Epidemiological Characteristics of COVID-19 and Efforts to Prevent Community Transmission: The Sri Lankan Experience

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Abstract

Background – With the onset of COVID-19 pandemic, the government of Sri Lanka took proactive measures to prevent a community outbreak in the country. This paper describes the measures taken by the government in the initial stages to contain the virus, along with the epidemiological characteristics of the first 200 laboratory confirmed COVID-19 patients.

Methods – Telephone interviews were conducted for first 200 consecutive patients diagnosed with COVID-19, after obtaining informed verbal consent. Descriptive data are presented as binary variables and in frequency distribution tables.

Results - From the diagnosis of the first patient, 76 days elapsed for the first 200 patients to be diagnosed. Majority were males in the 40-49 age group. There were three foreign nationals, while others were Sri Lankans. Among the Sri Lankans, 81 (41.1%) had an overseas travel history. Following implementation of the cohort quarantine concept, 47% of the overseas returnees were reported from quarantine centres. Over two-thirds of the patients presented with symptoms (n=137, 68.5%) and the most common symptoms were fever, cough and sore throat. The case fatality rate for the sample was 3.5%. out of the 200 patients, 103 (51.5%) were primary patients, while 92 (46%) were secondary patients. The source of exposure could not be determined for five patients.

Conclusions – Due to measures instigated by the government, such as cohort quarantining, extensive contact tracing and testing of close contacts, Sri Lanka was able to prevent a wide spread community outbreak of COVID-19.

Introduction

The novel corona virus disease, which was first detected in Wuhan, China as a pneumonia of unknown origin, has spread to all regions of the world at an alarming speed, causing one of the worst pandemics the world has witnessed in the recent history. To date, it has affected 216 countries with over 15 million cases and 600,000 deaths (1).

Sri Lanka, being an island, is at an advantage of not receiving any imported cases by means other than ports of entry. However, as the country is highly dependent on tourist industry and foreign employment for revenue generation, introduction of the infection into the country could not be prevented, and many primary cases were detected among foreign nationals touring the country and Sri Lankans employed abroad returning to the country. Sri Lanka was able to detect the onset of the outbreak and take necessary measures to contain the spread, owing to the highly vigilant public health surveillance system, while many other countries experienced difficulties in identifying the onset of the outbreak.

Sri Lanka has a well-established preventive health care system, delivering comprehensive preventive health strategies as integrated packages at the field level, through public health staff at Medical Officer of Health (MOH) units. MOH units are geographically demarcated units, headed by a MOH, who is a MBBS

qualified medical officer, and is supported by a team of qualified health workers. Overall technical guidance and expertise for communicable disease control and prevention is provided by the National Epidemiology Unit, Ministry of Health. The technical guidance is coordinated to the field level via Regional Epidemiologists and further guidance is provided by Public Health Specialists at district and provincial levels.

Presence of such an organized system enabled the country to act proactively in preparation for the COVID-19 pandemic. The COVID-19 response was initiated based on the National Influenza Pandemic Preparedness Plan (NIPPP). Later, COVID-19 specific strategies and guidelines were incorporated for effective disease control, and were updated with evolving global evidence of the disease. Adequate isolation centres were identified in designated curative healthcare institutions for early referral and sample collection from COVID-19 suspected patients for laboratory confirmation via PCR testing. All COVID-19 confirmed patients were treated at curative care hospitals designated for COVID-19 where specialized attention for patient management and health care staff protection is assured. The capacity of the public health staff was strengthened for early case detection, contact tracing and prevention of community transmission of the infection.

With these measures in place, the first patient in Sri Lanka was reported on 27th January, 2020, and the second patient was reported 44 days afterwards, on 11th March, 2020. The time period between the first two cases was a crucial period for the country in preparation for the impending outbreak. A significant number of Sri Lankans in China were returning to the country, and maximum efforts were made to identify them at the airport to ensure home quarantine for 14 days. All persons who entered the country from January 2020 were approached through public health care system, and completion of recommended quarantine period of 14 days was ensured.

At the same time the Sri Lankan government took a number of measures to prevent the importation of cases in to the country. International tourism was temporarily suspended, and cohort quarantine concept was introduced for Sri Lankans returning from overseas. Facilities for cohort quarantine were designed by the government, under the guidance of the Epidemiology Unit.

All persons entering the country through ports of entry since 10th March 2020 were subjected to cohort quarantine for 14 days and were released initially based on the clinical absence of the disease, and later, following a negative PCR test at the end of 14 days. Upon returning to their residences, these individuals were quarantined for additional 14 days under the supervision of the field level public health care staff, as a measure of further ensuring prevention of community transmission.

The strategic approach adopted for disease mitigation ensured that the outbreak experienced by the country was limited mainly to imported cases and import related cases. This paper aims to share the Sri Lankan experience, the efforts taken to prevent community transmission in the initial stages of the outbreak, the successes and challenges encountered; and the epidemiological characteristics of the first 200 COVID-19 patients.

Methods

First 200 laboratory confirmed COVID-19 cases entered in the national COVID-19 surveillance Register were recruited for a descriptive study. Telephone interviews were conducted with all patients, and verbal consent was obtained after explaining the need for collecting relevant data- socio demographic information, COVID-19 risk exposure history, travel history, onset of symptoms and final outcome details. Epidemiological information collected by a public health physician for each patient was later cross checked with the national surveillance data to ensure accuracy.

Statistical analysis was conducted using the SPSS version 22. Descriptive data are presented as binary variables and in frequency distribution tables.

The COVID-19 patients were categorized as “primary” or “secondary”, based on the nature of exposure to the infection. Primary cases were further subdivided as “imported” or “import related” cases, based on the possibility of importation of the infection into the country. Overseas returnees who were diagnosed on arrival, or within 14 days of arrival to Sri Lanka, were defined as “primary imported cases”, in the absence of any contact history within the country. Any person who has had direct contact with a tourist or a recent overseas visitor within 14 days of diagnosis, without any other contact history, was categorized as an “import related primary case”. Cases with an identified history of exposure to a COVID-19 confirmed case in the country were categorized as “secondary cases”.

Results

The first COVID-19 case in Sri Lanka was a “primary imported” case, detected among a group of tourists on 27th January, 2020, who was a 43-year old female from Wuhan, China. Based on the travel itinerary and places visited by the travel group, 43 close contacts were identified by the public health care staff. They were quarantined for 14 days and followed up for development of signs and symptoms but no cases were reported among this group.

The second confirmed COVID-19 case was a Sri Lankan tourist guide, reported on 11th March 2020. He had developed signs and symptoms suggestive of COVID-19 while travelling with an Italian tourist group.

Henceforth, the country has experienced an outbreak situation, with 200 patients occurring within 76 days from the initial imported case. Occurrence of first 50 cases took 51 days while the second 50 cases were experienced within 6 days. The next 50 cases were reported within 9 days of reporting the 100th case while 200th case was reported on 12th April 2020, 10 days following reporting of the 150th case. All 200 cases were confirmed as COVID 19 by performing PCR testing. Approximately 1500 close contacts were identified for the initial 200 cases and close to 30,000 PCR tests had been performed.

The epidemiological curve of initial 200 COVID-19 cases shows several peaks (Figure). The initial peak coincides with reporting of patients among Sri Lankan overseas returnees from Italy (43 cases) and South Korea (2 cases). The second wave was caused by a group of pilgrims returning from Indonesia

and their close contacts. This resulted in the highest peak among the initial 200 cases, with 21 patients being detected within one day. The last peak was due to a cluster observed from Suduwella area in the Gampaha district due to a transmission initiating through a probable import related case.

The age of the study group ranged from 4 months to 85 years, with the highest number of cases being reported among patients in the 40-49-year group (n = 46, 23%). The mean age was 39.5 (SD $\pm$ 17.7) years and the median age was 41 years. Majority of patients were males (63.5%) with a male to female ratio of 1.7:1. Highest sex difference was reported in the 60 to 69 age group, with a male: female ratio of 4.7:1, while this ratio was reversed in 70–79 age group (0.75:1) (Table 1).

Table 1
Age and sex distribution of diagnosed patients

Age category	Male	Female	Total No	Male: Female
1_10	7(3.5%)	4 (2%)	11	1.75:1
10_19	7(3.5%)	7 (3.5%)	14	1:1
20_29	23(11.5)	13(6.5)	36	1.77:1
30_39	19(9.5)	17(8.5%)	36	1.12:1
40_49	33(16.5%)	13(6.5%)	46	2.54:1
50_59	19(9.5%)	11(5.5%)	30	1.73:1
60_69	14(7%)	3(1.5%)	17	4.67:1
70–79	3(1.5%)	4(2%)	7	0.75: 1
> 80	2(1%)	1(.5%)	3	2:1
Total	127(63.5%)	73(36.5)	200	1.74:1

There were three foreign nationals among the first 200 patients, who were detected within 14 days of arrival in Sri Lanka for tourism purposes. Rest of the 197 patients (98.5%) were Sri Lankans. Among them, 81 (41.1%) had an overseas travel history, and had developed symptoms within one incubation period on returning to Sri Lanka, compatible with a risk exposure at countries travelled by them. Majority of these cases have returned from Italy (43, 51.1%), Indonesia (11, 13.6%, United Kingdom (8, 9.9%), and India (6, 7.4%) (Table 2). The foreign nationals and the Sri Lankan patients with an overseas travel history were categorized as “primary imported” cases.

Table 2
Characteristics of the first 200 COVID-19 patients diagnosed in Sri Lanka

Characteristic	Number	Percent
Travel History (N = 200)		
Foreign Nationals (China, France, India)	3	1.5
Sri Lankans with foreign travel in preceding 14 days	81	40.5
Sri Lankans without recent foreign travel	116	58.0
Countries of Sri Lankan returnees (N = 81)		
Italy	43	53.1
Indonesia	11	13.6
UK	8	9.9
India	6	7.4
Germany	2	2.5
Qatar	2	2.5
South Korea	2	2.5
UAE	2	2.5
Pakistan	1	1.2
Saudi Arabia	1	1.2
Singapore	1	1.2
Thailand	1	1.2
USA	1	1.2
Type of exposure to disease (N = 200)		
Travel history/ foreigners Exposure to a tour group/tour guide	93	46.5
Close contacts of a diagnosed/suspected case	102	51
No definitive exposure	5	2.5

Table 2

Out of the Sri Lankans with an overseas travel history, 43 cases (53%) were detected in the community, either through active community-based surveillance system (19 cases, 23%) or voluntary visits to COVID-19 isolation hospitals with signs and symptoms (24 cases, 30%). Remaining 38 cases (47%) with overseas travel history were diagnosed at designated cohort quarantining centres maintained by the

government. Approximately 74% (27 cases) of these 38 cases have been detected from one quarantine centre (Kandakadu) in the Polonnaruwa district. This centre has received the majority of overseas returnees compared to other centres during this period, which was approximately 550 in number.

There were 103 (51.5%) primary cases, categorized as either “primary imported” (84, 81.6%) or “primary import related” (19, 18.4%), and 92 (46%) “secondary” cases, who had developed the disease following exposure to a primary case. The exact source of exposure could not be ascertained for five cases, which included three health care workers, one person with a possible exposure to a tourist, and one person without any identifiable exposure history. However, no disease transmission was observed from these five cases.

Among the “secondary” cases, 79 (86%) had contracted the infection in the first cycle of transmission, and have transmitted the infection to 13 others (15%), leading to the second cycle of transmission. No further transmission was detected beyond this level. The majority of secondary cases were family members of overseas returnees living in the same household with them (61, 66.3%), and the rest were close associates of the overseas returnees (31, 33.7%). The shortest observed duration of exposure between primary and secondary cases was approximately 30 minutes.

One exceptional situation was reported when an infected Sri Lankan priest residing in Switzerland, oblivious of his infected nature, visited Sri Lanka and conducted a service for a gathering. All close contacts were quarantined when his infectious status was revealed later, and six secondary cases resulted from this group.

Among the 200 patients, 137 (68.5%) were symptomatic at the time of diagnosis. The most common presenting complaint was fever (81.2%), followed by cough (64.5%), and sore throat (19.6%). Non-specific symptoms such as body aches (13.8%), headache (15.9%) and fatigability (11.6%) were also reported along with major symptoms. Altogether, 106 (77.4%) symptomatic cases reported more than one symptom, the commonest combination being fever and cough (22, 16.1%). Rest presented with only one symptom, the commonest being fever (13, 9.5%) or cough (10, 7.3%). Symptoms suggestive of more severe disease such as shortness of breath were found among 7.2% of patients (Table 3).

Table 3
Common symptoms presented by patients and
outcomes of the disease for diagnosed patients

Major Symptom (N = 138)	No	Percent
Fever	112	81.2
Cough	89	64.5
Sore Throat	27	19.6
Runny Nose	19	13.8
Shortness of breath	10	7.2
Headache	22	15.9
Diarrhoea	6	4.3
Vomiting	2	1.4
Fatigue	16	11.6
Body Ache	27	19.6
Chest Pain	4	2.9
Outcomes of the disease (N = 200)		
Recovered	193	65.5
Death	7	3.5

With the revision of the initial case definition and testing strategies by the 3rd week of March 2020, all close contacts of COVID-19 cases were subjected to PCR testing, and 64 asymptomatic cases detected by this means.

Out of the 200 cases, seven patients developed severe disease and died, giving a case fatality rate of 3.5%. All deaths had occurred among males between the ages of 44 to 80 years, with a mean age of 60.86 years (SD $\pm$ 12.6). All seven were admitted to hospitals with fever and cough. Out of them, three cases had overseas travel histories (Germany, India and Italy) within 14 days prior to onset of symptoms. There was a delay on average of 5.14 days from the onset of symptoms to date of admission, and the hospital stay ranged from 1 to 25 days, with a mean duration of 11 days (SD $\pm$ 7.8).

Rest of the 193 patients, including the three foreign nationals, recovered completely without complications. The duration of hospital stay for these patients ranged from 5 to 66 days (mean 26.8 days, SD $\pm$ 13.9).

Discussion

This paper reports the results of the first comprehensive epidemiological analysis of the initial 200 laboratory confirmed COVID-19 cases in Sri Lanka with case categorization based on risk exposure histories, and the public health response in preventing community transmission of the disease. Such epidemiological assessments are vital for further strengthening of the health system for successful control of COVID-19 outbreak.

Sri Lanka, being a popular tourist destination, is at a high risk of a wide spread community outbreak in the absence of adequate control measures. However, the country was able to successfully manage the initial stage of the COVID-19 outbreak through sound epidemiologically guided strategies. Global evidence and strategic directions were closely followed by the National Surveillance Programme in the wake of the pandemic, and active surveillance of foreign tourists was initiated in an attempt to identify imported cases. As a result of this vigilance, the first case, who was a foreign tourist, was detected. The first COVID-19 case in Sri Lanka was reported on 27th January, 2020, only a few days before the disease was declared a Public Health Emergency of International Concern by the World Health Organization. Immediate and extensive contact tracing which followed this detection, prevented the establishment of disease transmission from this patient. The second patient being a tourist guide indicated the possibility of importation of cases with continued tourism. Acting on the epidemiological directives, tourism was temporary halted in the country, and Sri Lankan returnees were subjected to cohort quarantine under government supervision. These actions contributed to curtailing the outbreak in the initial stages.

The cohort quarantine policy endorsed by the government aimed at preventing imported cases for establishing the transmission within the country. The effective implementation of this strategy was ensured through a multi-sectoral approach, with the support of the tri-forces. This was initially restricted to individuals returning from identified high risk countries, which was later expanded to include all overseas returnees entering through all ports of entries. The success with regard to preventing community transmission and the cost effectiveness of this strategy will be assessed in future.

The long lag time between the first patient and the second patient has been experienced by a number of other countries. This could be owing to the extra vigilance and application of individual and community based preventive strategies such as lockdown measures, or not capturing the asymptomatic cases. It was also observed that a long duration has taken for reporting of the first 200 patients in Sri Lanka when compared to other countries (United Kingdom reported first 200 cases in 33 days and Italy in 25 days) (1).

Few notable clusters are depicted in the epi curve, which were successfully controlled via rigorous measures imposed to interrupt transmission.

The majority of patients being in the young adult and middle age group could be an artifactual illustration, as the majority of the first 200 patients were overseas employees/ travellers in the productive age group. However, this finding coincides with the emerging global evidence which suggests that the infection is common among the young adult age group. Analysis of epidemiological characteristics of 44,672 confirmed patients in China revealed that majority of patients were between 30–79 years (2). The

older and most vulnerable groups for the disease may have been protected by interrupting COVID-19 transmission beyond limited clusters.

Males being the majority affected based on the country epidemiology could be attributed to travel preponderance by males, and further information is required to exclude the possible confounding effect of travel.

Prior to the outbreak, the existing surveillance system was strengthened to facilitate prompt source detection and contact tracing. With the onset of the outbreak, meticulous case investigations were conducted, focusing on identifying the source of exposure and all possible contacts of the COVID-19 cases, and the contacts were followed up for early case detection. These strategies were successful in limiting the secondary cases to only 34% during initial period of the outbreak. Further, transmission of the disease beyond two incubation periods was also not observed. The capacity of containing the virus with well-planned outbreak response strategies has been tested and proven in China with regards to COVID-19 (3), and was re-confirmed in Sri Lanka. These efforts were made possible by the presence of a designated team of public health staff at field level to provide integrated preventive health care. The lessons learnt through this endeavour are valuable for further strengthening of preventive health care in the country.

Despite extensive investigations, the exact source of exposure could not be ascertained for five cases. This could be attributed to programme errors such as failing to identify asymptomatic cases transmitting the disease, or well-known system errors such as false positive PCR results. A probable source of exposure was presumed for three health care workers at their health care settings, and the fourth case could be linked to a group of tourists, though the history was vague and uncertain. No possible source of exposure could be ascertained for the fifth case. All five cases recovered without giving rise to secondary cases, re-iterating the possibility of asymptomatic transmission or the false positive results.

Since SARS-CoV-2 has the possibility of causing severe disease in human, (4) attempts were made to evaluate the symptoms presented by COVID-19 patients. Majority presented with common respiratory tract symptoms (cough, fever, sore throat), similar to the pattern of symptoms observed around the globe (WHO-China). Severe symptoms were not commonly experienced by this group, probably as the majority was healthy individuals in the productive age group.

However, seven cases progressing to severe disease, giving rise to a case fatality rate of 3.5% is alarming at the beginning of the outbreak. The overall case fatality rate of China was reported as 2.3% by the February (5). The CFR of Italy was as high as 4.96%, while Spain and France have reported a value as low as 1.70% (6). All seven deaths have occurred in males, indicating that the disease tends to be severe in males. This is consistent with global evidence, which suggests a high case fatality rate in males, probably due to risk factors such as smoking (7). Further, the age range of the deaths were much lower than the age range reported by other countries (5). The outcome of the disease is reliant on many factors such as the patient factors, epidemiology of the disease, preparedness and the capacity of the health system to cope with the outbreak (8). Consequently, the disease fatality rate for COVID-19 has varied considerably between countries (6) as well as between patient groups, based on factors such as age, and

presence of co-morbidities (5). Being a novel disease, the outcome of COVID-19 has improved with advancement of standards of care in line with accumulating evidence of the infection. It has been noted that in China, the Crude Fatality Rate has improved from 17.3–0.7% as time passed (9).

The presence of asymptomatic patients, who may transmit the disease unwittingly, is an important concern in the international arena, and the rates vary between 4% and 41% in different countries (4, 9, 10). Sri Lanka had detected a considerable proportion of asymptomatic cases by 12th April, 2020 (31%), as a result of revising the testing strategy in mid-March, which recommended testing of all close contacts of COVID-19 diagnosed cases. Categorization of these patients as pre-symptomatic, post-symptomatic and truly asymptomatic cases is important and will be evaluated in a separate study. Identification of the truly asymptomatic proportion and investigating into the probability of asymptomatic transmission is vital for providing programmatic guidance on investing in asymptomatic case detection.

The main drawback of this descriptive study was the possibility of recall bias when data were collected through telephone interviews. This limitation was addressed through cross checking the provided information with the existing National COVID-19 Surveillance Register data.

In conclusion, the epidemiological pattern depicts that Sri Lanka has been successful in keeping the outbreak of COVID-19 under control within the country. Early preparedness and proactive decision making by the responsible authorities at the Ministry of Health, well-organized surveillance system in the country, accountability and the dedication of the central and field level public and clinical health care staff with multi-sectoral approach enabled the country to prevent community transmission that would otherwise have overwhelmed the health resources and have led to thousands of deaths. It is recommended that the country carries out a retrospective cost-effectiveness analysis of control measures implemented for the COVID-19 outbreak.

Abbreviations

COVID-19
corona virus disease

Declarations

Ethics approval and consent to participate

Epidemiology Unit, Ministry of Health data review board exempted the requirement of ethical approval as only epidemiological related data were collected as a component of routine case investigation.

Availability of data and materials

The datasets are available from the corresponding author on reasonable request.

Conflicts of interest

Authors declare that they have no conflicts of interest.

Authors contributions

MK, DG and SW contributed to concept development; writing and editing of the manuscript. SG, SS, PP, TR, CJ, HM, AP and TH reviewed and finalized the document.

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Figures

Figure 1

Epi graph of first 200 COVID-19 patients in Sri Lanka according to the date of confirmation