

**Analysis of SARS Containment policies
adopted by SARS affected and non affected countries**

**Master Thesis
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To my Parents and Reshma

Abbreviations

A	Austria
CA	Canada
CH	China
D	Germany
DK	Denmark
EU	European Union
GB	Great Britain
HCWs	Health care workers
HK	Hong Kong
IHR	International Health Regulation
IN	India
JP	Japan
NL	The Netherlands
PCR	Polymerase Chain Reaction
PRC	People's Republic of China
SARS	Severe Acute Respiratory Syndrome
SARS-CoV	Severe Acute Respiratory Syndrome related Corona Virus
SG	Singapore
US	United States
WHO	World Health Organization

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Abstract

Introduction: Newly emerged SARS corona virus infection outbreak started in China in November 2002, spread across the 30 countries in a short period World health organization issued global health alert and travel advice first time in history and the cascade reaction to control SARS started. SARS affected and non affected countries implemented measures to control SARS and prevent importation, at local to National level and extended cooperation to international level.

Methods: Study of official documents of SARS control measures taken by twelve countries from 3 categories, four countries with SARS out break, 4 countries with imported cases and non- SARS case countries. analysis focused on National legal frame work, Early detection of cases, reporting, contact tracing and isolation measures, Measures for infection control and protection of health care workers, Preparedness and response to health care facilities, Travel related measures, Measures for Laboratory safety and diagnosis, Public education and communication.

Results: Policy analysis show all the countries took measures to control SARS or to prohibit the entry of infection in to there territory. They differ according to the magnitude of infection, susceptible and at the risk population, political commitments, international pressure, fear of importation and exportation of infection, infrastructures and resources available, intensity of rumor and fear in the society.

Discussion: SARS epidemic controlled successfully with the help of all nations across the world under the leadership of WHO. Control measures seem effective but not all proved their efficacy and sustainability for long term. Effective surveillance, transparent, accurate and timely reporting of event like SARS, early identification and isolation of cases are the key of emerging infectious disease control.

Background:

Severe acute respiratory syndrome (SARS) is a newly emerged acute viral respiratory syndrome caused by a novel corona virus, the SARS Corona Virus (SARS-CoV) which is believed to have crossed the species barrier recently from animals to humans. The first case was retrospectively recognized as having occurred in Guangdong Province, China, in November 2002[34]. By July 2003, the international spread of SARS-CoV resulted in 8098 SARS cases in 30 countries, with 774 deaths [35]. The epidemic caused significant social and economic disruption in areas with sustained transmission of SARS, and on the travel industry internationally, in addition to the impact on health services directly.

Most of the countries took individual and collective actions to implement effective measures to control the spread of SARS. The control of SARS required intensive regional and global collaboration, effective strategies and additional resources at local, national, regional and international levels. There was a crucial role of World Health Organization (WHO) in a worldwide campaign to control and contain the spread of SARS. The great efforts were made by affected countries, including those with limited resources, and other Member States in containing SARS. On 5 July 2003, the WHO declared the last breakdown of Human chain of SARS, with all the efforts worldwide to control SARS, a transnational epidemic came to an end.

WHO as a global organization formulated policies, guidelines and directives to combat with SARS epidemic, based on that, according to their own perspective all the affected countries, countries with imported cases, and countries with no SARS cases tried to formulate policies, guidelines and directives. They implemented those according to their available infrastructures, resources and capacities at national, regional and local levels. Most of the measures were regarding public health, trades, communication and travel regulations.

Material and Methods:

To study the policies implemented by various country states, We reviewed documents of 12 countries such as state SARS control policy manuals, reports related to SARS, communicable disease control centers documents related to SARS, SARS guidelines and recommendations published by that country, information regarding measures undertaken to control the outbreak of SARS. Preparedness and response guidelines documents for SARS, Research papers, articles published in various journals and interviews posted on authorized government site of various ministries or official press release. Information provided to international organizations like WHO, UN, European commission [38], etc. The actions taken were categorized under specific headings and analyzed by Using the Microsoft Excel 2003.

For study purpose Countries are categorized in three groups,

Countries with SARS outbreak	Countries with only imported cases	Non SARS affected countries
Canada	Germany	Austria
China	Great Britain	Denmark
Hong Kong+	India	Japan
Singapore	United States	Netherlands

+ Hong Kong is a special administrative region of People's Republic of China; the special administrative region has a high degree of autonomy and executive, legislative and independent judicial power, including that of final adjudication. They formulate their own monetary and financial policies, maintain their own currencies, formulate their own policies on education, culture, sports, Health, social welfare system, etc. within the framework of the basic laws.

We analyzed the above mentioned countries' policy and measures undertaken during the outbreak of SARS in 2003. Analysis focused on Major areas as follows;

- National legal frame work,
- Early detection of cases, reporting, contact tracing and isolation measures
- Measures for infection control and protection of health care workers
- Preparedness and response to health care facilities measures
- Travel related measures
- Measures for Laboratory safety and diagnosis
- Public education and communication

It is a quantitative summarization of measures implemented by SARS affected and Non-affected countries. Most of the data is derived from the officially disseminated information by the respective country. This study only provides information about measures implemented by the country under study not the efficacy of those measures. It is a sum of countries reactions to SARS-CoV disease during out-break period.

Results

Table 1: Summary of SARS cases in Study countries

Country	Female	Male	Total	Imported cases	Health care worker	Deaths	Case fatality	Date onset of first probable case	Date onset of last probable case
China	2674	2607	5327*	NA	1002(19)	349	7%	16/11/02	03/06/03
Canada	151	100	251	5(2%)	109(43)	43	17%	23/02/03	12/06/03
Hong Kong	977	778	1755	NA	386(22)	299	17%	15/02/03	31/05/03
Singapore	161	77	238	8(3%)	97(41)	33	14%	25/02/03	05/05/03
Germany	4	5	9	9(100%)	1(11)	0	0	09/03/03	06/05/03
India	0	3	3	3(100%)	0	0	0	25/04/03	06/05/03
Great Britain	2	2	4	4(100%)	0	0	0	01/03/03	01/04/03
United States	13	14	27	27(100%)	0	0	0	24/02/03	13/07/03**
Japan	0	0	0	0	0	0	0	NA	NA
Netherlands	0	0	0	0	0	0	0	NA	NA
Denmark	0	0	0	0	0	0	0	NA	NA
Austria	0	0	0	0	0	0	0	NA	NA

Source: WHO Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003(revised 26 September 2003)

* Case classification by sex is unknown for 46 cases

** Due to differences in case definitions, the United States has reported probable cases of SARS with onsets of illness after 5 July 2003.

More than 98% cases of SARS occurred in 6 outbreak countries, only 118 cases found in rest of the 14 countries affected out of that 106 cases were labeled as imported cases as they had link to outbreak area epidemiologically. In study countries this distribution is almost same as global, 7571 cases, 724 deaths 19 to 43% cases are health care workers in outbreak countries and 43 imported cases in countries with SARS imported cases without any fatality and secondary transmission.

Table 2: Legal frame work and Public health law

National Legal framework	Yes	No	Missing Value
SARS mandatory notification	CH, CA, HK, SG, <i>D, US, JP, NL</i> ,DK, A (10)	<i>IN, GB (2)</i>	--
Obligation to quarantine	CH, CA, HK, SG, <i>IN, US, JP, NL,</i> DK, A (10)	<i>GB (1)</i>	<i>D (1)</i>
Probable cases conformed as corona virus SARS cases (lab test)	CH, CA, HK, SG, <i>IN, US, JP, DK</i> (8)	--	<i>D, GB, NL, A (4)</i>
Reports of suspected cases received centrally	CH, CA, HK, SG, <i>D, IN, US, JP,</i> DK (9)	--	<i>GB, NL, A (3)</i>
Explicit guidelines on what immediate local action to undertake if a probable case is detected or if local transmission is suspected? (e.g. immediate isolation, alerting central national bodies etc.)	CH, CA, HK, SG, <i>D, IN, US, JP,</i> DK (9)	--	<i>GB, NL, A (3)</i>

Except India, Great Britain and Netherlands, all the nine countries from three categories made SARS mandatory notifiable disease. In Great Britain quarantine of SARS suspects and contacts is not obligatory, Germany didn't give response to this action but all 10 countries from 3 categories made SARS suspects and contact quarantine obligatory. Except Great Britain, Netherlands, Austria, all countries reported suspected SARS cases centrally. Nine countries except Germany, Great Britain, Netherlands, and Austria confirmed the number of suspected cases by laboratory test. Most of the countries except Great Britain, Netherlands, and Austria have prepared explicit guidelines for local level immediate action if a probable case is detected.

Table 3: Management of travel related transmission risk

Management of travel related transmission risk	Yes	No	Missing value
Health screening at arrival	CH, CA, HK, SG, IN, US, JP (7)	<i>D, GB, NL, DK, A (5)</i>	--
Travel advice provided	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Information leaflets to incoming passengers	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Information leaflets to departing passengers	CH, CA, HK, SG, IN, US, JP, NL, A (9)	<i>D, DK (2)</i>	<i>GB (1)</i>
Distribution of traceability cards to all passengers coming from affected areas	CH, CA, HK, SG, IN, US, JP (7)	<i>D, GB, NL, DK (4)</i>	<i>A (1)</i>

Five countries didn't do Health screening of travelers on arrival at port of entry. All the twelve countries provided travel advice and information leaflets to incoming passengers. Except Germany, Denmark and Great Britain all countries distributed information leaflets to departing passengers. Only seven countries distributed traceability cards to all passengers coming from affected areas.

Table 4: Laboratory guidance measures

Laboratory guidance measures	Yes	No	Missing value
Centralized testing	CH, CA, HK, SG, IN, GB, US, JP, NL, DK, A (11)	<i>D (1)</i>	--
Serology for SARS-CoV	CH, CA, HK, SG, D, IN, GB, US, JP, NL (10)	<i>DK, A (2)</i>	--
PCR for SARS-Cov	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
National protocol for SARS Diagnosis	CH, CA, HK, SG, GB, US, JP, NL, DK (9)	<i>D, IN (2)</i>	<i>A (1)</i>

Most of the countries assigned centralized SARS testing and serology for SARS-CoV for the detection of cases. PCR for SARS-CoV was used by all countries. Except Germany, India and Austria all countries have national protocol for SARS diagnosis.

Table 5: Communication and education measures

Communication and Education measures	Yes	No	Missed value
Information on SARS	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Guidance on how individual should react to appearance of SARS compatible symptoms	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Guidance to health care workers coming back from affected areas	CH, CA, HK, SG, D, GB, US, JP, NL, DK, A (11)	IN (1)	--
Information disseminated by dedicated web site	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Information disseminated by Media	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Information disseminated by telephone hot line	CH, CA, HK, SG, D, GB, US, JP, NL, DK, A (11)	IN (1)	--

Almost all countries provided information through various modes to general population, media, policymakers, and health workers. Dissemination of accurate, rapid and complete information in all stages of outbreak is an important measure to reduce the panic and fear in general public and target population like health workers, hospitals and stake holders

Table 6: Infection control measures in community Settings

Infection Control Measures in community settings	Yes	NO	Missing Value
Special measures for mass gatherings	CH, CA, HK, SG, GB, US, JP (7)	D, IN, NL, DK (4)	A (1)
Medical staff at air port	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Model and Exercise	CH, CA, HK, SG, GB, US, JP, DK, NL (9)	D, IN, A (3)	--

All countries under study have provided medical staff at airport. Seven countries have implemented special measures for mass gatherings. Nine countries have model and exercises for infection control measures in health care and in community settings.

Table 7: Preparedness and response to health care facilities measures

Preparedness and response to Health care facilities measures	Yes	No	Missing value
Triage guidelines	CH, CA, HK, SG, D, IN, US, JP, NL, DK (10)	GB, A (2)	--
Triage facility	CH, CA, HK, SG, D, IN, US, JP, NL, DK (10)	GB, A (2)	--
Guidance to emergency and ambulance team	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Guidance to primary health care and general practitioners	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
Guidance to Hospital staff	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--
In-Hospital infection control committees	CH, CA, HK, SG, D, IN, US, GB, JP, NL, DK, A (12)	--	--
Guidance to regional public health authorities	CH, CA, HK, SG, D, IN, US, GB, JP, NL, DK, A (12)	--	--
Guidance to laboratory staff	CH, CA, HK, SG, D, IN, GB, US, JP, NL, DK, A (12)	--	--

Except Great Britain and Austria all countries have developed of triage guidelines and triage facilities. Most of the countries under study have provided guidelines and special information materials to emergency and ambulance teams, laboratory staff, in-hospital infection control committees and medical staff at airports. The guidelines generated by all responding countries focus special attention on health care facilities, health care workers, primary health care and general practitioners.

Discussion:**Timely reporting:**

All countries we studied reported WHO 'probable', 'confirmed' and zero SARS cases day to day basis. All countries have had setup contact with WHO through Ministry of health of respective country by appointing a task force and one national focal point to disseminate updated information nationally and Internationally. Some countries provided information to other affiliated organizations also like European commission, ASEAN, SAARC, etc. Countries informed to airport authorities, airline operators, cargo and export import authorities about the status of SARS within the country and internationally. Member states of WHO had international obligation under the IHR to report outbreak of cholera, plague and yellow fever but during SARS outbreak every country under study reported WHO SARS cases considering its seriousness of public health impact, unusual nature, potential of spread within the country and internationally and risk of restriction to travel, trades and its impact on economy and society.

Though the china experienced cases of SARS since November 2002, first official figures of probable cases and deaths in china reported to WHO on March 26th, 2003 it shows that there was some problem with the reporting at local level and at the center and flow of information at national and international level [13, 28]. In early April, there appeared to be a change in official policy when SARS began to receive a much greater prominence in the official media. However, it was also in early April that accusations emerged regarding the undercounting of cases in Beijing military hospitals [5]. After intense international pressure from individual countries, as well as the WHO, People's Republic of China officials allowed international officials to investigate the situation [36]. In late April, major revelations came to light as the PRC government admitted to underreporting the number of cases due to the problems inherent in the health care system [2]. In contrast China, Hong Kong, special administrative region reported SARS more openly. Multi-sectoral hierarchical administrative structure, layered notification system and red tape bureaucracy underestimation of situation caused delay in reporting to SARS cases to central government and WHO [1]. CDC reported the time between disease onset and reporting to CDC increased in the latter phase of the outbreak. This increased reporting lag may reflect the growing surveillance workload as the outbreak progressed, delays in reporting until alternative diagnoses were evaluated, or a

decreasing sense of urgency because of low disease rates and low likelihood of confirmed SARS among U.S. case-patients and lack of evidence for community transmission [16]. This shows that there were different reasons and problems in timely reporting of SARS cases to WHO among the study countries.

Legal framework and Public health law

Law plays a critical role in public health emergencies like SARS epidemic or potential epidemic of other infectious disease. To respond promptly and effectively to SARS a newly emerging disease, countries felt need of an established mechanism to regulate the system of enhanced surveillance, notification and reporting of disease, to disseminate information through correct channel, to improve co-operation in inter-department and across the nation from central to local level, and to implement coercive measures like quarantine, isolation. SARS is a communicable disease and spread by droplets, direct and indirect contact with patient's secretions or fomites [17]. In the absence of effective treatment isolation of cases, suspects and contact was required. SARS was newly emerged disease so it was not included in notifiable disease list. Law in most of the countries was not supporting to isolation, quarantine of contact. The compulsory notification of notifiable disease under the infectious disease act is an exception to the law of medical confidentiality, as statutory law authorizes it. So countries made changes or amendment in infectious disease control and quarantine law.

The countries we studied are of different size, population, political system and with different SARS epidemic situation. Most of the countries found that to implement measures against SARS, existing public health laws are not sufficient, and can't empower public health agencies. Except India and Great Britain all countries under study made amendment in laws related to disease prevention and treatment to make SARS as a mandatory notifiable disease. On March 24th Singapore government [18], and In order to effectively control the spread of SARS in Hong Kong, the Director of Health issued an Order on 27 March 2003 to amend the First Schedule of the Quarantine and Prevention of Disease Ordinance by adding "Severe Acute Respiratory Syndrome" to the list of infectious diseases specified in that Schedule [11]. On April 8, 2003 The Government of China listed SARS as the dangerous infectious disease which must be monitored closely according to the law. No individual or no administration allowed to pamper with delay the reporting information [20]. After that the government

functionaries started reacting to SARS epidemic seriously in china. On April 4, 2003 US government made amendment in Public health service Act to add SARS in notifiable disease list [21]. Canada took the same measures and provided authorities to local and port officials about isolation and quarantines the suspects and their contacts under the law framework [19]. Countries like Japan also reacted to SARS epidemic early but did the law amendment few months after outbreak on October 10, 2003 [22]. Great Britain and India did not make any changes in there present law structure or amendment in notifiable disease list or in quarantine law as they have not experienced any significant transmission of SARS in there country the adequacy of legal powers has not been tested. Despite SARS not being a notifiable disease, surveillance in the most of the countries worked satisfactorily during the global emergency.

Law allows authority to government at all levels to step up a head quarter to handle emergencies, set up an information network from provincial to local level to collect and Update information. Timely notification about the occurrence and spread of infection is crucial for the effective control of infectious disease. Under the Infectious disease Act any person who is suspected to be a case or contact or carrier of an infectious disease may be ordered to undergo surveillance for a specified time period if such a person fails to comply with any condition regarding this surveillance, he shall be guilty of offence.

SARS was not universal in the degree of impact on different population, posing as it did a serious threat to the health of people in China, Hong Kong, Singapore, Vietnam, Canada with limited impact else where. No were responses to SARS universal, some state conferred strong positive powers and duties on institutions and individuals to behave in ways which reduced the threat of disease, some states strengthened existing public powers to bring in to play powers of notification, detention, quarantine and treatment. Some states do not make SARS notifiable disease, and other states have no power of quarantine or detention in relation to any infectious disease e.g. France [25]. The change in law framework and public health law during the epidemic period may not be effective; it may increase confusion among general public and official authorities, but to develop a plan at national level and assign responsibility of safeguard the health, safety, and welfare of its citizens at jurisdiction level legal support is required.

Travel restrictions:

SARS has proved that it has no border limit and spread across the 30 countries within a short time period. Travel to an affected area was the most commonly reported among the cases and time proved epidemiologic link with travel to affected area and SARS spread. To prevent any further spread, stringent action was required in the form of travel restrictions. first case of SARS in Germany and Europe was reported on April 15, 2003 a physician from Singapore, who had treated first case of SARS there, was onboard an airplane from New York on the return journey to homeland, ask to disembark in Frankfurt and immediately hospitalized in isolation this event got the focus of intense international concern [23]. WHO issued a second, stronger alert after this event; countries become more vigilant about the incoming passengers from affected area [24]. WHO issued emergency travel advisory and News of the global SARS epidemic caused the voluntary curtailment of international travel to affected areas. All countries under study issued travel advisories and travel alerts to the travelers traveling to affected areas and updated the list of SARS affected and cases reported countries time to time helped to provide timely and accurate information. Countries with SARS outbreak issued domestic health advice for the travelers traveling to affected area within the country and guided about the measures to protect themselves from SARS. This measure was taken to prevent spread of disease nationwide. Countries with imported cases and no SARS cases issued travel advice for international travelers only as there was no outbreak situation within the country.

Exit screening:

All of the countries in SARS affected group we studied followed the WHO recommendation concerning exit screening for SARS [37], addressing air travel and sea as well as ground. Under the intense pressure of the SARS outbreak, many countries were forced to adopt novel approaches to population risk assessment and disease containment, like screening for symptoms, screening for at risk travelers, ear temperature measurement, thermal screening to identify febrile persons at risk for SARS along with the health declaration. In china they implemented exit screening measures at railway stations and local transport facilities also which was not the case in other countries.

Health screening at arrival:

Health screening at arrival for SARS was carried out by 7 out of 12 countries. Germany, Great Britain, Netherlands, Denmark and Austria countries from Europe did not screened passengers at arrival. Airport entry screening has been advocated for travelers coming from affected areas, but not formerly evaluated as a means of protecting populations from importing infections. Study from Great Britain concluded entry screening is virtually ineffective in preventing or delaying an epidemic resulting from the importation of SARS [26] but, fever screening at airports in Taiwan showed promising results in identification of imported dengue cases. [12] During SARS outbreak, entry screening might not have showed any promising results because several other measures were in action at the same time, the use of exit screening by affected countries, the subjective measures used by affected countries in the screening process, and the very low prevalence of SARS. With current knowledge about SARS, border screening should focus on educating in coming travelers, especially group at high risk of transmitting the disease (the elderly and those with underlying chronic illnesses). Objective screening measures should be used during SARS outbreak to prevent importation of the disease [14]. Health screening at arrival may be considered when host country suspect exit screening at traveler's point of embarkation is suboptimal or if country's internal surveillance capacity is limited.

Guidance and information to travelers:

All the countries under study provided guidance and information to travelers to areas where local transmission is present. This was resulted in reduced travel to the affected area during the outbreak period. All countries under study distributed SARS information leaflets to all incoming passengers at arrival. Great Britain and Austria did not distribute SARS information leaflets onboard to passengers incoming from affected areas. Except Netherlands all countries studied have had posted posters at arrival airport lounges. In major countries, these measures may have prevented imported cases from spreading disease. Distribution of information leaflets and alert notices made travelers aware of main symptoms of SARS; sensitize them about the issue and importance of seeking help if symptoms occur within the said period. Including all SARS affected countries under study India, United States and Japan distributed traceability cards to all passengers coming from affected areas. This measure seems to be more

important and may have more emphasis on informing and educating travelers coming from affected area in accordance to early identification and isolation of suspects.

Surveillance and epidemiology:

Early identification of case clusters, expert laboratory and pathology analysis, timely tracking of contacts, and prompt reporting of findings to public health officials at all levels are the first lines of defense [27]. All countries under study carried out enhanced surveillance activities in their settings for early detection of SARS cases and cluster of atypical respiratory infection, though early clinical features of SARS-CoV diseases are not specific enough to distinguish from other respiratory illnesses and no availability of definitive diagnosis in early phase of illness. At the beginning of the outbreak of SARS the pathogen was not known [29], the diagnosis criteria was based on fever with respiratory symptoms and exposure history i.e. travel to affected area and close contact to probable cases. With initiative of WHO, 11 laboratories in 9 countries worked together and come up with the identified SARS pathogen a new SARS related Corona virus and also developed diagnostic test with in two weeks period.

With the help of WHO suspected and probable case definition most of the countries identified even a single case. Surveillance was heightened for suspected cases of SARS among arriving passengers from affected area. State and local public health departments of study countries carried out enhanced surveillance activity for SARS even in no-SARS outbreak situation. SARS-CoV confirmatory laboratory testing was performed only on patients identified by the surveillance system. This surveillance allowed for rapid and frequent updates to the healthcare and public health communities and to the public on the status of the outbreak. Classification of patients as suspect and probable case-patients was dynamic and often changed as new information became available. This situation sometimes created seeming discrepancies between national and state and local health department case counts, which in turn complicated public communication. The evolution of the worldwide outbreak required frequent modifications of the case definition, and establishing consistent criteria to define a SARS-affected area on the basis of community transmission was difficult. All the countries under study having good established surveillance system at national level since long time this may have contributed to effective surveillance for SARS with rapidly evolving information.

Laboratory guidance measures

Most of the countries assigned centralized SARS testing and serology for SARS-CoV detection in suspected cases. PCR for SARS-CoV was used by all countries. This helped countries to get the exact picture of SARS situation within the country. Except Germany, India and Austria all countries have national protocol for SARS diagnosis. National protocol is important to maintain the quality and standard of diagnosis to make them comparable with in the country and internationally [30]. SARS-CoV confirmatory laboratory testing was performed only on patients identified by the surveillance system.

Every country under study designated at least one Laboratory for SARS investigation and one national reference laboratory to act as country focal point for national coordination of clinical laboratory specimens for SARS diagnosis. Laboratories and institutes from Canada, China, Hong Kong, Germany, Great Britain, Japan, Netherlands, Singapore, and United States worked together with WHO contributed on SARS epidemiological research, Identification of the SARS causative agent and the development of a diagnostic test [31]. All study countries had better facilities and infrastructures in the form of high standard laboratories, technology, staff and funding in there setting for SARS diagnosis and research activities.

Existing PCR diagnostic tests are insufficient to rule out with confidence, the presence of the virus in suspect or probable SARS cases. To confirm the case serology testing takes longer time and required two sample of serum. In this condition central testing is important to maintain the standard and quality of laboratory test. This gives advantage of real time information about the disease in the country. Except Denmark and Austria all countries used both methods PCR and serology for SARS-CoV diagnosis. Some of the countries have national screening and laboratory diagnosis protocol but differ among the countries there should be a standard protocol.

Communication and Education measures

During the SARS outbreak, almost all countries tried to disseminate preventive messages through travel alerts, advisories and other SARS related information rapidly, accurately and completely to target population, health workers, hospitals and stake holders like airlines, shipping corporations. They used electronic media like internet, television and telephone hotline. In the history first time WHO given travel alert and

advisory. The need for education material to heighten the awareness of health care providers and public about SARS to reduce rumors and panic became obvious early in the outbreak. Intensive public education programs through information booklets, posters, advertisements and commercials via the TV, radio and print media carried out by most of the countries. Countries like Singapore, Canada, and Hong Kong, United States made available information in various languages and for various target groups. Singapore dedicated a special TV channel entirely for SARS which operated 12 hours a day. In the absences of effective treatment, vaccination and no reliable point-of-care diagnostic test created atmosphere of rumors and fear around the world. In such condition communication and education are the measures to rely on. Information communicated in a transparent, accurate and timely manner showed effective response to reduce the risk of people exposing themselves unnecessarily to SARS and to ensure that potential SARS illness is recognized and reported as quickly as possible. In affected countries this activities had very much emphasis and allocated lot of funding than imported cases and non affected countries.

Infection Control Measures in Health care, Home and community settings

Appropriate protection of Hospital personnel

Transmission of SARS-CoV in health care works was 0% to 43% in countries under study. In major outbreak areas, it was 19% to 43%. It was observed during the outbreak most of the transmission was in close contacts like family members. Care givers, Health care works and close contact. There are few exceptional examples of Amoy garden residence apartment and Metropole Hotel incidence where casual contacts or sharing of common utility like floor or drainage system proved to be source of infection [32].

Simple personal hygiene measures, barrier nursing and use of personal protective equipments (PPE) played a major role in containment of SARS. After the WHO guidelines and recommendation for the health care works (HCWs) for handling of SARS cases and suspects the rate of secondary transmission dramatically steeped down. All countries under study have implemented these measures in their health care setting by procuring stock of PPE, trained health care personnel in simple personnel hygiene and barrier nursing and correct use of PPE while caring suspect and cases. Activities for education of healthcare workers on SARS control, with written guidelines, pictures, and demonstrations, were undertaken in most of the countries. Full protective

equipment for healthcare workers was also widely available, and such equipment was provided in sufficient quantity. This demanded major resources but all countries provided the required equipments to manage patients and to protect health care workers. Active surveillance of exposed health care workers and contact was carried out in all countries while caring for suspected cases in hospital settings. In affected countries monitoring for absenteeism in all employees of hospital setting and triage facility was done. In SARS affected countries China, Hong Kong, Singapore, Canada SARS suspect and probable cases were managed in negative pressure rooms. China has built a fully dedicated hospital for SARS within a period of a month. In the case of second outbreak of SARS in Toronto the findings indicate that exposure to hospitalized patients with unrecognized SARS after a provincewide relaxation of strict SARS control measures probably contributed to transmission among HCWs [33]. This underscores the need for monitoring fever and respiratory symptoms in hospitalized patients and visitors, particularly after a decline in the number of reported SARS cases. This showed that the sustainability of these measures for longer time is difficult but highly demanded.

Infection control measures in Home and community settings

Suspected cases and contacts that do not required hospitalization were isolated and quarantined in home settings in most of the countries. This was of more concern in outbreak areas; home quarantine was very strictly implemented in China, Hong Kong, Singapore and Canada. In Hong Kong and Singapore home quarantine was monitored by electronic picture camera and telephone if person fails to comply they were punished. Hospitals, University campus, construction sites, and residential apartments were converted in isolation units. In Canada, a high school was closed and 1500 students ordered to home quarantine because of a single case involving a student with symptoms of SARS. In community settings measures like separate waiting lounges for respiratory symptoms and non respiratory symptoms were uses in some countries. “Cough etiquettes” were conveyed in the society, usage of surgical mask and N-95 respirator was advised for persons having respiratory symptoms. In Hong Kong and Singapore millions of SARS protection kits were distributed. Public places like market, hotels, schools, colleges, business centers were closed down in outbreak areas and international seminars, business exhibitions were postponed during that period. In outbreak areas in work setting every employee was asked for temperature check before and after work. Singapore launched daily temperature taking in school settings during

outbreak period, taxi drivers asked to ventilate the interior after every customer and disinfect vehicle after every 8 hours. Medical staff trained with screening and triage guidelines and facility were deployed by all the countries on international airports as per WHO guidelines. In imported cases and non affected countries this measures were practiced in a small scale only if suspect found and evidence of contact. In Hong Kong after the Amoy garden incidence they carried out the inspection of private and government properties for external drainage pipes and carried out cleaning operations for buildings in an unhygienic condition. This points toward the how intensively countries affected by SARS opened front against SARS.

Preparedness and response to Health care facilities measures

For rapid and effective identification of SARS-CoV disease, to exclude other respiratory illnesses and exposed contact except Great Britain and Austria all countries followed the triage guidelines and has triage facility for the management of probable SARS cases, which is important to avoid transmission to health care works, other patients in hospital settings. Fever clinics and make shift rooms are the examples of triage facility this are carried out only in affected countries. All countries prepared emergency and ambulance team to avoid the risk of SARS-CoV transmission during the transportation of Suspected or probable case of SARS to the designated hospital. General practioners and primary health care givers are the one who more likely to confront with the suspected or probable cases. All countries provided guidelines, information and training sessions for them. Training and guidance about the SARS-CoV disease, barrier nursing, correct use of PPE and patient management, communication and information about SARS activity to the local health authority. All countries established in-hospital infection control committee in designated SARS hospitals. Provided guidelines and training to regional public health authorities and laboratory staff.

Currently used measures to prevent transmission of SARS in health care settings were theoretically highly effective, but required proper infrastructure, training, and consistent application to ensure efficacy. Such measures were also extremely resource intensive, socially disruptive, and difficult to sustain over time. Infection control capacity and practices in health care settings needed to make routine. Countries with SARS outbreak used all possible measures to control SARS irrespective of evaluating its efficacy, cost effectiveness, feasibility in long term.

Measures to control community transmission and prevent international spread required further evaluation to determine their effectiveness. Such measures included public information and education campaigns to encourage prompt reporting of symptoms, health alert notice to establishment of fever clinics to relieve pressure on emergency rooms, temperature screening in public places, recommendations to travelers, and entry and exit screening at borders using questionnaires and temperature checks. The effectiveness of contact tracing and voluntary isolation or quarantine of contacts had been demonstrated its purpose.

Control measures in the community would have the greatest impact if focused on links between health care settings and the wider community, contact tracing prioritized according to the nature of exposure. Home or institutional quarantines, included in control strategies of all countries whether they had SARS cases or not, financial support for SARS control activities were allocated by all countries.

More than 98% cases were in SARS outbreak countries and only 118 cases occurred in other 14 countries out of that 106 were demonstrated links with travel to outbreak country. It shows the disease burden on the outbreak countries. The magnitude of the disease was far more in outbreak countries than countries with SARS imported cases and non-SARS case countries. Newly disease, no much information, absence of definitive diagnostic test, higher rate infection and death rates in health care providers, rumor and fear in general public this factors forced governments in SARS outbreak countries to take stringent actions and implement all possible measures to control SARS within the country and not to spread any further in other areas. To implement all those measures at different level was difficult task, demanded resources which may not have sustain for a longer time. Fortunately SARS outbreak came under control with in a few months. Countries with imported cases implemented measures according to their perception of risk of importation of infection within the territory and the risk of population. Non SARS affected countries became vigilant and carried out preparedness exercises against SARS during that period.

Conclusion:

Control of SARS is a success story. Growing inter-dependence of nations with respect to economics and commerce has led to similar link between nations regarding concern over global spread of newly emerged disease. Coupled with its ease of transmission and high cross-border mobility, necessitated a rapid learning process that involved networks and institutions working around the world, accurate epidemiological information, suggestions for public health interventions. Control of SARS-CoV infection all over the world was a result of collective efforts. In the absence of effective treatment, vaccine and point care diagnostic test a disease spread in 30 countries contained within a period of 6 month is a great achievement in the today's world.

Figure 1. Summary box

SARS spread across the nations because of

- Failure to identify and report cases in early phase of outbreak
- Absence of a minimum level of safe practice at health care setup

Figure 2. Summary box

SARS Contained because of

- Global and National leadership's strong commitment
- Coordinated global response and information sharing
- Transparency, accuracy and timely reporting of cases at local and global level
- Real time based surveillance and disease reporting system at local and national level
- Adaptation of health system according to surged conditions and advanced knowledge
- Implementation of complying multitude of public health and public related policies
- Vigilance and preparedness

In perspective, the threat of newly emerging diseases like SARS, Avian influenza there should be a minimum level safe practice at local, regional, national and international level i.e. standard precaution supplemented by risk-based precautions. There should be time to time evaluation of current policies and contingency plan.

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Appendix

Certificate of Originality

I hereby certify that the master thesis, I am submitting for the partial fulfillment of the Master degree in Public health, is fully and completely original to me and that I neither copied, improperly used, nor otherwise violated any rights of any third party in preparing and submitting the paper and that it was not partially or in whole written, revised, or substantially edited by anyone other than me.

Rajesh Mali

Hamburg, February 28, 2006

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