatment and evaluation study)	\$190,500.00	Lim Swee Han	Emergency Medicine	SGH
NMRC/0518/2001	The effect of angiotensin converting enzyme (ACE) inhibitor and angiotensin receptor blocker (ARB) on the endothelial and renal function of subjects with type 2 diabetes	\$129,966.00	Lim Su Chi	Endocrinology	AH

Project No	Project Title	Amount	PI	Dept	Inst
NMRC/0519/2001	Application of microarray technology to divulge the molecular mechanisms of drug resistance in mycobacteria	\$249,000.00	Gopalakrishnakone P.	Anatomy	NUS
NMRC/0520/2001	Assessment of endothelial factors in stroke using skin biopsy	\$151,010.00	Wilder-Smith Einar	Medicine	NUS
NMRC/0521/2001	Carcinogenic heterocyclic amines in the Chinese diet: development of an instrument for exposure assessment in population-based studies	\$211,850.00	Koh Woon Puay	COFM	NUS
NMRC/0522/2001	Pharmacokinetic study of thalidomide in patients with unresectable hepatocellular carcinoma; an extension of phase II clinical trial of thalidomide in the treatment of unresectable hepatocellular carcinoma by cancer therapeutics research group	\$60,000.00	Lee How Sung	Pharmacology	NUS
NMRC/0523/2001	Combining serial analysis gene expression and array technology to identify novel temozolomide responsive and resistance genes in Asians with malignant gliomas	\$188,500.00	Zhu Cong Ju	DMS	NCC
NMRC/0524/2001	The biological markers of alcoholism: a comparative study of the alcohol dehydrogenase and aldehyde dehydrogenase systems in Indian and Chinese alcohol dependent patients	\$30,000.00	Lim Leslie	Psychological Med	IMH
NMRC/0525/2001	The investigation of expression of Forkhead family of transcription factors in human skin	\$45,000.00	Wong Soon Tee	Medicine	NUS
NMRC/0526/2001	Cloning of structural genes for the biosynthesis of antitumour anthracycline antibiotics by the actinomycete isolates NS3-166 and NC4 obtained from soil in Singapore. Characterisation of the chemical compounds produced by them	\$80,000.00	Nga Been Hen	Microbiology	NUS
NMRC/0527/2001	Vasomotor reflex testing in healthy volunteers	\$61,200.00	Wilder-Smith Einar	Medicine	NUS
NMRC/0528/2001	A study to assess the affect of glaucoma on postural control with age matched normal subjects	\$47,450.00	Chew Tec Kuan Paul	Ophthalmology	NUH
NMRC/0529/2001	Development of bio-compatible artificial nerve growth guidance conduit for optic nerve transplantation	\$246,600.00	Xiao Zhi Cheng	DCR	SGH
NMRC/0530/2001	Regulation of mucosal permeability and tight junction proteins in intestinal epithelial cells in inflammation	\$187,100.00	Ooi Choon Jin	Gastroenterology	SGH
NMRC/0531/2001	Development of an objective scar assessment by measuring colour and oxygen tension in scars	\$130,000.00	Song Colin	Plastic Surgery	SGH

Project No	Project Title	Amount	PI	Dept	Inst
NMRC/0532/2001	The application of Osseo-integrated bone anchored hearing aids in the rehabilitation of irradiated NPC patients with hearing impairment	\$148,000.00	Murugasu Euan	Otolaryngology	TTSH
NMRC/0533/2001	Practical Bayesian methods for clinical trials	\$187,250.00	Tan Say Beng	CTE	NCC
NMRC/0534/2001	Chemotherapy induced glioma endothelial cell global gene expression	\$195,000.00	Zhu Cong Ju	DMS	NCC
NMRC/0535/2001	Expression and functional studies on venom nerve growth factor	\$254,000.00	Jeyaseelan K	Biochemistry	NUS
NMRC/0536/2001	Role of OP 1 in enhancing anterior lumbar interbody fusion using allografts	\$304,967.00	Nather Aziz	Orthopaedic Surgery	NUS
NMRC/0537/2001	Trans-rectal prostate biopsy - a precise biopsy device for accurate prostate biopsy	\$295,000.00	Cheng Christopher Wai Sam	Urology	SGH
NMRC/0538/2001	Evaluation of the role of neural cell adhesion and extracellular matrix molecules in modulating sodium channels during axonal development and regeneration: molecular mechanisms and therapeutic application for neurogenic pain and multiple sclerosis	\$797,667.00	Xiao Zhi Cheng	DCR	SGH
NMRC/0539/2001	Effector mechanisms that enhance sensitivity of tumor cells to drug-induced apoptosis	\$512,000.00	Pervaiz Shazib	Departments of Physiology & Medicine	NUS
NMRC/0540/2001	Growth and apoptosis of islet beta-cells during depletion of cellular GTP by inhibition of IMP dehydrogenase	\$598,400.00	Li Guo Dong		NUMI
NMRC/0541/2001	Purification and characterization of growth inhibitor (BEGI) for breast cancer cells	\$646,168.00	Huynh The Hung		NCC
NMRC/0542/2001	Studies on the role of AIK1 as an oncogene in the development of ovarian cancer	\$474,000.00	Gopalan Ganesan	CMR	NCC
NMRC/0543/2001	A study into the cytogenetic determinants of tumor behaviour in gastric adenocarcinoma (GA) using comparative genomic hybridization (CGH)	\$452,804.00	Lim Dennis Teck Hock		NCC
NMRC/0544/2001	Epidemiology and prevention of unintentional childhood injuries in Singapore	\$143,715.00	Ang Su Yin Angelina	Emerg Med	KKH
NMRC/0545/2001	Molecular studies and development of diagnostic tests for the periodontal diseases in Singapore	\$127,000.00	Song Keang Peng	Microbiology	NUS
NMRC/0546/2001	Shortening quality-of-life measurement scales: methods and application to cancer research	\$59,500.00	Cheung Yin Bun	CTES	NCC

Project No	Project Title	Amount	PI	Dept	Inst
NMRC/0547/2001	A pilot study of adenosine deaminase levels and M. tuberculosis polymerase chain reaction assays in the diagnosis of tuberculosis in patients infected with the human immunodeficiency virus (HIV)	\$90,335.00	Paton Nicholas I.J.	Infectious Diseases	TTSH
NMRC/0548/2001	Signal Transduction Pathways mediated by Mycobacteria Heat Shock Protein 65	\$176,300.00	Gan Yunn Hwen	Biochemistry	NUS
NMRC/0549/2001	Role of adenosine in cell death.	\$88,000.00	Tan Chee Hong	Biochemistry	NUS
NMRC/0550/2001	Digital pre-training for microsurgery	\$197,524.00	Lim Beng Hai	Hand Surgery	NUS
NMRC/0551/2001	Role of Phospholipase-A2 Inhibitors and/or it's Antibodies in the Pathogenesis and Prevention of Surgically Induced Adhesions	\$169,516.00	Ratha Mahendran	Surgery	NUH
NMRC/0552/2001	Cytokines and Inflammatory Response in Coronary Artery Bypass Graft Surgery: Is Non-pump method better than cardiopulmonary bypass technique?	\$66,800.00	Ong Biauwei Chi	Anaesthesia & SIC	SGH
NMRC/0553/2001	Analysis of 'homing' specificity of Endothelial Progenitor Cells to angiogenic sites of tumor, as a platform for future cell delivery of therapeutic genes	\$126,000.00	Moore Xiao Lei	Medical Science	NCC
NMRC/0554/2001	Development of non-pathogenic lactobacillus as a potential vector.	\$179,700.00	Bay Boon Huat	Anatomy	NUS
NMRC/0555/2001	Pro-inflammatory and anti-inflammatory cytokines profiles in rheumatoid arthritis patients: Effect of methotrexate and genotype.	\$178,250.00	Fong Kok Yong	Medicine	NUS
NMRC/0556/2001	Tandem duplications of the FLT3 receptor gene-association with adult acute myeloid leukemia.	\$40,000.00	Lim Lay Cheng	Haematology	SGH
NMRC/0557/2001	Epidemiology of Mycobacterium tuberculosis: development of a semi-automated, fluorescent-based strain-typing system suitable for construction of a digital database	\$78,700.00	Richard Bellamy	Infectious Diseases	TTSH
NMRC/0558/2001	Regulation of Serine/Threonine Protein Kinase PRK1 in Health and Diseases.	\$296,000.00	Duan Wei	Biochemistry	NUS
NMRC/0559/2001	Inhibition of proteasomal function as a mechanism of cell death in neurodegenerative disease. Induction by reactive oxygen species and the role of nitric oxide.	\$273,207.00	Halliwel Barry	Biochemistry	NUS
NMRC/0560/2001	Agonists and Antagonists of aquaporins and related ion channels from toxins	\$375,000.00	Jeyaseelan K	Biochemistry	NUS
NMRC/0561/2001	Non-invasive prenatal diagnosis using fetal erythroblasts derived from first trimester maternal blood.	\$449,970.00	Choolani Mahesh A	Obsterics & Gynaecology	NUS

Project No	Project Title	Amount	PI	Dept	Inst
NMRC/0562/2001	Genetic polymorphisms of the IL-13 gene and IL-13 receptor complex genes in minimal change nephrotic syndrome of childhood	\$281,450.00	Gong Wei Kin	Paediatrics	NUS
NMRC/0563/2001	Characterisation of the genetics and complications of childhood obesity in Singapore	\$350,105.00	Lee Yung Seng	Paediatrics	NUS
NMRC/0564/2001	Multidisciplinary approach to design of a potent anti-inflammatory agent for therapeutic applications	\$240,100.00	Gopalakrishnakone P.	Anatomy	NUS
NMRC/0565/2001	Use of synthetic porous biodegradable polymer sheets for ligament tissue engineering	\$197,400.00	Goh James Cho Hong	Orthopaedic Surgery	NUS
NMRC/0566/2001	An investigative study on the efficacy of a novel anti-reflux biliary-enteric bypass construction in an animal model	\$57,500.00	Chow Kah Hoe Pierce	General Surgery	SGH
NMRC/0567/2001	Sebum measurements among different ethnic group in Singapore correlations to acne severity	\$22,000.00	Yosipovitch Gil		NSC
NMRC/0568/2001	Intra-articular injection of microsphere-encapsulated chondroitin sulphate for the treatment of osteoarthritis in a rabbit model.	\$149,240.00	Hui James Hoi Po	Orthopaedic Surgery	NUS
NMRC/0569/2001	Effectiveness of nurse clinician case manager and telemedicine in the management of patients with uncontrolled diabetes mellitus.	\$29,800.00	Tan Chee Eng	Endocrinology	SGH
NMRC/0570/2001	Identification of putative tumour suppressor genes involved in the carcinogenesis of breast and colorectal cancer.	\$199,600.00	Lee Ann, Siew Gek	Division of Medical Sciences	NCC
NMRC/0571/2001	Computational Modelling of Biological Signaling Pathways	\$60,000.00	Tan Patrick	Biomedical Science Lab	DMRI
NMRC/0572/2001	Risk factors of Depression in Elderly People	\$93,000.00	Chiam Peak Chiang	IMH	WH
NMRC/0573/2001	An epidemiological Study of Depression in Singapore	\$92,800.00	Chua Hong Choon	Dept of Psychiatric Rehabilitation	IMH
NMRC/0574/2001	Prevention of Restenosis After Stent Placement Using Retroviral Cell-Mediated Gene Therapy	\$122,500.00	Reida El Oakley	Cardiac	NUH
NMRC/0575/2001	Analysis of Parkin Gene Mutations in Parkinson's Disease	\$135,500.00	Tan Eng King	Neurology	SGH
NMRC/0576/2001	Structure / function analysis of p53 in vivo	\$626,375.00	Sabapathy Kanaga	CMR	NCC
NMRC/0577/2001	Vascular endothelial growth factor and receptor expression in cerebral arteriovenous malformations (AVM) of the brain	\$376,493.00	Ng Puay Yong	Neuroradiology	NNI
NMRC/0578/2001	Brain tissue oxygenation in acute brain injury	\$490,729.00	Ng Ivan	Neurosurgery	NNI
NMRC/0579/2001	Determination of the role of iron in the cell death of dopaminergic neurons in hemi-parkinsonian rats	\$749,990.00	Soong Tuck Wah	Research	NNI



Project No	Project Title	Amount	PI	Dept	Inst
NMRC/0580/2001	The Actions of Natriuretic Peptides in Human Vascular Smooth Muscle Cells Isolated From Internal Mammary Arteries and Saphenous Veins	\$213,868.00	Wei Chiming	Surgery	NHC
NMRC/0581/2001	Structural and functional studies of glutamate receptor proximal N-terminal domain	\$1,886,098.00	Low Chian Ming		NNI
NMRC/0582/2001	A Singapore Nation-wide study in Childhood Acute Lymphoblastic Leukemia incorporating Minimal Residual Disease based risk-stratification, Pharmacogenomic study of Thiopurine Methyltransferase deficiency and establishment of a cell bank.	\$1,494,350.00	Yeoh Eng Juh Allen	Paediatrics	NUS
NMRC/0583/2001	Functional analysis of Ncr1p, a NPC1 ortholog in the yeast <i>Saccharomyces cerevisiae</i> .	\$480,200.00	Yang Robert Hong Yuan	Biochemistry	NUS
NMRC/0584/2001	Identification of the proteins involved in intracellular trafficking of lysosomal/late endosomal cholesterol.	\$454,930.00	Li Qiu-Tian	Biochemistry	NUS
NMRC/0585/2001	Construction of DNA and protein databases and development of potential therapeutic agents from toxin genes	\$378,000.00	Jeyaseelan K	Biochemistry	NUS
NMRC/0586/2001	Genetic variability of estrogen receptor genes and human reproductive disorders	\$291,850.00	Roy Ashim C	O & G	NUS
NMRC/0587/2001	Epidemiology of the meningococcal transmission during Hajj 2001: Investigation of the epidemic strain of <i>Neisseria meningitidis</i> by Multilocus Sequence Typing.qn	\$42,030.00	Wilder-Smith Annelies	Infectious Diseases	TTSH
NMRC/0588/2001	The atopy patch test to aeroallergens and <i>pityrosporum orbiculare</i> in patients with atopic dermatitis	\$84,640.00	Goon Teik Jin Anthony	Dermatology	NSC
NMRC/0589/2001	Correlation of the duration of untreated illness with structural brain abnormalities and cognitive impairment in patients with first-episode psychosis.	\$73,860.00	Chong Siow Ann		WH/IMH
NMRC/0590/2001	Gas Chromatography/Mass Spectrometry Analyses of Cholesterol and Cholesterol Oxidation Products(COPs) in the Rat Hippocampus after Kainate Induced Neuronal Injury and Toxicity of COPs in Hippocampal Slice Cultures.	\$67,100.00	Ong Wei Yi	Anatomy	NUS
NMRC/0591/2001	Role of neuronal growth inhibitory molecules on brain tumours: development of a novel therapeutic approach	\$130,360.00	Xiao Zhi Cheng	DCR	SGH
NMRC/0592/2001	Host-bacteria and bacteria-bacteria interactions in human gastrointestinal tract	\$155,430.00	Lee Yuan Kun	Microbiology	NUS
NMRC/0593/2001	Epitope Specificity of GAD Autoantibodies in immune-mediated diabetes	\$46,620.00	Ng Wai Yoong	Medicine	NUS
NMRC/0594/2001	Proteomics in human diseases: Application to hepatocellular carcinoma (HCC).	\$64,260.00	Chung Ching Ming Maxey	Biochemistry	NUS

Project No	Project Title	Amount	PI	Dept	Inst
NMRC/0595/2001	Development of therapeutic antibodies, compounds, and vaccine with neuronal growth inhibitory molecules for axon regeneration of spinal injury	\$125,360.00	Xiao Zhi Cheng	DCR	SGH
NMRC/0596/2001	Identification and therapeutic use of the peptides of tenascin-R for neuroprotection after CNS injury	\$155,360.00	Xiao Zhi Cheng	DCR	SGH
NMRC/0597/2001	Mechanism, pathophysiology and possible treatment options for female sexual disorders	\$62,130.00	Adaikan P. Ganesan	O&G	NUS
NMRC/0598/2001	Characterisation and functional Exploration of a novel gene, hepn1, whose expression is down regulated in 79% (72/91) of human hepatocellular carcinoma	\$163,030.00	Shen Shali	Physiology	NUS
NMRC/0599/2001	The roles of endothelin receptors expressed in neurons and microglia in the acute phase of brain ischemia.	\$206,640.00	Wong Peter T.H.	Pharmacology	NUS
NMRC/0600/2001	Is Oxidative DNA damage a predictor of cancer development?	\$242,300.00	Halliwell Barry	Biochemistry	NUS
NMRC/0601/2001	The gene expression profile underlying endothelial dysfunction in a microvascular stroke syndrome	\$124,740.00	Shen Yi	Neurology	SGH
NMRC/0602/2001	A prospective, randomised, double cross-over trial of continuous venovenous haemodialysis (CVVHD) vs. haemofiltration (CVVH) in critically ill acute renal failure (ARF) patients: impact on extracorporeal circuit lifespan	\$111,510.00	Tan Han Khim	Renal Med	SGH
NMRC/0603/2001	Effects of metformin, rosiglitazone and diet with exercise on regulation of menstrual cyclicity in Asian women with Polycystic Ovarian Syndrome - A pilot study	\$17,370.00	Choo Wan Ling	O&G	NUH
NMRC/0604/2001	Characterization of clinical and therapeutic outcomes in high-risk primary breast cancers using quantitative measurements of telomerase activation	\$189,000.00	Rajan Sandeep Kumar	Medical Oncology	NCC
NMRC/0605/2001	A 3-year multiphasic prospective study on deliberate self harm (parasuicide) behaviour in Singapore	\$31,500.00	Chua Hong Choon	Dept of Psychiatric Rehabilitation	IMH
NMRC/0606/2001	NURR1 gene mutations in Parkinson's disease	\$125,060.00	Tan Eng King	Neurology	SGH
NMRC/0607/2001	Molecular Genetics Programme in neuromuscular diseases	\$1,040,880.00	Yee Woon Chee	Neurology	NNI
NMRC/0608/2001	Oxidative stress in neuronal injury: Functional genomic and proteomic analyses in cultured neurones from genetically manipulated mice.	\$314,030.00	Cheung Nam Sang	Biochemistry	NUS
NMRC/0609/2001	Expression profiling in human biliary atresia in comparison to other paediatric cholestatic disorders	\$516,600.00	Tan Eng Looi Carolyn	Paediatric Surg	KKH
NMRC/0610/2001	Influence of extra-cellular micro-environment on cellular dynamics for tissue engineering.	\$156,560.00	Yu Hanry	Physiology	NUS

Project No	Project Title	Amount	PI	Dept	Inst
NMRC/0611/2001	Characterization of Differentially Expressed Genes from CD8+ Th2 cells in Children with Idiopathic Nephrotic Syndrome in relapse and remission	\$195,370.00	Yap Hui Kim	Paediatrics	NUH
NMRC/0612/2001	Evaluation of metallothioneine as a molecular and prognostic biomarker of breast cancer	\$63,000.00	Bay Boon Huat	Anatomy	NUS
NMRC/0613/2001	Anti-microbial and anti-parasitic peptides in scorpion hemolymph and venom	\$229,950.00	Jeyaseelan K	Biochemistry	NUS
NMRC/0614/2001	The Osteoarthritis in Asian Twins (OATS) study: the contribution of genetic and environmental factors to the prevalence of osteoarthritis in Asians	\$157,300.00	Thumboo Julian	Medicine	NUS
NMRC/0615/2001	A randomised controlled trial to compare steroid with cyclosporine for the topical treatment of oral lichen planus (renewal)	\$41,070.00	Seldrup Jorgen	CTERU	
NMRC/0616/2001	Role of histone deacetylases in colorectal carcinogenesis and metastasis	\$124,430.00	Hooi Shing Chuan	Physiology	NUS
NMRC/0617/2001	The biochemical characteristics of the tendons of the hand - a human cadaveric study	\$44,100.00	Ooi Lai Hock	Hand and Reconstructive Microsurgery	NUH
NMRC/0618/2001	Platelet Endothelial Cell Adhesion Molecule Polymorphism and Cardiovascular Disease Risk in Singaporeans.	\$1,998,180.00	Chatterjee Subroto	Pediatrics	NHC
NMRC/0619/2001	The efficacy of BMP-7 & TGF-beta1 in directing the transformation of Mesenchymal stem cells into bone - an in vitro study	\$79,620.00	Wong David HC	Orthopaedic Surgery	NUS
NMRC/0620/2001	Acetylcysteine in the Prevention of Renal Impairment in Coronary Procedures(APRICate)	\$34,650.00	Wong Philip		NHC
NMRC/0621/2001	Investigating ion channel gene mutations and expression in hypokalemic thyrotoxic periodic paralysis	\$234,000.00	Lee Kok Onn	Medicine	NUS
NMRC/0622/2001	Analysis of long term results of cleft lip and palate patients using the cleft palate information system (CPIS) : Phase 2	\$213,890.00	Lee Seng Teik	Plastic Surgery	SGH
<b>Total Amount:</b>		<b>\$28,746,707.00</b>		<b>Total Number:</b>	<b>117</b>

# Appendix 4 Publications Resulting from Research Programmes And Projects Funded by NMRC

- 1 Tai BC, Machin D, White IR and GebSKI V on behalf of the European Osteosarcoma Intergroup.  
Competing Risks Analysis of Patients with Osteosarcoma: A comparison of Four Different Approaches.  
Stat Med 2001;20: 661-84
- 2 Tai BC, Peregoudov A and Machin D on behalf of the United Nations Development Programme/United Nations Population Fund World Health Organization/World Bank Special Programme of Research, Development and Research Training in Human Reproduction.  
A competing risk approach to the analysis of trials of alternative intrauterine devices (IUDs) for fertility regulation.  
Stat Med 2001;20:3589 – 600
- 3 Tang CL, Eu KW, Tai BC, Soh JGS, Machin D and Seow-Choen F  
A randomised controlled trial of open versus laparoscopically-assisted colectomy on systemic immunity in patients with colorectal cancer.  
Br J Surg 2001;88:80 -7
- 4 Chong YS, Chua S, El-Refaey H, Choo WL, Chanrachakul B, Tai BC, Rodeck C, Arulkumaran S.  
Postpartum intrauterine pressure studies of the uterotonic effect of oral misoprostol and intramuscular syntometrine.  
Br J Obstet Gynaecol 2001;108: 41-7
- 5 Ip-Yam PC, Goh MH, Chan YH, Kong CF.  
Clinical evaluation of the Mapleson theoretical ideal fresh-gas flow sequence at the start of low-flow anaesthesia.  
Anaesthesia 2001;56:160-4
- 6 Chua L, Chong SA, Pang E, Ng VPY, Chan YH.  
The effect of Risperidone on Cognitive Functioning in a sample of Asian Patients with Schizophrenia in Singapore.  
Singapore Med J 2001;42:243 - 6
- 7 Sim K, Rajasoorya C, Sin Fai Lam KN, Chew LS, Chan YH.  
High Prevalence of Psychiatric Morbidity in a Medical Intensive Care Unit.  
Singapore Med J 2001;42:522-5
- 8 Yosipovitch G, Widijanti Sugeng M, Goon A, Chan YH, Goh CL.  
A comparison of the combined effect of cryotherapy and corticosteroid injections versus corticosteroids and cryotherapy alone on keloids: a controlled study.  
J Dermatol Treatment 2001;12:87-90
- 9 Yosipovitch G, Kaplan I, Calderon S, David M, Chan YH, Weinberger A.  
Distribution of oral mucosal pH on the buccal, tongue, lip and palate: A study in healthy volunteers and patients with Lichen Planus, Behcet's disease and Burning Mouth Syndrome.  
Acta Derm Venereol 2001;81:178-180
- 10 Parker G, Chan YH, Koh ES.  
Factors contributing to frequent admissions of patients with schizophrenia.  
Singapore Nurs J 2001;28:28-33
- 11 Yosipovitch G, Sugeng MW, Chan YH, Goon A, Ngim S, Goh CL  
The Effect of Topical Applied Aspirin on Localize Circumscribed Neurodermatitis.  
J Am Acad Dermatol 2001;910-3
- 12 Lee J, Heng D, Chia KS, Chew SK, Tan BY, Hughes K.  
Risk factors and incident coronary heart disease in Chinese, Malay and Asian Indian males: the Singapore Cardiovascular Cohort Study.  
Int J Epidemiol 2001;30:983-8
- 13 Teoh G  
The role of CD40 in the discovery of tumour-specific antigens  
SGH Proceedings 2001;9(3):174-180
- 14 Koh LP, Goh YT, Teoh G, Tan P  
Treatment of acute promyelocytic leukaemia using a combination of all-trans-retinoic-acid and chemotherapy  
Ann Acad Med Singapore 2001;30:401-408
- 15 ASG Lee, LLH Tang, IHK Lim, SY Wong  
Novel mutations in ndh in isoniazid-resistant Mycobacterium tuberculosis isolates  
Antimicrob Agents Chemother 2001;45(7)
- 16 Valerie C-L Lin, Swee Eng Aw, Eng Hen Ng, Esther H-L, Sanaul H Chowdbury  
Effect of progesterone on the invasive properties and tumor growth of progesterone receptor (PR) transfected breast cancer cells MDA-MB-231  
Clin Cancer Res, 2001;7:2880-2886
- 17 Ling Moi Lin, Wang Grace, Toh Say Ling  
Pulsed-field gel electrophoresis characterisation of Salmonella enterica serotype enteritidis PT4 isolates from chicken, food and human specimens  
SGH Proceedings 2001;10(2):93-96

- 18 MKP Lai, OF Lai, J Keene, MM Esiri, PT Francis, T Hope, CPLH Chen  
Psychosis of Alzheimer's disease is associated with elevated muscarinic M2 binding in the cortex  
*Neurology* 2001;57:805-811
- 19 Katie Kazarinova-Noyes, Jyoti Dhar Malhotra, Dyke P McEwen, Laura N Mattei, Erik O Berglund, Barbara Ranscht, S Rock Levinson, Melitta Schachner, Peter Shrager, Lori L Isom, Zhi Cheng Xiao  
Contactin associates with Na<sup>+</sup> channels and increases their functional expression  
*J Neurosci* 2001;21(19):7517-7525
- 20 Lie Kuo Liem, Lina Hui Lin Choong, Keng Thye Woo  
Action of dipyridamole and warfarin on growth of human endothelial cells cultured in serum-free media  
*Clin Biochem* 2001;34:141-147
- 21 Woo KT, Lau YK  
Proteinuria: Clinical significance and basis for therapy  
*Singapore Med J* 2001;42(8):385-389
- 22 Valerie C-L. Lin, Swee Eng Aw, Eng Hen Ng, Esther H-L, Michelle G-K. Tan  
RU486 inhibits cell growth via mechanisms distinct from that of progesterone in breast cancer cells transfected with progesterone receptor cDNA  
*Br J Cancer* 2001;85(12):1978 -1986
- 23 OF Lai, SC Ho, PHK Eng, et al.  
A comparison of adipogenesis induced by Grave's ophthalmopathy and normal serum in anterior orbital and 3T3-L1 fibroblasts  
*J. Endocrinol. Invest.*24 (Suppl. to no.6): 200  
European Thyroid Association Meeting 2001, Warsaw, Poland
- 24 Oon Chong Jin, Chen Wei Ning  
Defense of blood supplies  
*Supplement to Medical Progress* 2001;28(7):105-108
- 25 Oon Chong Jin, Chen Wei Ning  
Hepatitis B virus surface antigen mutants and their significance  
*Supplement to Medical Progress* 2001;28(7):85-88
- 26 Chen Wei Ning, Oon Chong Jin, Lim Gek Keow  
Frequent occurrence of hepatitis B virus surface antigen mutants in subtype adw in vaccinated Singapore infants  
*Vaccine* 2001:1-2
- 27 Wei Ning Chen, Chong Jin Oon, Kian Sim Goo  
Hepatitis B virus X protein in the proteasome of mammalian cells: defining the targeting domain  
*Mol Biol Rep* 2001;28:31-34
- 28 Teo EC, Ng HW  
Evaluation Of The Role Of Ligaments, Facets And Disc Nucleus In Lower Cervical Spine Under Compression And Sagittal Moments Using Finite Element Method.  
*Med Eng Phys* 2001;23:155-164
- 29 Teo EC, Paul JP, Evans JH, Ng HW  
Experimental Investigation Of Failure Load And Fracture Patterns Of C2 (Axis).  
*J Biomech* 2001;34:1005-1010
- 30 Rohner D, Yeow V, Hammer B  
Endoscopically Assisted Le Fort I Osteotomy  
*J Cranio-Maxillofacial Surg* 2001;29:337-343
- 31 Rohner D, Yeow V, Hammer B  
Repair of Zygomatico-Maxillary Defects With Free Bone Grafts And Free Vascularised Tissue Transfer  
*J Cranio-Maxillofacial Surg* 2001;29:337-343
- 32 Yang EB, Zhao YN, Zhang K, Mack POP  
Microsatellite Alteration In Human Hepatocellular Carcinoma Infected With Hepatitis B Virus  
*Int J Oncol* 2001;19:513-518
- 33 Yang EB, Guo YJ, Zhang K, Chen YZ, Mack POP  
Inhibition Of Epidermal Growth Factor Receptor Tyrosine Kinase By Chalone Derivatives  
*Biochim Biophys Acta* 2001;19:144-152
- 34 Tan BK, Hung CC, Fu CW, Shou FM  
Formation Of Independantly Revascularised Bowel Segments Using The Rectus Abdominis Muscle Flap: A Rat Model For Jejunal Prefabrication  
*Plast Reconstr Surg* 2001;109(2):655-663
- 35 Ang ESW, Ng TH, Song IC, Irene HCKee  
2-Octylcyanoacrylate Assisted Microvascular Anastomosis: Comparison With A Conventional Suture Technique In Rat Femoral Arteries  
*J Reconstr Microsurg* 2001;17(3):193-201
- 36 Zhang K, May C, Yang EB, Kim PW, Mack POP  
Modulation Of Cisplatin Cytotoxicity And Cisplatin Induced DNA Cross-Links In HepG2 Cells By Regulation Of Glutathione-Related Mechanism.  
*Mol Pharmacol* 2001;59:837-843

- 37 Yeo SJ, Yung SW, Kwoh CK, Wong TS, Ng WS, Teo MY  
Augmented Reality With X Ray Localisation For Total  
Hip Replacement.  
SGH Proceedings 2001;9(4):250-259
- 38 Wasser S, Lim GY, Ong CN, Tan CEL  
Anti-oxidant ebselen causes the resolution of  
experimentally-induced hepatic fibrosis in rats  
J Gastroenterol Hepatol 2001;16:1244-1253
- 39 Liu J, Yang CF, Wasser S, Shen HM, Tan CEL  
and Ong CN  
Protection of *Salvia miltiorrhiza* against aflatoxin-B1  
induced hepatocarcinogenesis in Fischer 344 rats: dual  
mechanisms involved  
Life Sci 2001;69(3):309-326
- 40 Ali SM, Olivo.M, Gan YY and Soo K.C  
Photodynamic induced apoptosis of human  
nasopharyngeal carcinoma cells using Hypocrellins.  
Int J Oncol 2001;19(3):633-643
- 41 Ali SM, Olivo. M, Gan YY, Soo KC  
Induction of apoptosis by Hypericin through activation of  
caspase-3 in human carcinoma cells.  
Int J Mol Medicine 2001;8(5):521-530.
- 42 Ali SM, Olivo M, Gan YY, Soo KC  
Hypericin and Hypocrellin induced apoptosis in human  
mucosal carcinoma cells.  
E. J. Photochem Photobiol B. 2001;65(1):59-63.
- 43 Ang P, Tan EH, Leong SS, Koh LCL, Eng P, Agasthian T,  
Cheah FK  
Primary Intrathoracic Malignant Effusion – a  
descriptive study.  
Chest 2001;120:50-54
- 44 Ang P and Garber JE  
Genetic susceptibility for breast cancer-risk assessment  
and counseling.  
Semin Oncol. 2001;28:419-433
- 45 Au E, Koo WH, Kee KS, Chua EJ, Soo KC,  
Seow-Choen F, Low CH, Ng BK, Hoe M  
Adjuvant postoperative 5-fluorouracil chemotherapy  
combined with pelvic radiation for rectal cancer: Result  
form an Asian population.  
Cancer Investigation. 2001;19(4):340-345.
- 46 Balram C, Khoo KS.  
High-Dose Methotrexate In Fibroblastic Osteosarcoma.  
Ann of Pharmacotherapy 2001;35:1669
- 47 Behrens, A, K. Sabapathy, I. Graef, M. Cleary, G.  
Crabtree and E.F. Wagner  
Jun N-terminal kinase 2 modulates thymocyte apoptosis  
and T cell activation through c-Jun and nuclear factor of  
activated T cell (NF-AT).  
Proc Natl Acad Sci U S A 2001;98(4):1769-1774
- 48 Brown SR, Ballan K, Ho E, Ho YH, Seow-Choen F  
Stapled mucosectomy for acute thrombosed  
circumferentially prolapsed piles: A prospective  
randomized comparison with conventional  
haemorrhoidectomy.  
Br J Surg 2001;3:175-178
- 49 Brown SR, Donati D, Seow-Choen F, Ho YH  
Biofeedback avoids surgery in patients with slow transit  
constipation: Report of four cases.  
Dis Colon Rectum 2001;44:737-738
- 50 Brown SR, Donati D and Seow-Choen F  
Rectal cancer after mucosectomy for ileoanal pouch in  
familial adenomatous polyposis: report of a case.  
Dis Colon Rectum 2001;44(11):1714-1715
- 51 Brown SR, Eu KW, Seow-Choen F  
Consecutive series of laparoscopic assisted vs  
minilaparotomy restorative proctocolectomies.  
Dis Colon Rectum 2001;44:397-400
- 52 Brown SR, Seow-Choen F, Eu KW, Heah SM  
and Tang CL  
Prospective randomized of drains in infra-peritoneal  
rectal anastomosis.  
Tech Coloproct 2001;5:89-92
- 53 Cao X, Eu KW, Seow-Choen F and Zhao Y  
Topoisomerase-I- and Alu-mediated genomic deletions of  
the APC gene adenomatous.  
Hum Genet 2001;108:436-442
- 54 Chan MGTW, Huynh H  
Induction of mammary epithelial cell differentiation and  
inhibition dimethylbenz(A)anthracene-induced mammary  
tumour by co-administration of a pure anti oestrogen ICI  
182780 and testosterone enanthate.  
Int J Oncol. 2001;19(2):263-269.
- 55 Chan MGTW, Pollak M, Huynh, H.  
Inhibition of insulin-like growth factor signaling pathways  
in mammary gland by pure anti-estrogen ICI 182780.  
Clin Cancer Res. 2001;7(8):2545-2554

- 56 Cheung YB, Tan SB, Khoo KS  
The need for collaboration between clinicians and statisticians: some experience and examples.  
*Ann Acad Med Singapore* 2001;30:552-555
- 57 Cheung YB  
Adjustment for selection bias in cohort studies.  
*J Clin Epidemiol* 2001;54(12):1234-1239
- 58 Chong VFH, Rumpel H, Fan YF, Mukherji SK  
Temporal Lobe Changes Following Radiation Therapy: Imaging and Proton MR Spectroscopic Findings.  
*Eur Radiol.* 2001;11:317-324
- 59 Chow P.K., Huynh, H., and Soo, K.C.  
Estrogen receptor status in inoperable hepatocellular carcinoma.  
*Am J Gastroenterol* 2001;96:1297-1298
- 60 Gao F, Machin D, Khoo KS and Ng EH  
Seasonal variation in breast cancer diagnosis in Singapore.  
*Br J Cancer* 2001;84(9):1185-1187
- 61 Gao Hui and Kam M. Hui  
Synthesis of a novel series of cationic lipids that can act as efficient gene delivery vehicles through systematic heterocyclic substitution of cholesterol derivatives.  
*Gene Ther* 2001;8(11):855-863
- 62 Heah SM, Eu KW, Ooi BS, Ho YH and Seow-Choen F  
Tumour size is irrelevant in producing malignant potential of carcinoid tumour of the rectum.  
*Tech Coloproct* 2001;5:73-78
- 63 Ho YH, Seow-Choen F, Tan M  
Colonic J-Pouch function at six months versus straight coloanal anastomosis at 2 years: Randomized Controlled Trial.  
*World J Surg* 2001;25:876-881
- 64 Ho YH, Seow-Choen F  
Randomized clinical trial of micronized flavonoids in the early control of bleeding from acute internal haemorrhoids.  
*Br J Surg* 2001;87:1732-1733
- 65 Ho YH, Seow-Choen F, Tsang C and Eu KW  
Randomized trial assessing anal sphincter injuries stapled haemorrhoidectomy.  
*Br J Surg* 2001;88(11):1449-1455
- 66 Ho KS, Tsang C, Seow-Choen F, Ho YH, Tang CL, Heah SM and Eu Kw  
Prospective randomized trial comparing ayurvedic cutting seton and fistulotomy for low fistula-in-ano.  
*Tech Coloproct* 2001;5:137-141
- 67 Huynh H, Alpert L, Lair DW, Batist G, Benlimame, Alaoui-Jamali MA  
Regulation of the Gap junction connexin 43 gene by androgens in the prostate.  
*J of Mol Endocrinol* 2001;1:1-10
- 68 Huynh H, Ng CY, Lim KB, Ong CK, Ong CS, Tran E, Tuyen Nguyen TT, Chan TW  
Induction of (UO-44) gene expression by tamoxifen in the rat uretus and ovary.  
*J Endocrinol* 2001;142(7):2985-2995
- 69 Huynh H, Alpert L, Alaoui-Jamali M.A., Chan MGTW, and Ng CY  
Co-administration of finasteride and the pure anti estrogen ICI 182780 act synergistically in modulating IGF system and PSA in rat prostate.  
*J Endocrinol* 2001;171:109-118
- 70 Huynh H, Ng CY, Lim KB, Ong CS, Tran E, Nguyen TTT and Chan MTW Mark  
Induction of UO-gene expression by tamoxifen in the rat uterus and ovary.  
*J Endocrinol* 2001;142(7):2985-2995
- 71 Huynh H, Lim KB, Ng CY, Ong CK, Tran Evelyne, Nguyen TT Tuyen, Chan TW Mark  
Cloning and characterization of a novel pregnancy induced growth inhibitor (OKL38) in the mammary gland.  
*J Endocrinol* 2001;142(8):3608-3615
- 72 Karuman P, Gozani O, Odze RD, Zhou XC, Zhu H, Shaw R, Brien TP, Bozzuto CD, Ooi D, Cantley LC, Yuan J  
The Peutz-Jegher gene product LKB1 is a mediator of p52-dependent cell death.  
*Mol Cell* 2001;7(6):1307-1319
- 73 Kraemer M, Wiratkapun S, Seow-Choen F, Ho YH, Eu KW, Nyam D  
Stratifying risk factors follow-up: A comparison of recurrent and non-recurrent colorectal cancer.  
*Dis Colon Rectum.* 2001;44:815-821
- 74 Kush A and Sabapathy K  
Oxy5, a novel protein from Arabidopsis thaliana, protects mammalian cells from oxidative stress.  
*Int J Biochem Cell Biol* 2001;33(6):591-602
- 75 Lee ASG  
A clinician's guide to the human genome project.  
*SGH Proceedings* 2001;9(3): 154-159.

- 76 Lee ASG, Lee TKY, Tohari S, Chang APC, Wang J, Shen YW, TT Yeo, Khoo J  
Loss of heterozygosity of the chromosomal region 11q22-q23 in primary tumours of the central nervous system.  
Front in Hum Genet: Dis and Technol 2001;225-232
- 77 Lee ASG, Teo ASM, Wong SY  
Novel mutations in *ndh* in isoniazid-resistant *Mycobacterium tuberculosis* isolates.  
Antimicrob Agents Chemother 2001;45:2157-2159
- 78 Leong SS, Tan EH, Wee J, HS Khoo Tan, TL Yang, SH Tan, WT Poh NG Tan  
Recurrent nasopharyngeal carcinoma presenting as diffuse dermal lymphatic infiltration in the neck: 3 case reports.  
Head Neck 2001;23(2):160-5
- 79 Lim K.B, Ng C.Y, Ong C.K, Ong C.S, Tran E., Nguyen T.T.T, Chan T.W Mark and Huynh H.  
Induction of apoptosis in mammary gland by pure anti-estrogen ICI 182780.  
Breast Cancer Res Treat 2001;68:127-138
- 80 Marcantonio D, Moulay A, Chalifour L, Huynh H  
SSG1 is an androgen regulated gene expressed in prostatic smooth muscle cell *in vivo*.  
J Mol Endocrinol 2001;26(3):175-184
- 81 Marcantonio D, Moulay A, Chalifour L, Huynh H  
Cloning and characterization of a novel gene that is regulated by estrogen and is associated with mammary gland carcinogenesis.  
Endocrinol 2001;142(6):2409-2418
- 82 Maw A, Heah SM, Eu KW, Seow-Choen F  
Novel use of the purse string endoscope for transanal surgery.  
Tech Coloproct. 2001;5:19-22
- 83 Ng WS, Kassim MI, Phee SJ, Nadier OK, Teng MH, Tan IC, Seow-Choen F and Davies BL  
Colonoscopy with automated locomotion.  
SGH Proceedings 2001;9(3):163-169
- 84 Olivo M, Soo KC  
Review: Photodynamic Therapy Comes of Age.  
SGH Proceedings 2001;9(3):197-201.
- 85 Ooi BS, Eu KW, Seow-Choen F  
Primary anorectal malignant melanoma: Clinical features and results of surgical therapy in Singapore - A case series.  
Ann Acad Med Sing 2001;30:203 – 205
- 86 Ouyang X, Gulliford T, Zhang H, Smith G, Huang G and Epstein RJ  
Association of ErbB2 Ser1113 phosphorylation with epidermal growth factor receptor co-expression and poor prognosis in human breast cancer.  
Mol Cell Biochem 2001;218:47-54
- 87 Ouyang X, Gulliford T, Huang GC, Harper-Wynne C, Shousha and Epstein RJ  
Multisite phosphoty핑 of the ErbB2 oncoprotein in primary breast cancer.  
Mol Diagnosis 2001;6:17-25
- 88 Parker G, Gao F and Machin D.  
Seasonality of suicide in Singapore: data from the equator.  
Psychol Med 2001;30(3):549-553
- 89 Pasupathy S, Eu KW, Ho YH, Seow-Choen F  
A comparison between versus laparoscopic assisted colonic pouches for rectal cancer.  
Tech Coloproct. 2001; 5:19-22
- 90 Rajan S and Liebman HA  
Treatment of Hepatitis C related Thrombocytopenia with interferon alpha: A patient series and review of literature.  
Am J Hematol 2001;68:202-209
- 91 Rumpel H, Khoo JBK, Chang HM, Lim WE, Chen C, Wong MC, Tan KP.  
Correlation of the apparent diffusion coefficient and the creatine level in early ischemic stroke: A comparison of different patterns by magnetic resonance.  
J Magn Reson Imaging 2001;13(3):335-43
- 92 Sabapathy K  
Structure/function analysis of the tumour-suppressor gene, p53, *in vivo*.  
SGH Proceedings 2001;9(3):170-173
- 93 Sabapathy K, Kallunki T, David JP, Karin M and Wagner EF  
c-Jun NH(2)-Terminal Kinase (JNK)1 and JNK2 Have Similar and Stage-dependent Roles in Regulating T Cell Apoptosis and Proliferation.  
J Exp Med. 2001;193(3):317-328.
- 94 S Pasupathy, Eu KW, Ho YH and Seow-Choen F  
A comparison between open versus laparoscopic assisted colonic pouches.  
Tech Coloproct. 2001;5:19-22
- 95 Seow-Choen F  
Stapled Haemorrhoidectomy: Pain or Gain.  
Br J Surg 2001;88:1-3



- 96 Seow-Choen F  
Circumferential Haemorrhoids-Current Options.  
SGH Proceedings 2001;9(3): 1-3
- 97 Seow-Choen F, Brown S  
The best pouch for rectal function after anterior resection.  
Osp Ltal Chin 2001;6:500-571
- 98 Smith GL, Doherty AP, Banks L, Dutton J, Hanham IW, Christmas TJ and Epstein RJ  
Dual X-ray absorptiometry (DXA) detects disease induced and treatment-related alterations of bone density in prostate cancer patients.  
Clin Exp Metastasis 2001;18:385-390
- 99 Tan JY, Seow-Choen F  
Prospective randomized trial comparing diathermy and harmonic scalpel haemorrhoidectomy.  
Dis Colon Rectum 2001;667-669
- 100 Tan JY, Seow-Choen F  
Prospective randomized trial comparing diathermy and harmonic scalpel haemorrhoidectomy.  
Dis Colon Rectum 667-669
- 101 Tang CL, Eu KW, Tai BC, Soh JGS, Machin D, Seow-Choen F.  
Randomized Clinical trial of effect of open versus laparoscopically assisted colectomy on systemic minimally inpatients with colorectal cancer.  
Br J Surgery 2001;88:801-817
- 102 Tan SB  
Introduction to Bayesian methods for medical research.  
Ann Acad Med Sing 2001;30(4):444 - 446
- 103 Thng CH  
Magnetic Resonance Cholangiopancreatography in the evaluation of neoplastic and non-neoplastic biliary conditions.  
SGH Proceedings 2001;9(3):190-196
- 104 Zheng W, Olivo M, Soo KC  
Diagnosis of oral tumors using light-induced autofluorescence spectra at multiple excitation wavelengths.  
SPIE Biophotonics Instrumentation and Analysis 2001;4597:133-138
- 105 Zheng W, Olivo M, Sivanandan R, Karuman P, Lim TK, Soo KC  
Endoscopic Imaging of 5-ALA-Induced PPIX Fluorescence for Detection of Early Neoplasms in Oral Cavity.  
SPIE Biophotonics Instrumentation and Analysis 2001;4597:128-132
- 106 Wiratkapun S, Kraemer M, Seow-Choen F, Ho YH, Eu KW  
High Preoperative Serum Carcinoembryonic Antigen predicts metastatic recurrence in potentially curative colonic cancer: Results of a five year study.  
Dis Colon Rectum 2001;44:231-5
- 107 Wong LC and Choi P  
Malignant Spinal Cord compression treated with palliative radiotherapy: The Prince of Wales Hospital Experience.  
J HK Coll Radiol. 2001;4:202-208
- 108 Wu X, He Y, Falo LDJ, Hui KM and Huang L  
Regression of human mammary adenocarcinoma by systemic administration of a recombinant gene encoding the hFlex-TRAIL fusion protein.  
Mol Ther 2001;3(3):368-374
- 109 You Z, Huang X, Hester J, Toh HC, Chen SY  
Targeting dendritic cells to enhance DNA vaccine potency.  
Cancer Res. 2001;61:3704-3711
- 110 Ali S.M, Olivo.M, Gan YY and Soo K.C  
Apoptosis induced by photosensitizers (perulquinone derivatives) in human carcinoma cells: A possible relevance to photodynamic therapy.  
Asian J of Surg 2001;25(1):26-34.
- 111 Balram C, Sabapathy K, Gao F, Khoo KS, Lee EJ  
Genetic polymorphisms of UDP glucuronosyltransferase in Asians: UGT1A1\*28 is a common allele in Indians.  
Pharmacogenetics 2002;12:81-83
- 112 Ho YH, Yu S, Ang ES and Seow-Choen F  
Small colonic J-pouch improves colonic retention of liquids-randomized controlled trial with scintigraphy.  
Dis Colon Rectum. 2002;45:76-82
- 113 Foo KF, Tan EH, Leong SS, Wee JT, Tan T, Fong KW, Koh L, Tai BC, Lian LG, Machin D.  
Gemcitabine in metastatic nasopharyngeal carcinoma  
Ann Oncol. 2002;13 (1): 150-156
- 114 Zheng W, Tay SK, Soo KC, Olivo M (2002).  
Development and clinical applications of digitized fluorescence endoscopic imaging system for the detection of early neoplasms in the oral cavity and uterine-cervix.  
SPIE Biophotonics Biomedical Optics. 2002;4613
- 115 Sabapathy, K.  
Structure/function analysis of the tumour suppressor gene, p53, in vivo.  
SGH Proceedings (2001) 170-173

- 116 W.Zheng, M.Olivo, K.C.Soo  
Diagnosis of oral tumors using light-induced autofluorescence spectra at multiple excitation wavelengths  
Proceedings of SPIE-Biophotonics Instrumentation and Analysis 2001;4597:133-138
- 117 W.Zheng, M.Olivo, R.Sivanandan, P.Karuman, T.K.Lim, K.C.Soo  
Endoscopic Imaging of 5-ALA-Induced PPIX Fluorescence for the Detection of Early Neoplasms in Oral Cavity  
Proceedings of SPIE-Biophotonics Instrumentation and Analysis 2001;4597:128-132
- 118 Tan, S. B.  
Introduction to Bayesian methods for medical research.  
Ann Acad Med Sing 2001;30(4):444-446
- 119 Cheung, Y. B.  
Adjustment for selection bias in cohort studies.  
J of Clin Epidemiol 2001;54(12):1234-1239
- 120 Foo, K. F., Tan, E. H., Leong, S. S., et al.  
Gemcitabine in metastatic nasopharyngeal carcinoma.  
Ann Oncol 2002;13(1):150-56
- 121 Balram, C., B., Sabapathy, K., Fei, G., Khoo, K. S., Lee, E. J. D.  
Genetic polymorphisms of UDP glucuronosyltransferase in Asians: UGT1A1\*28 is a common allele in Indians.  
Pharmacogenetics 2001;81-83
- 122 Ounpuu, S., Negassa, A., Yusuf, S.  
Inter-heart: A global study of risk factors for acute myocardial infarction  
Am Heart J 2001;141:711-721
- 123 Tang F.R., Lee W.L., Yang J., Sim M.K., Ling E.A.  
Expression of metabotropic glutamate receptor 1 in the hippocampus of rat pilocarpine model of status Epilepsy Res. 2001;179-189
- 124 Tang F.R., Lee W.L., Yang J., Sim M.K., Ling E.A.  
Expression of metabotropic glutamate receptor 8 in the rat hippocampus after pilocarpine induced status epilepticus  
Neurosci. Lett. 2001;137-140
- 125 Tang F.R., Yeo J.F., Leong S.K.  
Qualitative light and electron microscopy study of glutamate receptors in the caudal spinal trigeminal nucleus of the rat  
J.Dent. Res 2001;1736-41
- 126 Tang F.R., Lee W.L.  
Expression of the group II and III metabotropic glutamate receptors in the Hippocampus of patients with mesial temporal lobe epilepsy  
J.Neurocytol 2001;135-141
- 127 CD DeMaria, TW Soong, BA Alseikhan, RS Alvania and DT Yue  
Calmodulin bifurcates the local Ca<sup>2+</sup> signal that modulates P/Q-type Ca<sup>2+</sup> Channels  
Nature 2001;411:484-489
- 128 Clément M-V, RamalinganJ.K., Long L.H., and Halliwell B.  
The in vitro cytotoxicity of ascorbate depends on the culture medium used to perform the assay and involves hydrogen peroxide.  
Antiox Redox Signal 3 2001;157-164
- 129 Hirpara JL, Clément M-V, and Pervaiz S.  
Intracellular acidification triggered by mitochondrial-derived hydrogen peroxide is an effector mechanism for drug-induced apoptosis in tumor cells.  
J. Biol. Chem 2001;276:514-521
- 130 Pervaiz S., Cao J., Chao OSP, Chin YY, Clément M-V.  
Activation of the RacGTPase inhibits apoptosis in human tumor cells.  
Oncogene 2001;20: 6263-6268
- 131 Clément, M. V., and Pervaiz, S.  
Intracellular superoxide and hydrogen peroxide concentrations: a critical balance that determines survival or death.  
Redox Rep 2001;6,211-214
- 132 Pervaiz, S. and Clément MV.  
A permissive apoptotic environment: function of a decrease in intracellular superoxide anion and cytosolic acidification.  
Biochim Biophys Res Commun. 2002;290(4):1145-1150
- 133 Gao, R., Kini, R.M., Li, G.D., Luo, R.H., Selvanayagam, Z.E. and Gopalarishnakone, P. Purification and properties of three new phospholipase A<sub>2</sub> isoenzymes from Micropechis ikaheka venom.  
Biochem. Biophys. Acta 2001;1545, 30-40
- 134 Lim, S.-K.  
Consequences of hemolysis without haptoglobin.  
Redox Reports 2001;6:375-378

- 135 Wang, Q., Lu, J. and Yong, E. L.  
Ligand- and coactivator-mediated transactivation function (AF2) of the androgen receptor ligand binding domain is inhibited by the cognate hinge region.  
J. Biol. Chem 2001;276:7493-7499
- 136 Li, B., New, J. Y., Yap, E. H., Lu, J., Chan, S. H., Hu, H.  
Blocking L-selectin and alpha4-integrin changes donor cell homing pattern and ameliorates murine acute graft versus host disease.  
Eur. J. Immunol 2001;31:617-624
- 137 Chang, J., Hilsenbeck, S.G., Sng, J-H., Wong, J., and Ragu, G.C.  
Pathologic features and BRCA1 mutation screening in premenopausal breast cancer patients.  
Clin Can Res 2001;7:1739 – 1742
- 138 Pervaiz, S., Cao, J., Chao, O. S. P., Chin, Y. Y., Clement, M-V.  
Activation of the RacGTPase inhibits apoptosis in human tumor cells.  
Oncogene 2001; 20: 6263-6268
- 139 Clement, M-V., Ramalingan, J. K., Long, L. H., Halliwell, B.  
The in vitro cytotoxicity of ascorbate depends on the culture medium used to perform the assay and involves hydrogen peroxide.  
Antiox Redox Signal 157-164
- 140 Clement, M-V., Pervias, S.  
Intracellular superoxide and hydrogen peroxide concentrations: A critical balance that determines survival or death.  
Redox Rep 211-214
- 141 Lim, A., Pereira, B. P., Kumar, V. P.  
The long head triceps brachii as a free functioning muscle transfer.  
Plastic and Reconstructive Surgery 2001;107(7):1746-52
- 142 Liow SL, Yong EL, Ng SC  
How reliable is the outcome of Y deletion analysis in providing a sound prognosis?  
Hum Reprod 2001;16(1):9-12
- 143 Chong YS, Chua S, El-Refaey H, Choo WL, Chanrachakul B, Tai BC, Rodeck C, Arulkumaran S  
Postpartum intrauterine pressure studies of the uterotonic effect of oral misoprostol and intramuscular syntometrine  
BJOG 2001;108:1-7
- 144 Xu Wei Xin  
Mechanistic studies of the role of cyclooxygenase (COX) in cell growth inhibition induced by tea flavonoids in human colorectal  
Nutr Cancer prevention 2001;492: 339-340
- 145 Loke Kah Yin  
Molecular Characterization of the CYP21 gene for congenital adrenal hyperplasia in Singapore  
Sing Paediatr J 2001;43(3):79-119
- 146 Loke Kah Yin, Roli Mathur, Lee Yung Seng, Larry Poh  
Two novel mutations of the CYP21 gene in congenital adrenal hyperplasia  
Paediatr Res 2001;49(6):112A
- 147 Yap, H. K., Han, E. J. S., Heng, C. K., Gong, W. K.  
Risk factors for steroid dependency in children with idiopathic nephrotic syndrome.  
Paediatr Nephrol 2001;16:1049-1052
- 148 ML Ng, SH Tan and JH Chu  
Transport and budding at two distinct sites of visible nucleocapsids of West Nile (sarafend) virus  
J Med Virol 2001;65:758-764
- 149 Wang Q, Lu JH, Yong EL  
Ligand- and coactivator-mediated transactivation function (AF2) of the androgen receptor ligand binding domain is inhibited by the cognate hinge region  
J Biol Chem (USA) 2001;276:7493-7499
- 150 Goh, V. H. H.  
The challenges of the aging population in the Asia Pacific region.  
The Aging Male 2001;13-19
- 151 ASC Tan, TC Quah, PS Low, SS Chong  
A rapid and reliable seven-deletion multiplex-PCR assay for alpha-thalassemia  
Blood 2001;98(1):250-251
- 152 SKH Tay, HH Khng, WL Lee, PS Low & PS Lai  
Confirmation of predicted mutational effect by in vitro protein translation in a patient with Duchenne muscular dystrophy  
Front Hum Genet 2001;173-184
- 153 Shek LPC, Tay AH, Chew FT, Goh DLM, Lee BW  
Genetic susceptibility to asthma and atopy among Chinese in Singapore-linkage to markers on chromosome 5q31-33  
Allergy 2001;56(8):749-753

- 154 Hutmacher, D. W., Goh, J. C. H., Teoh, S. H.  
An introduction to biodegradable materials for tissue engineering applications.  
Ann Acad Med Sing 2001;30:183-91
- 155 Liang, F., Chang, C. F.  
Signaling of GPI-anchored CD157 via focal adhesion kinase in MCA102 fibroblasts.  
FEBS Letters 2001;506:207-210
- 156 Wong, B. S., Brown, D. R., Pan, T., Whiteman, M., Liu, T., Li, R., Gambetti, P., Olesik, J., Rubenstein, R. & Sy, M.  
Oxidative impairment in scrapie-infected mice is associated with brain metal perturbations and altered anti-oxidation activities  
J Neurochem 2001;79:689-698
- 157 Basu, S., Whiteman, M., Matthey, D. L. & Halliwell, B.  
Elevated levels of F2-isoprostanes and prostaglandin F2a in different rheumatic diseases.  
Ann Rheum Dis 2001;60:627-631
- 158 Zhao, K., Whiteman, M., Spencer, J. P. E. & Halliwell, B.  
DNA damage by nitrite and peroxynitrite: protection by dietary phenols.  
Methods Enzymology 2001;335:296-307
- 159 Halliwell, B., Zhao, K. & Whiteman, M.  
The gastrointestinal tract: A major site of antioxidant action?  
Free Radic Res 2001;33:819-830
- 160 Wong, B. S., Brown, D. R., Pan, T., Whiteman, M., Liu, T., Li, R., Gambetti, P., Olesik, J., Rubenstein, R. & Sy, M.  
Oxidative impairment in scrapie-infected mice is associated with brain metal perturbations and altered anti-oxidation activities  
J Neurochem 2001;79:689-698
- 161 Basu, S., Whiteman, M., Matthey, D. L. & Halliwell, B.  
Elevated levels of F2-isoprostanes and prostaglandin F2a in different rheumatic diseases.  
Ann Rheum Dis 2001;60:627-631
- 162 Zhao, K., Whiteman, M., Spencer, J. P. E. Halliwell, B.  
DNA damage by nitrite and peroxynitrite: protection by dietary phenols.  
Methods Enzymology 2001;335:296-307
- 163 Halliwell, B., Zhao, K. & Whiteman, M.  
The gastrointestinal tract: A major site of antioxidant action?  
Free Radic Res 2001;33:819-830
- 164 HH Khng, PS Low, WL Lee, HT Ong & PS Lai  
Analysis of deletion breakpoints in dystrophin transcripts  
Front Hum Genet 2001;159-171
- 165 Tan, K., Ng, S. C.  
Development of a computer controlled piezo micromanipulation system for biomedical applications.  
Engineering Science and Education J 2001;10(6):249-256
- 166 Halliwell, B.  
Role of free radicals in neurodegenerative disease therapeutic implications for antioxidant treatment.  
Drugs Aging 2001;685-716
- 167 Hughes, H., Lee, B. L., Lee, J., Ong, C. N.  
Coenzyme Q10 and differences in heart disease risk in Asian Indians and Chinese.  
Free Rad. Biol. Med. 2002; 32:132-138
- 168 Choolani M, O'Donnell H, Campagnoli C, Kumar S, Roberts I, Bennett PR, Fisk NM  
Simultaneous fetal cell identification and diagnosis by epsilon-globin chain immunophenotyping and chromosomal fluorescence in situ hybridisation  
Blood 2001;(98):554-557
- 169 Choolani M, Campagnoli C, Roberts I, Bennett PR, Fisk NM  
Prenatal detection of fetal Down's syndrome  
Lancet 2001;357:958-959
- 170 Jin R, Bay BH, Chow VTK, Tan PH  
Metallothionein 1F mRNA expression correlates with histological grade in breast carcinoma  
Breast Cancer Res Treat 2001;1993:1-8
- 171 Shen H. M., Zhang, Z., Zhang, Q. F., Ong, C. N.  
Reactive oxygen species and caspase activation mediated silica-induced apoptosis in alveolar macrophages.  
Am. J. Physiol. 2001;280:L10-L17
- 172 Huang, Z. L., Wang, D. Y., Zhang, P. C., Yeoh, K. Y.  
Evaluation of nasal cavity by acoustic rhinometry in the ethnic groups, Chinese, Malay and Indian.  
Acta Otolaryngologica 2001;121:844-848
- 173 Hirpara, J.L., Clement, M-V., and Pervaiz, S  
Intracellular acidification triggered by mitochondrial-derived hydrogen peroxide is an effector mechanism for drug-induced apoptosis in tumor cells.  
J. Biol. Chem 2001;276(1): 514-521
- 174 Jin R, Bay BH, Chow VTK, Tan PH, ST Dheen  
Significance of metallothionein expression in breast myoepithelial cells  
Cells Tissue 2001;303:221-226

- 175 Stephen M Kwong, Chew Chieng Yeo, and Chit Laa Poh  
Molecular analysis of the pRA2 partitioning region: ParB autoregulates parAB transcription and forms a nucleoprotein complex with the plasmid partition site, parS  
*Mol Microbiol* 2001;40(3):621-633
- 176 Oh, VMS, HM Wu, EPH Yap, X Zhou, EA Taylor  
Linkage of dopamine D2 receptor markers with essential hypertension  
*Front Hum Genet (monograph)* 2001;261-272
- 177 Stephen I-Hong Hsu, Christopher Maolin Yang, Khe Ghuan Sim, Dirk M.Hentschel, Eileen O'Leary and Joseph V.Bonventre  
TRIP-Br: a novel family of PHD zinc finger- and bromodomain-interacting proteins that regulate the transcriptional activity of E2F-1/DP-1  
*EMBO J* 2001;20(9):2273-2285
- 178 Heng, C. K., Low, P. S., Saha, N.  
Variations in the promoter region of the Apolipoprotein A-1 gene influence plasma Lipoprotein(a) levels in Asian Indian neonate  
*Paediatr Res* 2001;49:514-518
- 179 Alsagoff Z, Chew PT, Chee CKL, Wong J-S, Aung T.  
Indocyanine green anterior segment angiography for studying conjunctival vascular changes after trabeculectomy.  
*Clin Experiment Ophthalmol* 2001; 29:22-26.
- 180 Ang LPK, Eong KG, Ong SG.  
Herpes zoster ophthalmicus.  
*J Paediatr Ophthalmolo & Strabismus* 2001;38(3):174-176.
- 181 Aung T, Looi AL, Chew PT.  
The visual field following acute primary angle closure.  
*Acta Ophthalmol Scand* 2001; 79(3):298-300.
- 182 Aung T, Ang LP, Chan SP, Chew PT.  
Acute primary angle-closure: long-term intraocular pressure outcome in Asian eyes.  
*Am J Ophthalmol* 2001;131(1):7-12.
- 183 Aung T, Chew PT, Yip C, Chan Y, See JL, Khng CG, Hoh S, Ng L, Lee H.  
A randomized double-masked crossover study comparing latanoprost 0.005% with unoprostone 0.12% in patients with primary open-angle glaucoma and ocular hypertension.  
*Am J Ophthalmol* 2001; 131(5):636-642.
- 184 Aung T, Foster PJ, Seah SK, Chan SP, Lim WK, Wu HM, Lim AT, Lee LL, Chew SJ.  
Automated static perimetry: the influence of myopia and its method of correction.  
*Ophthalmol* 2001; 108(2):290-295.
- 185 Carkeet A, Lee L, Kerr JR, Keung MM.  
The slope of the psychometric function for Bailey Lovie charts: defocus effects and implications for modeling letter-by-letter scores.  
*Optometry and Vision Science* 2001;78(2):113-121
- 186 Carkeet A.  
Modeling logmar visual acuity scores: Effects of termination rules and alternative forced choice options.  
*Optometry and Vision Science* 2001;78(7):529-538.
- 187 Carkeet A.  
Interpreting the defocus equivalent index.  
*J Refractive Surg* 2001;17(3):383-385.
- 188 Chan CML, Chew PTK, Alsagoff Z, Wong JS, Tan DTH.  
Vascular patterns in pytergium and conjunctival autografting: a pilot study using indocyanine green anterior segment angiography.  
*Br J Ophthalmol* 2001;85(3):350-353.
- 189 Chee S-P, Jap A, Theng JTS.  
Induced myopia associated with capsular bag distension syndrome.  
*Ophthalmol* 2001; 108(9):1517.
- 190 Chee S-P, Jap A.  
Endogenous endophthalmitis.  
*Curr Opin Ophthalmol* 2001;12(6):464-470.
- 191 Cheng CLi, Chee SP, Tan DTH.  
Patient reliability in the administration of topical ocular medication.  
*Singapore Med J* 2001;42(6):252-254.
- 192 Gazzard G, Friedman DS, Devereux J, Seah S.  
Primary acute angle closure glaucoma associated with supra-choroidal fluid in three Chinese patients.  
*Eye* 2001;15(1):358-360
- 193 Khng CYW, Voon LW, Yeo KT.  
Causes and Management of Descement's Membrane Detachment Associated with Cataract Surgery - Not Always a Benign Problem.  
*Ann Acad Med* 2001;30(5):532-535

- 194 Koh AHC, Hogg CR, Holder GE.  
The incidence of negative ERG in clinical practice.  
Doc Ophthalmol 2001;102:19-30
- 195 Lim B-A, Ang CL.  
Purtscher-like retinopathy after retrobulbar injection.  
Ophthalmic Surg Lasers 2001; 32(6):477-478
- 196 Lim L, Tan DTH, Chan W-K.  
Therapeutic Use of Bausch & Lomb PureVision  
Contact Lenses.  
CLAO J 2001;27(4):179-185
- 197 Looi ALG, Gazzard G, Tan DTH.  
Surgical exploration minimised by pre-operative  
UBM localisation of IOFB.  
Eye 2001;131(5):636-642
- 198 Looi ALG, Choo CT, Poh WT, Hong A.  
An Unusual Orbital Bone Lesion.  
Singapore Med J 2001;42(1):38-40
- 199 Moe KT, Ji Z, Barathi A, Beuerman RW.  
Differential Expression of Glyceraldehyde-3 Phosphate  
Dehydrate (GAPDH), Actin and Hypoxanthine  
Phosphoribosyltransferase (HPRT) in Postnatal rabbit Sclera.  
Curr Eye Res 2001;23(1):44-50
- 200 Saw SM, Wu HM, Hong CY, Chua WH, Chia KS, Tan DTH.  
Myopia and night lighting in children in Singapore.  
Br J Ophthalmol 2001;85(5):527-528
- 201 Saw SM, Wu HM, Seet B, Wong TY, Yap E, Chia KS,  
Stone RA, Lee L.  
Academic achievement, close up work parameters, and  
myopia in Singapore military conscripts.  
Br J Ophthalmol 2001;85(7):855-860
- 202 Saw SM, Hong R-Z, Zhang M-Z, Fu Z-F, Mei Ye,  
Tan DTH, Chew SJ.  
Near work and myopia in school children in  
Xiamen, China.  
J Paediatr Ophthalmol Strabismus 2001;38(3):149-155
- 203 Saw SM, Hong CY, Chia KS, Stone RA, Tan DTH.  
Nearwork and myopia in young children.  
Lancet 2001;357(9253):390
- 204 Saw SM, Hong RZ, Zhang MZ, Fu ZF, Ye M, Tan D,  
Chew SJ.  
Near-work activity and myopia in rural and urban  
schoolchildren in China.  
J Paediatric Ophthalmol Strabismus 2001;38(3):149-155
- 205 Saw SM, Chan B, Seenyen L, Yap M, Tan D, Chew SJ.  
Myopia in Singapore kindergarten children.  
Optometry 2001;72(5):286-291
- 206 Scott A, Tan DTH.  
Therapeutic lamellar keratoplasty for limbal dermoids.  
Ophthalmol 2001;108(10):1858-1867
- 207 Seet B, Wong TY.  
Military laser weapons: current controversies.  
Ophthalmic Epidemiol 2001;8(4):215-226
- 208 Seet B, Wong TY, Tan DT, Saw SM, Balakrishnan V,  
Lee LK, Lim AS.  
Myopia in Singapore: taking a public health approach.  
Br J Ophthalmol 2001;85(5):521-526
- 209 Smith JR, Chee S P.  
Nodular Anterior Scleritis Associated With Ocular Trauma.  
Singapore Med J 2001;42(4):180-181
- 210 Smith JR, Chng H, Chee S.  
Primary antiphospholipid syndrome masquerading as  
diabetic retinopathy.  
Japan J Ophthalmol 2001;45(1):105-108
- 211 Tan DTH, Chee SP, Lim L, Theng J, Van Ede M.  
Randomized clinical trial of Surodex steroid drug delivery  
system for cataract surgery: anterior versus posterior  
placement of two Surodex in the eye.  
Ophthalmol 2001;108(12):2172-2181
- 212 Theng JTS, Lim WK, Lee Lionel, Tan DTH, Chew SJ.  
Microbiological Profile of a Shipboard Environment and the  
Flora on Contact Lenses of Seamen.  
CLAO J 2001;27(1):47-52
- 213 Theng JTS, Chan C, Ling ML, Tan DTH.  
Microsporidial keratoconjunctivitis in a healthy contact  
lens wearer without human immunodeficiency virus  
infection.  
Ophthalmol 2001;108(5):976-978
- 214 Ti SE, Tan DTH.  
Recurrent Corneal Erosion After Laser In Situ  
Keratomileusis.  
Cornea 2001;20(2):156-158
- 215 Ti SE, Tow SL, Chee SP.  
Amniotic membrane transplantation in entropion surgery.  
Ophthalmol 2001;108(7):1209-1217

- 216 Tin A, Foster PJ, Seah SK, Chan S-P, Lim WK, Wu Hui -Min, Lim TH, Lee Lionel, Chew S-J.  
Automated static perimetry: The influence of myopia and its method of correction.  
*Ophthalmol* 2001; 108(2):290-295
- 217 Tong L, Carkeet A, Saw SM, Tan DTH.  
Corneal and refractive error astigmatism in Singaporean schoolchildren: a vector-based Javal's rule.  
*Optometry Visual Science* 2001;78(12):881-887
- 218 Tong L, Carkeet A.  
A new colour vision arrangement test to detect functional changes in diabetic macular oedema.  
*Br J Ophthalmol* 2001;85(8):1013-1014
- 219 Voon LW, See J, Wong TY.  
The epidemiology of ocular trauma in Singapore: perspective from the emergency service of a large tertiary hospital.  
*Eye* 2001;15:75-81
- 220 Wang J-C, Tow S, Aung T, Lim S-A, Cullen JF.  
The presentation, aetiology, management and outcome of optic neuritis in an Asian population.  
*Clin Exp Ophthalmol* 2001;29(5):312-315
- 221 Wong TY, Klein BE, Klein R, Tomany SC, Lee KE.  
Refractive errors and incident cataracts: the Beaver Dam Eye Study.  
*Invest Ophthalmol Vis Sci* 2001;42(7):1449-1454
- 222 Wong TY.  
Cataract extraction rates among Chinese, Malays, and Indians in Singapore: a population-based analysis.  
*Arch Ophthalmol* 2001;119(5):727-732
- 223 Wong TY, Foster PJ, Johnson GJ, Seah SK, Tan DTH.  
The Prevalence and risk factors for pterygium in an adult Chinese population in Singapore: the Tanjong Pagar survey.  
*Am J Ophthalmol* 2001;131(2):176-183
- 224 Wong TY, Foster PJ, Ng TP, Tielsch JM, Johnson GJ, Seah SKL.  
Variations in ocular biometry in an adult Chinese population in Singapore: the Tanjong Pagar Survey.  
*Invest Ophthalmol Vis Sci* 2001;42(1):73-80
- 225 Wong TY, Moss SE, Klein R, Klein BE.  
Is the pulse rate useful in assessing risk of diabetic retinopathy and macular oedema? The Wisconsin Epidemiological Study of Diabetic Retinopathy.  
*Br J Ophthalmol* 2001;85(8):925-927
- 226 Wong TY, Klein R, Klein BE, Tielsch JM, Hubbard L, Nieto FJ.  
Retinal microvascular abnormalities and their relationship with hypertension, cardiovascular disease, and mortality.  
*Surv Ophthalmol* 2001;46(1):59-80
- 227 Wong TY, Foster PJ, Johnson GJ, Klein BE, Seah SKL.  
The relationship between ocular dimensions and refraction with adult stature: the Tanjong Pagar Survey.  
*Invest Ophthalmol Vis Sci* 2001;42(6):1237-1242
- 228 Wong TY, Klein R, Couper DJ, Cooper LS, Shahar E, Hubbard LD, Wofford MR, Sharrett AR.  
Retinal microvascular abnormalities and incident stroke: the Atherosclerosis Risk in Communities Study.  
*Lancet* 2001;358(9288):1134-1140
- 229 Wong TY, Foster PJ, Johnson GJ, Seah SKL, Tan DTH.  
The prevalence and risk factors for pterygium in an adult Chinese population in Singapore: the Tanjong Pagar survey.  
*Am J Ophthalmol* 2001;131(2):176-183
- 230 Wong TY.  
The Benefits and Risks of Cataract Surgery: Is Old Age an Issue?  
*Br Med J* 2001;322:1104-1106
- 231 Xiong X, Lim BA, Lat-Luna M, Chew PTK, Tan DTH.  
Quantitation of mitomycin C in human ocular tissues by high-performance liquid chromatograph-photo-diode array detection.  
*J Chromatogr B Biomed Sci Appl* 2001;755(1-2):65-72
- 232 Yew DT, Lai HW, Ma SA, Zhou L, Lam KW.  
Chromatographic identification of a biochemical alteration in the aqueous humour of megalophthalmic Black Moor goldfish.  
*J Chromatogr B Biomed Sci Appl* 2001;751(2):349-355
- 233 Zhou L, Tan DTH, Theng J, Lim Li, Liu YP, Lam KW.  
Optimized analytical method for cyclosporin A by high-performance liquid chromatography-electrospray ionization mass spectrometry.  
*J Chromatogr B Biomed Sci Appl* 2001;754(1):201-207
- 234 Chee MWL, Hon N, Lee HL, Soon CS  
Relative language proficiency modulates BOLD signal change biliguals perform semantic judgements  
*Neuroimage* 2001;13:1155-63

- 235 KW Ng, JT Schantz, DW, Hutmacher, I Zein, TC Lim, HP Too, TT Phan, SH Teoh  
The evaluation of ultra-thin poly (ε-caprolactone) films for tissue engineered skin  
*Tissue Eng* 2001;441-456
- 236 Katie Kazarinova-Noyes, Jyoti Dhar Malhotra, Dyke P.McEwen, Laura N.Mattei, Erik O.Berglund, Barbara Ranscht, S.Rock Levinson  
Cantactin Associates with Na<sup>+</sup> Channels and Increases their Functional Expression  
*J Neurosci* 2001;21(19):7517-7525
- 237 TT Phan, P See, ST Lee, Chan SY  
Antioxidant effects of the extracts from the leaves of *Choromalaena Odornata* on Human Dermal Fibroblasts and Epidermal Keratin  
*Burns* 2001;319-327
- 238 Lim, TT Phan, C Song, W Tan, MT Longaker  
Investigation of influence of keloid-derived keratinocytes on fibroblast growth and proliferation  
*Plast Reconstr Surg* 2001;797-808
- 239 TT Phan, P See, ST Lee, SY Chan  
Protective effect of curcumin on skin cells in vitro against oxidative damage: Its implication for wound healing  
*J Trauma* 2001;51(5):927-931
- 240 Chong VFH, Rumpel H, Fan YF, Mukherji SK  
Temporal lobe changes following Radiation Therapy: Imaging and Proton MR Spectroscopic Findings  
*Eur Radiol* 2001;11:317-324
- 241 Zhang Kai, Chow May, Yang Er Bin, Wong Kim Ping, Mack Peter  
Modulation of cisplatin cytotoxicity and cisplatin induced DNA cross-links by regulation of glutathione related mechanisms  
*Mol. Pharmacol* 2001;837-843
- 242 Yang EB, Zhao YN, Zhang K, Mack P.  
Microsatellite alterations in human hepatocellular carcinoma infected with hepatitis B virus: Associated with the elevation of serum α-fetoprotein  
*Int J Oncol* 2001;513-518
- 243 Yang EB, Gup YJ, Zhang K, Chen YZ, Mack P.  
Inhibition of epidermal growth factor receptor tyrosine kinase by chalcone derivatives  
*Biochim Biophys Acta* 2001;144-152
- 244 Cao X, Eu KW, Seow-Choen F, Cheah PY  
Molecular and Clinical Profiles of Singapore Familial Adenomatous Polyposis patients  
*Front Hum Genet: Diseases and Technologies-monograph* 2001;245-259
- 245 Valerie CL Lin, Aw Swee Eng, Ng Eng Hen, Esther HL Ng, and Sanaua H Chowdhury  
Effect of progesterone on invasive properties and tumor growth of progesterone receptor-transfected breast cancer cells in vivo  
*Clin Cancer Res* 2001;2880-2886
- 246 Ho SC, Van Sande J, Lefort A, Vassart G, Costagliola S  
Effects of mutations involving the highly conserved S281HCC motif in the extracellular domain of the thyrotropin (TSH) receptor  
*Endocrinol* 2001;142(7):2760-2767
- 247 Cao X, Eu KW, Seow-Choen F, Zhao Y, Cheah PY  
Topoisomerase I- and Alu- mediated genomic deletions of the APC gene in familial adenomatous polyposis  
*Human Genet* 2001;108:436-442
- 248 Chee MWL, Hon N, Lee HL, Soon CS  
Relative language proficiency modulates BOLD signal change when bilinguals perform semantic judgements  
*Neuroimage* 2001;13:1155-63
- 249 ES Tai, ESC Koay, E Chan, TJ Seng, LM Loh, SK Sethi, CE Tan  
Compound heterozygous familial hypercholesterolaemia and familial defective apolipoprotein B-100 results in exaggerated hypercholesterolaemia  
*Clin Chem.* 2001;47(3):438-43
- 250 ES Tai, LM Loh, SK Sethi, ESC Koay, YT Lim, CE Tan  
MEDPED comes to Singapore  
*Atherosclerosis* 2001;154(1):252
- 251 Ann SG Lee, Audrey SM Teo, Sin-Yew Wong  
Novel mutations in *ndh* in isoniazid-resistant *Mycobacterium tuberculosis* isolates  
*Antimicrob Agents Chemother* 2001;45(7):2157-2159
- 252 Ann SG Lee, Lynn LH Tang, Irene HK Lim, Richard Bellamy, Sin-Yew Wong  
Discrimination of single-copy IS6110 DNA fingerprints of *Mycobacterium tuberculosis* isolates by high-resolution minisatellite-b  
*J Clin Microbiol* 2002;40(2):657-659



## STATE OF HEALTH 2001 EDITORIAL COMMITTEE

### Chairman

***Dr Lyn James***

Deputy Director (Communicable Diseases)  
Communicable Diseases Branch  
Epidemiology and Disease Control Division

### Members

***Dr Angela Chow***

Assistant Director (Service Standards and Development)  
Service Standards and Development Branch  
Health Service Development Division

***Ms Marziyana A Rahman***

1 Eldercare Services Executive  
Eldercare Services Branch  
Elderly and Continuing Care Division

***Mr Tan Lai Hong***

Clinical Audit Officer 2  
Clinical Quality Branch  
Health Regulation Division

***Ms Doris Yu***

Clinical Audit Officer 3  
Clinical Quality Branch  
Health Regulation Division

***Dr Justin Chin***

Assistant Director  
Professional Standards and Development Division

***Dr Lilian Wong***

Medical Officer  
Professional Standards and Development Division

*Suggested citation:*

*Ministry of Health, Singapore. State of Health 2001 - The Report of the Director of Medical Services. Ministry of Health, Singapore 2002.*

**Ministry of Health**  
16 College Road  
College of Medicine Building  
Singapore 169854  
<http://www.moh.gov.sg>