参議院予算委員会資料

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補足資料

（3）日本に於ける新型コロナウイルス・パンデミックの抗体検査結果の比較と分析

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English version

Original Japanese version is available below:
https://www.ric.u-tokyo.ac.jp/topics/2020/ig-20200716_all.pdf

Supplementary material (3)

Title: Analysis of Antibody Tests for Coronavirus Disease 2019 (COVID-19) conducted in Japan

Submitted to the Japan's National Diet, House of Councilors, Budget Committee Meeting on "Measures against COVID-19" on July 16, 2020

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Purpose

This report aims to provide policy implications based on the statistical analysis of the three large-scale antibody tests for Coronavirus Disease 2019 (COVID-19), conducted by three institutions in Japan. These institutions include the Japan's Ministry of Health Labor and Welfare (MHLW), the Council for COVID-19 Antibody Measurement (Council), and the SoftBank Group Corp (SoftBank). These antibody tests were implemented between early May 2020 and early June 2020 to measure the seroprevalence of antibodies to "severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)" as a proxy for a past infection rate.

Of note, the World Health Organization (WHO) announced "COVID-19" as the name of this new *disease* on 11 February 2020, while the International Committee on Taxonomy of Viruses (ICTV) announced "SARS-CoV-2" as the name of the new *virus* on the same day.

Major Findings and Policy Implications

1) Absence of Experts in Statistics in Interpreting the Test Results:

The most serious problem is that there was no expert in statistics who was involved with the interpretations of the antibody tests conducted by MHLW and SoftBank -- to the best of the knowledge of this report's author (Dr. Byung-Kwang YOO). Without analyses by a statistical expert, it is impossible to (a) detect (i) the changes in the seroprevalence of antibodies to SARS-CoV-2 (as a proxy for a past infection rate) over time, (ii) the differences in the seroprevalence of antibodies across geographic areas, and (b) identify specific occupations with a higher infection risk.

To interpret a possible difference in the seroprevalence of antibodies to SARS-CoV-2, a statistical analysis is needed to test whether the difference is statistically significant or not. In other words, such an interpretation needs an estimation of a 95% confidence interval (CI) as well as a point estimate. As a general interpretation, if the CIs of the two groups in comparison are overlapping, there is no statistically significant difference between these two groups.

2) Comparison of Test Results by 3 Different Institutions in Tokyo Prefecture:

According to my analysis, the seroprevalence of antibodies in Tokyo prefecture (Table 1) was estimated as follows: MHLW (Point estimates ranged between 0.20% and 0.30%, 95% CIs ranged from 0.06% to 0.66%), Council (Point estimates ranged between 0.60% and 0.80%, 95% CIs ranged from 0.12% to 2.04%), SoftBank (Point estimates ranged between 0.37% and 0.70%, 95% CIs ranged from 0.27% to 0.86%). MHLW used two types of antibody test machines (Abbott ® and Roche®). There was no statistically significant difference in the seroprevalence of antibodies in Tokyo prefecture between these two types of antibody test machines (p-value >.05).

At least one of these two types of antibody test machines showed that there was no statistically significant difference in the seroprevalence of antibodies (a) between MHLW and Council and (b) between MHLW and SoftBank. Despite no significant difference in the seroprevalence of antibodies among the test results by the three institutions, the estimated number of Tokyo residents with a past infection ranged from around 8,000 (i.e., a lower bound of a 95% CI) to around 280,000 (i.e., an upper bound of a 95% CI). In order to make these 95 % CIs closer, i.e., making a more accurate estimation, we need to increase the number of test samples.

3) Comparison of Test Results Across 3 Prefectures: Tokyo, Osaka and Miyagi:

MHLW used two types of antibody test machines (Abbott ® and Roche®) for all of their three sites: Tokyo, Osaka, and Miyagi prefectures (Tables 1 through 6). My analysis indicated that there was no statistically significant difference in the seroprevalence of antibodies among these three prefectures. This was because at least one of the two types of antibody test machines showed that there was no statistically significant difference in any pair of these three prefectures (p-value>.05). These results could be interpreted that the past infection rate was the same among these three prefectures.

However, I think it more reasonable to interpret that the sizes of the test samples (around 2,000 - 3,000 per site) were too small to detect the potential difference in the past infection rate among these three prefectures. In order to observe a potentially statistically significant difference between Tokyo prefecture (Point estimates ranged between 0.20% and 0.30%, 95% CIs ranged from 0.06% to 0.66%) and Osaka prefecture (Point estimates ranged between 0.34% and 0.54%, 95% CIs ranged from 0.16% to 0.87%), at least 300,000 samples per site (per day) were needed. Likewise, at least 40,000 samples per site (per day) were needed to observe a potentially statistically significant difference between Tokyo prefecture and Miyagi prefecture (Point estimates ranged between 0.1% and 0.23%, 95% CIs ranged from 0.02% to 0.48%).

4) Substantial Restrictions of Past PCR Tests in 3 Prefectures:
My analysis implied that the past use of the polymerase chain reaction (PCR) test was restricted to a remarkable extent. This analysis calculated the ratio, dividing "estimated past infection rate, being equal to the seroprevalence of antibodies (numerator)" by "observed past infection rate, based on the cumulative number of the PCR test-positive cases, (denominator)" (Tables 3 and 6). This ratio was at most 54 times (Tokyo), 44 times (Osaka) and 120 times (Miyagi), using an upper bound of a 95% CI.

According to a WHO statement (issued on March 8, 2020), around 20% of the infected require hospital care. That is, in the worst scenario, only 1 in roughly 10 (=54 times*20%) patients was estimated to receive a PCR test among those who were infected and in need of hospital care. If the PCR test sensitivity (70%) is additionally assumed, only 1 in approximately 7 (=54 times*20%*70%) patients was estimated to have a PCR test-positive result among those who were infected and in need of hospital care. A PCR test-positive result is so important that it is required to provide some treatment options including a medication prescription for COVID-19. Similarly, among those who were infected and in need of hospital care, a PCR test-positive result was obtained by only 1 in 6 (=44 times*20%*70%) patients in Osaka prefecture and as small as 1 in 17 (=120 times*20%*70%) patients in Miyagi prefecture.

5) Occupations and Geographic Areas with a Higher Infection Risk:
To identify specific occupations with a higher infection risk, the results on the seroprevalence of antibodies from SoftBank were useful (Table 7). Those who worked in the health care industry were statistically higher in the seroprevalence of antibodies than those who worked for SoftBank (p-value < .0001). Among those who worked for SoftBank, the seroprevalence of antibodies was statistically higher (p-value < .0001) for those working in a call-center than those working at a retail shop and a regular office (0.04% and 0.16%, respectively, without a statistically significant difference between these two subgroups).

Also, there was a statistically significant geographic difference in the seroprevalence of antibodies among those who worked for the health care industry, e.g., Tokyo prefecture (3.09%) was higher than all other prefectures (1.41%; p-value $<$.001). In addition, SoftBank results include the seroprevalence of antibodies among five more detailed occupation categories within the health care industry, without any statistically significant difference across these five categories. As a policy implication, frequent PCR tests and/or antigen tests are expected to be implemented frequently among the occupations and the area whose seroprevalence of antibodies was found to be higher in this analysis.

The Supplemental Detailed Explanations for the Key Findings.

1) Brief overview of the antibody tests by 3 institutions

1-A) Test by MHLW
Source: https://www.mhlw.go.jp/content/000640287.pdf

- *"Tests were conducted in Tokyo, Osaka and Miyagi prefectures from June 1st to 7th, 2020. The sample was randomly selected from volunteer residents (Tokyo (1,971 individuals), Osaka (2,970 individuals) and Miyagi (3,009 individuals)), i.e., 7,950 individuals in total)."*
- *"To make a more accurate judgement of a test-positive, MHLW's criteria defined a "test-positive" to be positive in both types of the test machines (Abbott® and Roche®)."*

1-B) Council
Source: https://www.ric.u-tokyo.ac.jp/topics/2020/ig-20200531v04.pdf

- Patients visited clinics and hospital outpatient care located in Tokyo, without any COVID-19 symptoms
- 500 samples were collected on May 1st and 2nd, 2020. Another 500 samples were collected from different patients on May 25th, 2020.

1-C) SoftBank
Source: https://group.softbank/system/files/pdf/antibodytest.pdf

- Employees of SoftBank and those of SoftBank's business partner companies (38,216 cases) and those who worked in the health care industry (5,850 cases)
- Implemented between May 12 and June 8, 2020.
- Further details are in the footnotes of Table 7.

2) Estimation of the Past Infection Rate (Based on the Seroprevalence of Antibodies) and the Number of the Infected

2-A) Inappropriate criteria, defined by MHLW, to estimate the past infection rate:
From a statistical viewpoint, MHLW's criteria (described in 1-A above) are not appropriate for estimating the past infection rate based on the seroprevalence of antibodies yielded by the two types of antibody test machines (Abbott® and Roche®). The inappropriate criteria clearly biased the estimate of seroprevalence of antibodies (i.e., the past infection rate) downward. MHLW's criteria are inappropriate for three reasons explained hereafter.

The first reason is that the results from two different types of test machines should have been treated as "statistically independent." Being "not statistically independent" is exemplified by a case where two laboratory technicians used exactly the same test machine with exactly the same test-samples, but these technicians worked during different hours, which produced different test results. Such a "not-statistically-independent" case is not applicable for MHLW's tests, in my understanding. MHLW should have clarified why their test results were "not statistically independent," which could justify their criteria.

The second reason is that MHLW's inappropriate criteria do not theoretically enable you to estimate a statistical 95% confidence interval (95% CI). This is because their criteria do not follow any statistical distribution that could be reasonably justified. Instead, my analysis assumed that all proportions follow a binomial distribution in estimating 95% CIs, unless otherwise specified.

The third reason is that the most accurate method to estimate the past infection rate is to exclude the false-positive cases and to include the false-negative cases, using a mathematical simulation. This method is explained in more detail in the following subsection (2-B). My simulation results appeared to have a low validity. For instance, some estimates of the past infection rate were (a) a negative value (that cannot happen) and (b) more than 20% (which is quite unlikely). These estimates, with a low validity, could be explained by the small sample

sizes and the low seroprevalence of antibodies. Therefore, this report does not derive any policy implication from my simulation results, which were added to the bottom rows of Tables 1-6 only for reference.

Moreover, my analyses did not find any statistically significant difference in the seroprevalence of antibodies between the two types of the test machines (Abbott® and Roche®) in any of the three sites. Therefore, from a statistical viewpoint, it is more reasonable to present the results from both of the two types of the test machines. Namely, it is more reasonable to interpret that the true past infection rate is likely to be between the estimated 95% CIs for the two types of the test machines.

2-B) The most accurate method to estimate the past infection rate, using the two types of antibody test machines (Abbott® and Roche®):

When you use the test results from the two types of antibody test machines (Abbott® and Roche®), you have to distinguish the eight possible consequences. These consequences are labelled as Group 1 through Group 8 in Figure 1. In this tree-like figure, text above a branch indicates the features of each group. For instance, Group 1 includes individuals who are "truly positive (with an actual past infection)," "test-positive with Abbott®" and "test-positive with Roche®."

Also, text below a branch indicates the probabilities of each group. For example, those who had the two tests will belong to Group 1 with the probability, which is defined by the multiplication of "the past infection rate," "the sensitivity of Abbott®," and "the sensitivity of Roche®."

This tree-like figure helps demonstrate the underlying concept of this method. In order to estimate the past infection rate, you have to sum the probabilities of Group1 through Group 4, i.e., "true test-positive" and "false test-negative." However, we could only observe the following four probabilities: "the mix of Group 1 and Group 5 for those with two test-positive results," "the mix of Group 2 and Group 6 for those with test-positive with Abbott® and test-negative with Roche®," "the mix of Group 3 and Group 7 for those with test-negative with Abbott® and test-positive with Roche®," and "the mix of Group 4 and Group 8 for those with two test-negative results." In other words, for estimating the past infection rate, you have to exclude the probabilities for Group 5 through Group 8, i.e., "true test-negative" and "false test-positive" from the observed probabilities.

For this estimation, my analysis used the values of sensitivity and specificity of each test machine type, which were reported to the U.S. Food and Drug Administration (FDA) listed below Figure 1. To address the uncertainties of sensitivity and specificity for the test machines, my analysis performed a probabilistic analysis with Monte Carlo simulations by assigning parameter distributions. A triangular distribution (mode = a mid-point of 95% CIs, minimum = lower bound of 95% CI, maximum = upper bound of 95% CI) was assumed for sensitivity or specificity of each test machine type. Monte Carlo simulations allow us to provide the mean and the 95% probabilistic confidence interval (PCI) of the past infection rate.

Table 1 Comparison of the seroprevalence of antibodies, conducted by 3 institutions, in Tokyo prefecture

Survey institutions (Study population/test date)	Released Data			Additional calculations by Dr. Yoo	
	Numbers tested	Test positive cases	Sero-prevalence of antibodies (%)	95% Confidence Interval (CI) of seroprevalence of antibodies	
				Lower bound	Upper bound
Council*1 (Patients visited clinic and hospital outpatient care)					
May 1st and 2nd, 2020	500	3	0.60%	0.12%	1.74%
May 25th, 2020	500	4	0.80%	0.22%	2.04%
May 1st, 2nd, and 25th, 2020 (total numbers of above 2 rows)	1,000	7	0.70%	0.28%	1.44%
SoftBank (Employees of SoftBank and its business partner companies, and health care workers) (from May 12th to June 8th, 2020)					
(All except healthcare workers)	11,217	42	0.37%	0.27%	0.51%
(only healthcare workers)	1,325	41	3.09%	2.23%	4.17%
Additional calculations by Dr. Yoo (weighted average calculations represent Tokyo prefecture*2)	12,542	88	0.70%	0.56%	0.86%
MHLW (volunteer residents) from June 1st to June 7th, 2020					
Based on MHLW's criteria*3	1,971	2	0.10%	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	1,971	4	0.20%	0.06%	0.52%
Additional calculations by Dr. Yoo, based on Roche® test	1,971	6	0.30%	0.11%	0.66%
Additional calculations by Dr. Yoo, based on MC simulation*4	1,971	2	0.11%	0.10%	0.12%

*1: Executive Board; Council for COVID-19 Antibody Measurement
*2: The proportion of healthcare workers among the total employees in Japan is 11.9% (calculated by Dr. Yoo, based on the numbers of employees summarized in Japan Standard Industry Classification 2018 by the Statistics Bureau, the Ministry of Internal Affairs and Communications). Applying this proportion to Tokyo prefecture, the seroprevalence of antibodies after weighted average calculation can be 0.70% (=11.9%*3.09%+88.1%*0.37%).
*3: MHLW's criteria are inappropriate due to the three reasons explained in the subsection (2-A).
*4: Monte Carlo simulation, detailed in the subsection (2-B).

Table 2 Comparison of the estimated numbers of the infected (based on the seroprevalence of antibodies conducted by 3 institutions) in Tokyo prefecture

Survey institutions (Study population/test date)	Released Data		Additional calculations by Dr. Yoo	
	Sero-prevalence of antibodies	The number of the infected	95% Confidence Interval (CI) of the number of the infected	
			Lower bound	Upper bound
Council*1 (Patients visited clinic and hospital outpatient care)				
May 1st and 2nd, 2020	0.60%	83,997	17,347	244,064
May 25th, 2020	0.80%	111,997	30,574	284,970
May 1st, 2nd, and 25th, 2020	0.70%	97,997	39,463	201,163
(total numbers of above 2 rows)				
SoftBank (Employees of SoftBank and its business partner companies, and health care workers)				
(from May 12th to June 8th, 2020)	0.00%	0	0	0
(All except healthcare workers)	0.37%	52,419	37,797	70,808
(only healthcare workers)	3.09%	N/A	N/A	N/A
Additional calculations by Dr. Yoo (weighted average calculations represent Tokyo prefecture*2)	0.70%	97,731	78,833	120,920
MHLW (volunteer residents)				
from June 1st to June 7th, 2020				
Based on MHLW's criteria*3	0.10%	14,206	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	0.20%	28,411	7,745	72,628
Additional calculations by Dr. Yoo, based on Roche® test	0.30%	42,616	15,650	92,593
Additional calculations by Dr. Yoo, based on MC simulation*4	0.11%	15,040	13,718	16,282

*1: Executive Board; Council for COVID-19 Antibody Measurement
*2: The proportion of healthcare workers among the total employees in Japan is 11.9% (calculated by Dr. Yoo, based on the numbers of employees summarized in Japan Standard Industry Classification 2018 by the Statistics Bureau, the Ministry of Internal Affairs and Communications). Applying this proportion to Tokyo prefecture, the seroprevalence of antibodies after weighted average calculation can be 0.70% (=11.9%*3.09%+88.1%*0.37%).
*3: MHLW's criteria are inappropriate due to the three reasons explained in the subsection (2-A).
*4: Monte Carlo simulation, detailed in the subsection (2-B).
N/A: Not applicable

Table 3 The "ratio" - "estimated past infection rate*1" divided by "observed past infection rate*2," in Tokyo prefecture

Survey institutions (Study population/test date)	Released Data		Additional calculations by Dr. Yoo	
	Sero-prevalence of antibodies	Ratio defined above	95% Confidence Interval (CI) of the ratio defined above	
			Lower bound	Upper bound
Council*3 (Patients visited clinic and hospital outpatient care)				
May 1st and 2nd, 2020	0.60%	16	3	46
May 25th, 2020	0.80%	21	6	54
May 1st, 2nd, and 25th, 2020	0.70%	18	7	38
(total numbers of above 2 rows)				
SoftBank (Employees of SoftBank and its business partner companies, and health care workers)				
(from May 12th to June 8th, 2020)				
(All except healthcare workers)	0.37%	10	7	13
(only healthcare workers)	3.09%	N/A	N/A	N/A
Additional calculations by Dr. Yoo (weighted average calculations represent Tokyo prefecture*4)	0.70%	18	15	23
MHLW (volunteer residents)				
from June 1st to June 7th, 2020				
Based on MHLW's criteria*5	0.10%	3	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	0.20%	5	1	14
Additional calculations by Dr. Yoo, based on Roche® test	0.30%	8	3	17
Additional calculations by Dr. Yoo, based on MC simulation*6	0.11%	3	3	3

*1: Estimated past infection rate is assumed to be equal to seroprevalence of antibodies.
*2: The observed past infection rate (0.038%) as of May 31st, 2020, based on the cumulative number of the PCR test-positive cases (5,236).
*3: Executive Board; Council for COVID-19 Antibody Measurement
*4: The proportion of healthcare workers among the total employees in Japan is 11.9% (calculated by Dr. Yoo, based on the numbers of employees summarized in Japan Standard Industry Classification 2018 by the Statistics Bureau, the Ministry of Internal Affairs and Communications). Applying this proportion to Tokyo prefecture, the seroprevalence of antibodies after weighted average calculation can be 0.70% (=11.9%*3.09%+88.1%*0.37%).
*5: MHLW's criteria are inappropriate due to the three reasons explained in the subsection (2-A).
*6: Monte Carlo simulation, detailed in the subsection (2-B).
N/A: Not applicable

Table 4 The seroprevalence of antibodies among the volunteer residents in Osaka and Miyagi prefecture (from June 1st to June 7th, 2020)

Prefecture	Released Data			Additional calculations by Dr. Yoo	
	Numbers tested	Test positive cases	Sero-prevalence of antibodies (%)	95% Confidence Interval (CI) of seroprevalence of antibodies	
				Lower bound	Upper bound
Osaka prefecture					
Based on MHLW's criteria*1	2,970	5	0.17%	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	2,970	16	0.54%	0.31%	0.87%
Additional calculations by Dr. Yoo, based on Roche® test	2,970	10	0.34%	0.16%	0.62%
Additional calculations by Dr. Yoo, based on MC simulation*2	2,970	5	0.18%	0.17%	0.20%
Miyagi prefecture					
Based on MHLW's criteria*1	3,009	1	0.03%	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	3,009	3	0.10%	0.02%	0.29%
Additional calculations by Dr. Yoo, based on Roche® test	3,009	7	0.23%	0.09%	0.48%
Additional calculations by Dr. Yoo, based on MC simulation*2	3,009	1	0.03%	0.02%	0.04%

*1: MHLW's criteria are inappropriate due to the three reasons explained in the subsection (2-A).
*2: Monte Carlo simulation, detailed in the subsection (2-B).

Table 5 The estimated numbers of the infected (based on the seroprevalence of antibodies) among the general population in Osaka and Miyagi prefecture (from June 1st to June 7th, 2020)

Prefecture	Released Data		Additional calculations by Dr. Yoo	
	Sero-prevalence of antibodies	The number of the infected	95% Confidence Interval (CI) of the number of the infected	
			Lower bound	Upper bound
Osaka prefecture				
Based on MHLW's criteria*1	0.17%	14,856	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	0.54%	47,539	27,199	77,070
Additional calculations by Dr. Yoo, based on Roche® test	0.34%	29,712	14,258	54,564
Additional calculations by Dr. Yoo, based on MC simulation*2	0.18%	16,094	14,931	17,300
Miyagi prefecture				
Based on MHLW's criteria*1	0.03%	763	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	0.10%	2,289	472	6,682
Additional calculations by Dr. Yoo, based on Roche® test	0.23%	5,340	2,148	10,989
Additional calculations by Dr. Yoo, based on MC simulation*2	0.03%	711	569	836

*1: MHLW's criteria are inappropriate due to the three reasons explained in the subsection (2-A).
*2: Monte Carlo simulation, detailed in the subsection (2-B).

Table 6 The "ratio" - "estimated past infection rate, being equal to the seroprevalence of antibodies (numerator)" divided by "observed past infection rate*1," in Osaka and Miyagi prefectures

Prefecture	Released Data		Additional calculations by Dr. Yoo	
	Sero-prevalence of antibodies	Ratio defined above	95% Confidence Interval (CI) of the ratio defined above	
			Lower bound	Upper bound
Osaka prefecture				
Based on MHLW's criteria*2	0.17%	8	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	0.54%	27	15	44
Additional calculations by Dr. Yoo, based on Roche® test	0.34%	17	8	31
Additional calculations by Dr. Yoo, based on MC simulation*3	0.18%	9	8	10
Miyagi prefecture				
Based on MHLW's criteria*2	0.03%	8	theoretically impossible	
Additional calculations by Dr. Yoo, based on Abbott® test	0.10%	25	5	73
Additional calculations by Dr. Yoo, based on Roche® test	0.23%	58	23	120
Additional calculations by Dr. Yoo, based on MC simulation*3	0.03%	8	6	9

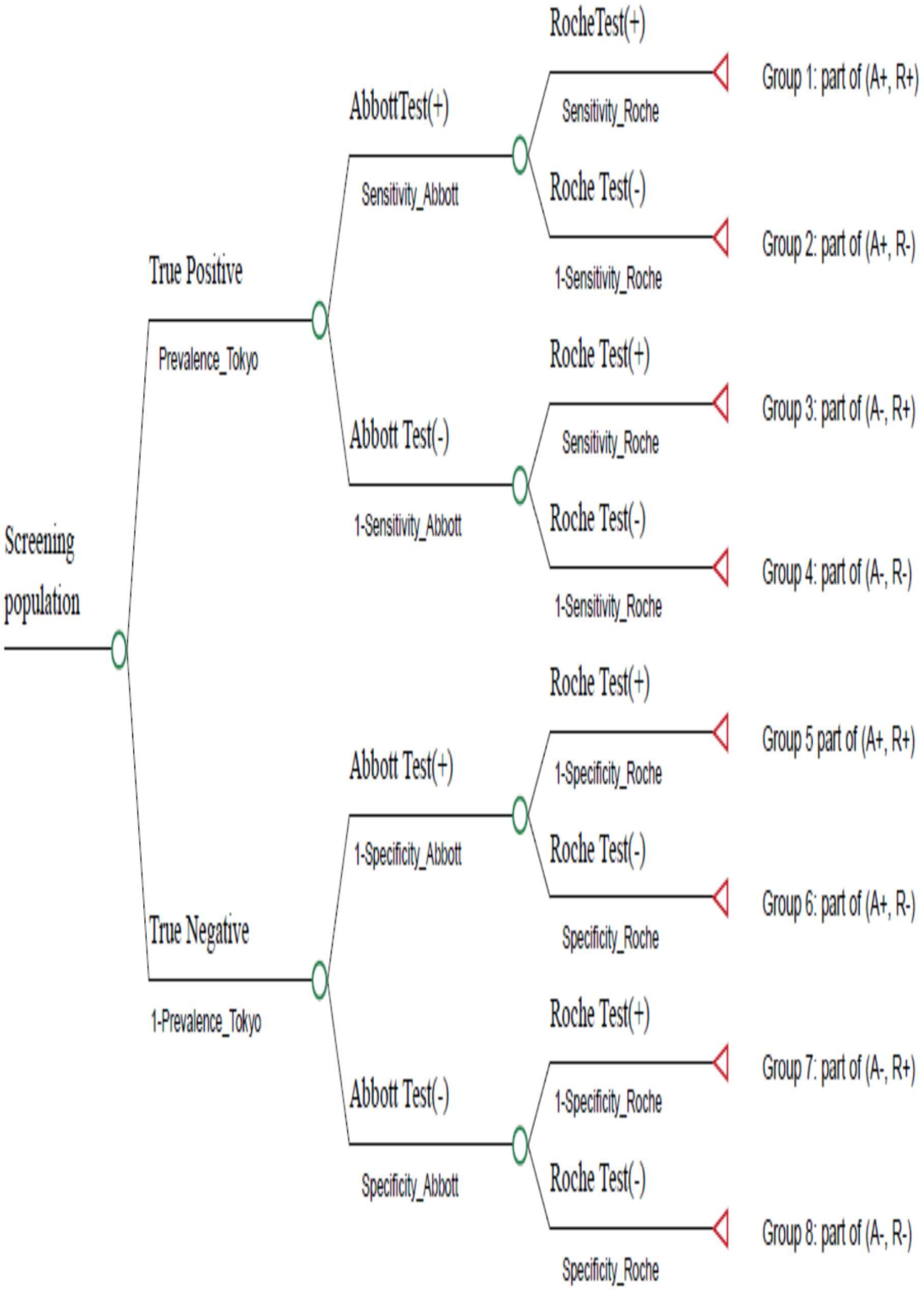
*1: As of May 31st, 2020, the observed past infection rate (based on the PCR test results) and the cumulative number of the PCR test-positive cases were 0.02% and 1,783 in Osaka prefecture and 0.004% and 88 in Miyagi prefecture, respectively.
*2: MHLW's criteria are inappropriate due to the three reasons explained in the subsection (2-A).
*3: Monte Carlo simulation, detailed in the subsection (2-B).

Table 7 The seroprevalence of antibodies reported by Softbank (conducted from June 1st to June 7th, 2020)

Categories	Released Data			Additional calculations by Dr. Yoo	
	Numbers tested	Test positive cases	Sero-prevalence of antibodies (%)	95% Confidence Interval (CI) of seroprevalence of antibodies	
				Lower bound	Upper bound
Total	44,066	191	0.43%	0.37%	0.50%
Health care workers	5,850	105	1.79%	1.47%	2.17%
Softbank and others*1	38,216	86	0.23%	0.18%	0.27%
Job categories					
Total*2	36,983	54	0.15%	0.11%	0.19%
Retail shops*3	19,075	8	0.04%	0.02%	0.08%
Regular office*4	10,832	17	0.16%	0.09%	0.25%
Call-centers	7,076	29	0.41%	0.27%	0.59%
Health care industry					
Areas					
Tokyo prefecture	1,325	41	3.09%	2.23%	4.17%
All except Tokyo prefecture	4,525	64	1.41%	1.09%	1.80%
Job categories among health care industries*5					
Receptionists	1,329	27	2.03%	1.34%	2.94%
Medical Doctors	695	13	1.87%	1.00%	3.18%
Nurses	1,218	21	1.72%	1.07%	2.62%
Dental Assistants	336	3	0.89%	0.18%	2.59%
Dentists	402	3	0.75%	0.15%	2.17%
(Reference) Those who work in close contact with customers	17	2	11.76%	1.46%	36.44%

*1: The data are obtained from SoftBank and its business partner companies. The high-risk sub-populations, e.g., those who work at retail shops, are included. Test kits are from INNOVITA and Orient Gene.
*2: The data are obtained from SoftBank and its business partner companies (including those who work for Fukuoka SoftBank Hawks).
*3: Those who work at SoftBank retailers, Y!mobile retailers, and home electronics mass retailers
*4: Employees such as office workers, salespersons, and technicians, who started working from home in the early stage of this COVID-19 pandemic.
*5: The data excludes the categories that had less than 300 cases tested (the values of those who work in close contact with customers are shown as a reference).

Figure 1. The most accurate method to estimate the past infection rate (based on the seroprevalence of antibodies), using the two types of antibody test machines (Abbott® and Roche®)



(Continued from the previous page on Figure 1)

The sensitivity and specificity of the two types of antibody test machines (Abbott® and Roche®)

Source: https://www.fda.gov/medical-devices/emergency-situations-medical-devices/eua-authorized-serology-test-performance

Developer: Abbott
Test: Architect SARS-CoV-2 IgG
Technology: High Throughput CMIA
Target: Nucleocapsid

Antibody	Performance Measure	Estimate of Performance	95% Confidence Interval
IgG	Sensitivity (PPA)	100% (88/88)	(95.8%; 100%)
IgG	Specificity (NPA)	99.6% (1066/1070)	(99.0%; 99.9%)
IgG	PPV*1 at prevalence = 5%	92.9%	(83.4%; 98.1%)
IgG	NPV*2 at prevalence = 5%	100%	(99.8%; 100%)

*1: PPV: Positive Predictive values
*2: NPV: Negative Predictive values

Developer: Roche
Test: Elecsys Anti-SARS-CoV-2
Technology: High Throughput ECLIA
Target: Nucleocapsid

Antibody	Performance Measure	Estimate of Performance	95% Confidence Interval
Pan-Ig	Sensitivity (PPA)	100% (29/29)	(88.3%; 100%)
Pan-Ig	Specificity (NPA)	99.8% (5262/5272)	(99.7%; 99.9%)
Pan-Ig	PPV*1 at prevalence = 5%	96.5%	(93.9%; 98.1%)
Pan-Ig	NPV*2 at prevalence = 5%	100%	(99.4%; 100%)

*1: PPV: Positive Predictive values
*2: NPV: Negative Predictive values