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Measles Epidemics During the Edo Period: An Analysis Using *DANJURO Ver. 7.0*

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ABSTRACT

Measles epidemics had a large influence on Japanese society during the Edo period (1600–1868). Spreading throughout the country periodically and particularly affecting young people, the disease had the power to drastically alter both rural and urban communities. This paper seeks to apply a mixed digital analysis to data garnered from religious membership registers (*Shūmon aratame-chō* 宗門改帳) taken from the *Edo jidai ni okeru jinkō bunseki shisutemu* 江戸時代における人口分析システム (*DANJURO ver. 7.0*) [Edo Period Population Analysis System (DANJURO ver. 7.0)] in order to determine what information these documents might hold pertaining to measles epidemics. Previous studies have suggested that these documents are only of limited use for studying epidemics since they do not feature information on the causes of deaths or on infant mortality. However, this paper illustrates that it is possible to garner insights about measles epidemics through data extracted from *shūmon aratame-chō*. In addition to this, the paper suggests that the data accessible through *DANJURO* can be used to challenge assumptions that measles outbreaks were not as significant as those of other diseases in terms of mortality and societal impact. Finally, the paper suggests that the ordering of information from *shūmon aratame-chō* in *DANJURO* acts to humanize those data. (JHM)

KEYWORDS: measles, epidemics, *shūmon aratame-chō*, demographics, environmental history

Introduction

Measles did not become endemic in Japan during the Edo period (1600–1868). Rather, the disease periodically reached Japan from overseas, causing large-scale epidemics approximately every twenty years, which tended to disproportionately affect young people. The extensive and diverse population records created during the Edo period have long been used by scholars to study demographics and the influence of epidemics in Japan.

Religious membership registers (*shūmon aratame-chō*宗門改帳), however, have traditionally been viewed as holding only limited utility for studying epidemics when compared to other population records. Nevertheless, this paper utilizes data from these records through the *Edo jidai ni okeru jinkō bunseki shisutemu* 江戸時代における人口分析システム (*DANJURO ver. 7.0*) [Edo Period Population Analysis System (DANJURO ver. 7.0)], exploring to what extent measles epidemics can be analyzed with recourse primarily to *shūmon aratame-chō* through using a mixed digital approach. I attempt to make three key points. First, that it is possible to garner insights about measles epidemics through data stored in and extracted from *shūmon aratame-chō*. Second, the data accessible through *DANJURO* call into question assumptions that measles outbreaks were not as significant as those of other diseases in terms of mortality and societal impact. Third, platforms such as *DANJURO* help to humanize the data contained in *shūmon aratame-chō*—something that is often missing in the digital humanities.

Measles epidemics in the Edo period

Measles epidemics were a fairly infrequent occurrence during the Edo period. Katsushika Roan's *Hashika hitsuyō* (麻疹必用) [Essential Knowledge on Measles] (1824) records eight epidemics in 1616, 1649, 1690–1691, 1708, 1730, 1753, 1776, and 1803, while the *Hashika ryūkō nensū* (麻疹流行年数) [The Years of Measles Epidemics] (1862) by Isshōsai Yoshimune (also known as Utagawa Yoshimune I, 1817–1880) also lists eight major epidemics in 1650 (1649 in other sources), 1690–1691, 1730, 1753, 1776, 1803, 1824, and 1862. Ann Bowman Jannetta provides a list of eleven major measles epidemics, which includes all those referred to in the aforementioned sources and an additional epidemic in 1836 (119). Noriko Suzuki, on the other hand, provides a slightly expanded list of thirteen with the addition of 1607 and 1670[1] (Suzuki "Edo jidai no mashin to iryō" [Measles and Medical Care in the Edo Period] 502). Elsewhere Suzuki includes another epidemic in 1646 bringing the total to fourteen (Suzuki *Edo no hayariyamai* [Epidemic Diseases in Edo] 2). Yū Fujikawa and Shizu Sakai list a total of thirteen but exclude the epidemic in 1670, in favor of one in 1782 (Fujikawa 130–35; Sakai 194–95), while Tasuku Yamazaki records twelve including the same change and excluding the 1607 epidemic (Yamazaki 387–91). In spite of these points of divergence and the possibility that measles outbreaks occurred more frequently, the evidence

contained in primary sources and the scholarly sources based thereon suggest a highly limited number of epidemics. Jannetta notes, for instance, "that a doctor would treat patients with measles only twice or, at most, three times during his lifetime" (126).[2] The occurrence and frequency of measles outbreaks can be better visualized in tabular format. As such, I have merged these divergent lists of epidemics in Table 1 producing a list of the "maximum" number of large-scale outbreaks.

Year	Month(s) of Outbreak (Approx.)	Interval
1607 (Keichō 慶長 12)	-	20
1616 (Genna 元和 2)	10th	9
1646 (Shōhō 正保 3)	5th	30
1649 (Keian 慶安 2)	3rd	3
1670 (Kanbun 寛文 10)	2nd	21
1690 (Genroku 元禄 3)〜1691 (Genroku 元禄 4)	3rd month of Genroku 3 to the 5th month of Genroku 4	20
1708 (Hōei 宝永 5)〜1709 (Hōei 宝永 6)	autumn of Hōei 5 to spring of Hōei 6	17
1730 (Kyōhō 享保 15)	summer to autumn, or winter of Kyōhō 15 to the spring of Kyōhō 16	21
1753 (Hōreki 宝暦 3)	4th month to 9th month	23
1776 (Anei 安永 5)	3rd month to autumn	23
1782 (Tenmei 天明 2)	5th	6
1803 (Kyōwa 享和 3)	3rd month to 6th month	21
1823 (Bunsei 文政 6)〜1824 (Bunsei 文政 7)	11th month of Bunsei 6 to 3rd month of Bunsei 7	20
1836 (Tenpō 天保 7)	summer to autumn	12
1862 (Bunkyū 文久 2)	4th month to autumn	26

Table 1:
Occurrences of measles epidemics during the Edo period.
Created by the author on the basis of data adapted from Jannetta (119); Sakai (194–95); Suzuki ("Edo jidai no mashin to iryō" 502; *Edo no hayariyamai* 2).

According to the data in Table 1, the mean average interval between measles epidemics was approximately 18.13 years with a bimodal average of

20 and 21 years. The longest interval was 30 years and the shortest 3. Jannetta's study, which, as noted, focuses on 11 major measles epidemics, records a similar mean average interval of 21.09 years (118). In other words, whether we accept liberal or conservative estimates we can observe that major measles epidemics were a bi-decadal occurrence. This was partially due to Japan's strict foreign policy measures and controls on international trade, and her existence as a series of islands (Suzuki *Kinsei kansenshō no seikatsushi* [The Life Cycle of Early Modern Infectious Diseases] 140). During an epidemic people would gain herd immunity, but once this had fallen after a period of approximately twenty years the disease would again spread through the country, particularly affecting young people who had no immunity to the disease due to not having lived through the previous epidemic (Suzuki *Kinsei kansenshō no seikatsushi* 140). Jannetta describes the epidemiology of the disease as follows:

> [M]easles would traverse the country, usually within the span of a single calendar year, and it would travel along the same general route. Detailed accounts of the measles epidemic of 1862 tell of its arrival on a foreign ship and of its progress northward from Nagasaki to the major population centers of central Japan. Such detailed accounts are rare for earlier epidemics, but when accounts from different parts of the country are pieced together, it is clear that the Tokugawa measles epidemics advanced in a north-easterly direction from Kyushu. The evidence is virtually overwhelming that measles remained an imported disease until the end of the Tokugawa period. (125)

The disease would enter from China or Korea through the port of Nagasaki, and during the second half of the nineteenth century through intercourse with European and North American powers (Suzuki *Kinsei kansenshō no seikatsushi* 140; Park 200–02).

Some measles outbreaks were severe. Matsuda Takeshi records that during the 1862 measles outbreak that in Senshū (泉州), Izumi-gun (泉郡), Minamiōji-mura (南王子村), and modern-day Izumi (和泉) city, 63.3% of the population were infected by the disease (31). Young people were disproportionally affected with 89.29% of the population under the age of 30 becoming infected in comparison to only 9.3% of the population over the age of 30 (Matsuda 31). The mortality rate was 5.4% and the case fatality rate 8.5% (Matsuda 32). Figures like these were not unusual. Elsewhere I noted that the *Edo shichū hashika byōnin chōsho*

(江戸市中麻疹病人調書) [A Survey of People Afflicted by Measles in Edo] indicates that during the 1862 epidemic there was a case fatality rate of 12.71% in the capital city of Edo, which might equate to a mortality rate of between 3.66% and 7.33% depending on how we calculate the population of the city (Morris Web). Similarly, Suzuki records case fatality rates of 3.5% in Tatsuno domain (modern-day Hyōgo prefecture), 4.7–5.7% in Edo, and 6.9% in Tonami-gun (modern-day Toyama prefecture) (Suzuki *Edo no hayariyamai* 6–7). Nevertheless, in spite of high levels of infectivity, not all outbreaks resulted in a large number of deaths. The records from villages in Hida (飛騨) between 1771 and 1852 used in Jannetta's study suggest that

> measles had little impact on mortality . . .. In fact, during the eighty-two-year period during which causes of death were entered into the temple records, only thirty-four deaths were attributed to measles. Measles deaths accounted for only .004 percent of all deaths. (139)

Yamazaki also records low mortality rates associated with some outbreaks noting, for example, the 1708 and 1803 epidemics (387–89). He argues that because of these low mortality rates the disease had less overall influence than other illnesses prevalent in the Edo period (Yamazaki 394). Given all this it should be clear that the mortality rate varied according to outbreak, location, and other contextual factors such as levels of immunity, the prevalence of other diseases or disasters, weather, the health and socio-economic circumstances of a given community, and the responses of local and national governments.

A digital approach to traditional sources

A number of studies focusing on measles epidemics during the Edo period have engaged with data from historical population records. Matsuda, for instance, used the *Byōsai kakiagechō* (病災書上帳) [Ledger of Illness] (1862) from Minamiōji-mura. Jannetta, on the other hand, makes use of temple death registers (*kako-chō* 過去帳) from Sendai (仙台) domain and Hida. Namikawa Kenji used records related to religious membership entitled the *Goryōbun-chū shūshi aratame ninsū mokuroku* (御領分中宗旨改人数目録) [Catalog of the Number of People listed in Religious Membership Registers in the Domain] compiled by retainers of Morioka (盛岡) domain (23–29). The digitization of data from population

records provides the potential to adopt new approaches including the ability to interact with these documents on a larger scale. Depending on the availability of data the researcher may, for example, be able to compare trends from different villages quickly and easily across time. As such, a sort of "distant reading" that favors the identification and analysis of over-arching demographic trends rather than a "close reading" of individual documents might provide a pertinent method for handling digitized population records. *DANJURO* is a platform developed by Kawaguchi Hiroshi which allows the user to quickly access and analyze data from its collection of *shūmon aratame-chō*. Originally developed in the late 1980s, the platform, which is now in its seventh version, has been explored in a number of papers by its creator and his collaborators[3] and has been used to analyze demographic information such as family structure and the average age of first marriage (Kawaguchi "'Edo jidai ni okeru jinkō bunseki shisutemu (DANJURO ver. 2.0)' no kōchiku unyō riyō" 21–24). The data can be freely searched and have also been sorted and organized for analysis according to different themes.

At the time of writing, *DANJURO* allows users to access 8 sets of data from 7 villages—3 villages from Mutsu-no-kuni (陸奥国), Aizu-gun (会津郡), namely Ishibushi-mura (石伏村) (modern-day Tadami-machi (只見町)), Tōnosu-mura (鴇巣村) (modern-day Minamiaizu-machi (南会津町)), and Komatsukawa-mura (小松川村), (modern-day Shimogō-machi (下郷町), Aikawa (合川)); two sets of data from Mutsu-no-kuni (陸奥国), Ōnuma-gun (大沼郡), Kuwabara-mura (桑原村), (modern-day Mishima-machi (三島町)); one set from Musashi-no-kuni (武蔵国), Tama-gun (多摩郡), Nakatō-mura (中藤村) (modern-day Musashimurayama-shi (武蔵村山市)); one set from Settsu-no-kuni (摂津国), Muko-gun (武庫郡), Kami-Kawarabayashi-mura (上瓦林村) (modern-day Nishinomiya (西宮市) city, Kawarabayashi-chō (瓦林町)); and one set from Settsu-no-kuni (摂津国), Yatabe-gun (八部郡,) Hanaguma-mura (花熊村) (modern-day Kōbe (神戸), Chūō-ku (中央区), Hanakuma-chō (花隈町)). The extent of the data also varies according to village—the data for Ishibushi extend from 1752–1812, Tōnosu from 1790–1859, Komatsukawa from 1792–1868, Kuwabara from 1750–1834 and 1840–1858, Nakatō from 1843–1864, Kami-Kawarabayashi from 1750–1819, and Hanakuma from 1789–1869. In other words, the data allow the user to compare demographic trends across three parts of the country during the latter

second half of the eighteenth century and the first half of the nineteenth century. Here I will attempt to see what details we can garner about measles epidemics from the data that the platform contains. Sorted data were accessed from *DANJURO* ver. 7.0 in September and October 2023, with analyses and calculations performed by the author.

As noted, *shūmon aratame-chō* are, effectively, a population register. They were collected on a yearly basis by village leaders or local officials originally with the intention of recording religious membership, but also evolved to include numerous pieces of demographic information such as the names, ages, relationships, births, and deaths of those in a family (see exploration in Morris 418–20; Tamamuro 261–65). While Fumio Tamamuro records that the system was standardized in 1671 (Tamamuro 262), *shūmon aratame-chō* and methods of compiling them were in fact diverse. Tamamuro provides an example of a register produced according to a sample format distributed by the *bakufu's* [Shogunate] intendants (*daikan* 代官) which includes data on a person's name, age, sect, temple affiliation, home, birthplace, familial relationships, and enumeration of each family's data (263–64). Conversely, a *Nezumidoshi shūmon aratame-chō* (子歳宗門改帳) [Religious Membership Register from the Year of the Rat] collected in Hitachi-no-kuni (常陸国), Tsukuba-gun (筑波郡), Kamisugama-mura (上菅間村) (modern-day Tsukuba-shi (つくば市) in 1864 from my personal collection includes no information on home or birthplace. Some of the *shūmon aratame-chō* included in *DANJURO* includes additional information. For example, the *shūmon aratame-chō* from Aizu-gun include information on the number of horses owned by a family, the size of land holdings and the family's home, and the materials used to construct said home's roof, while those from Kami-Kawarabayashi include extensive details about people's roles and statuses. The practices of collecting *shūmon aratame-chō* also varied depending on locality. In Tsu (津) domain the registers were collected every four years, while in the neighboring Kī (紀伊) domain they were collected every six years and only included those over the age of eight (Fukaya 115; Matsuo 514, 516–17; Mie-ken 557; Morris and Dulina 20). Therefore, although it is difficult to assume uniformity between *shūmon aratame-chō* from different regions or to postulate a homogenous *shūmon aratame* [inquiry into religious membership or religious inquisition], these documents invariably hold valuable demographic information.

Susan B. Hanley outlines the importance of *shūmon aratame-chō* for demographic studies noting that they can be used to compile statistics on

"average age at marriage, average number of children raised, average age at first and last childbirth (of children who lived past early infancy), average family size, the age composition of the population, the incidence of migration" (516). Nevertheless, *shūmon aratame-chō* also have a number of limitations. Jannetta argues that

> they are not the best records to use for research on epidemics and mortality. Not only is it difficult to detect short-term changes in mortality that marked the passage of an epidemic, but it is also impossible to analyse changes in seasonal or age patterns of mortality that provide clues to the kinds of epidemics that caused a rise in mortality. (Janetta 36)

Furthermore, unlike the temple death registers used by Jannetta, *shūmon aratame-chō* do not usually note the cause of death. This means that even if the *shūmon aratame-chō* record deaths in epidemic years, the scholar cannot be certain if these were caused by the epidemic or something else. Another issue is the registration of children. As noted above, in Kī domain only children above the age of 8 were included in the registers. In most places, however, "it was common to register children only after they reached the second or third year of life" (Hanley 518 n. 9). In *DANJURO*'s data the majority of births are recorded at the age of two (one by European counting methods), with only one birth (of 384) recorded at the age of one from Tōnosu, 12 (of 155) from Komatsukawa, 14 (of 166) from Kuwabara, two (of 103) from Nakatō, 17 (of 535) from Kami-Kawarabayashi, and 18 (of 480) from Hanakuma. Births were also recorded at the age of three, including eight in Nakatō, one in Kami-Kawarabayashi, and two in Hanakuma. Infants who died before their birth was registered were not included in the registers. Jannetta notes that the lack of records for infants in their first few years of life "leads to a serious underestimation of both fertility and mortality" (36). Although there are difficulties using *shūmon aratame-chō* for epidemic studies, the analysis included here shows that they still potentially hold useful information.

The first thing that can be garnered from the data is that years with measles epidemics had on average a higher incidence of deaths than the average year (Table 2). This is, of course, intuitive. In some cases, the increase in the average incidence of deaths is quite large. In Ishibushi, for example, the average number of deaths over the four measles epidemic years found in the data was more than double that of the average year. The villages in Mutsu-no-kuni, Aizu-gun saw a greater increase in the average

number of deaths during years with measles epidemic than other localities included in the data, potentially suggesting that the experience of measles epidemics was more severe there. The only outlier is Nakatō, which records zero deaths in the single epidemic covered in the data—the 1862 measles epidemic. This is quite unexpected since the 1862 measles epidemic is known for its severity (Jannetta 124–25). At present, I am unable to explain why there are no recorded deaths in 1862. The data for Nakatō from the following year (1863) record a much higher number of 10 deaths. These may have been related to the cholera epidemic that year (Jannetta 49). In any case, the data for all other villages indicate that there was an excess average number of deaths in years with measles epidemics.

Village	Extent of data (Years)	Average no. of deaths (per annum)	Average no. of deaths (per measles epidemic year)	Percentage increase
Ishibushi	1752–1812	2.96	6	102.70
Tōnosu	1790–1859	4.37	7.75	77.35
Komatsukawa	1792–1868	1.47	2.4	63.27
Kuwabara	1750–1834 1840–1858	2.13	2.33	9.39
Nakatō	1843–1864	5.32	0	-100.00
Kami-Kawarabayashi	1750–1819	6.17	9	45.87
Hanakuma	1789–1869	6.63	8.4	26.70

Table 2:
Average number of deaths. Compiled by the author.

The crude mortality rate (per 1000 people) was also higher on average during years with measles epidemics. Table 3 displays the crude mortality rates for each village during measles outbreaks highlighting in bold those crude mortality rates that were higher than the average year. All the villages apart from Kuwabara and Nakatō recorded higher crude death rates on average in years with measles epidemics. If we assume that the above noted excess deaths and the related increase in crude mortality rates were likely to have been caused by the measles epidemics either directly or

indirectly,[4] it is also possible to estimate which epidemics affected each area most severely. For example, the epidemic years of 1803 and 1824 show higher than average crude mortality rates across each village (excluding Komatsukawa in 1803), suggesting that these epidemics were severe in these areas and potentially across the country. It is also interesting to observe that while Komatsukawa had higher crude mortality rates for both 1823 and 1824, other villages only appear to have felt the effects of the 1823–1824 epidemic in 1824 since their crude mortality rates for 1823 were lower than the yearly average. For the year of 1776, on the other hand, we can see that the epidemic (or other contemporaneous factors) did not have a great effect in Kuwabara or Kami-Kawarabayashi, but did influence the crude mortality rate in Ishibushi.

Year	**Ishibushi**	**Tōnosu**	**Komatsukawa**	**Kuwabara**	**Nakatō**	**Kami-Kawarabayashi**	**Hanakuma**
1753	10.15	N/A	N/A	0	N/A	**40.29**	N/A
1776	**48.08**	N/A	N/A	19.42	N/A	22.44	N/A
1782	**29.27**	N/A	N/A	10	N/A	17.01	N/A
1803	**33.9**	**38.91**	9.62	**25**	N/A	**60.61**	**47.27**
1823	N/A	16.67	**23.26**	8.85	N/A	N/A	21.82
1824	N/A	**49.38**	**48.19**	**25.86**	N/A	N/A	**40.29**
1836	N/A	**19.23**	11.76	N/A	N/A	N/A	**28.46**
1862	N/A	N/A	**42.55**	N/A	0	N/A	20.66
Average (measles epidemic years)	30.5	40	26.55	18.12	0	34.53	32.04
Average (every year)	15.19	16.85	16.11	19.59	9.67	23.98	25.9

Table 3:
Differences in average crude mortality rates. Compiled by the author.

Since I have observed that there were an excess average number of deaths and an excess crude mortality rate during years with measles epidemics, it is worth calculating excess deaths for each epidemic year. Excess deaths are calculated as follows:

Excess Deaths = *Reported Deaths* – *Expected Deaths* (Giattino et al. Web).

In order to calculate the number of expected deaths the mean average number of deaths in the ten years preceding the start of the outbreak was calculated. As such, excess deaths could not be calculated for the 1753 outbreak since there are insufficient data to calculate the number of expected deaths. The data show small increases in excess deaths during several epidemic years. In Ishibushi, the 1776 epidemic shows a particularly large number of excess deaths (7.9) and in Tōnosu there were large numbers in 1803 (7.1) and 1824 (7.1). In all, eight data points (32%) show a mortality deficit, 15 (60%) show an excess number of deaths, and two data points (8%) show neither excess nor deficit. Higher average numbers of deaths, increased crude mortality rates, and excess deaths all suggest that the influence of these measles epidemics is at least partially reflected in the data.

Year	Ishibushi (no. of deaths)			Kuwabara (no. of deaths)			Kami-Kawarabayashi (no. of deaths)		
	Reported deaths	Expected deaths	Excess deaths	Reported deaths	Expected deaths	Excess deaths	Reported deaths	Expected deaths	Excess deaths
1776	10	2.1	7.9	2	1.6	0.4	7	6.2	0.8
1782	6	3.5	2.5	1	1.6	-0.6	5	7.8	-2.8
1803	6	2.4	3.6	3	1.8	1.2	9	6.3	2.7
1823	N/A	N/A	N/A	1	2.6	-1.6	N/A	N/A	N/A
1824	N/A	N/A	N/A	3	2.6	0.4	N/A	N/A	N/A

Year	Tōnosu (no. of deaths)			Komatsuka-wa (no. of deaths)			Hanakuma (no. of deaths)		
	Reported deaths	Excepted deaths	Excess deaths	Reported deaths	Expected deaths	Excess deaths	Reported deaths	Expected deaths	Excess deaths
1803	10	2.9	7.1	1	1.4	-0.4	13	9	4
1823	4	4.9	-0.9	2	1.6	0.4	6	6	0
1824	12	4.9	7.1	4	1.6	2.4	11	6	5
1836	5	5	0	1	2	-1	7	7.7	-0.7
1862	N/A	N/A	N/A	4	1.4	2.6	5	6.8	-1.8

Table 4:
Excess deaths. Compiled by the author.

Comparing the number of average deaths from years with other epidemics to those during measles epidemics (Table 5) suggests that measles outbreaks were more severe and potentially more significant than Jannetta and Yamazaki suggest. In Ishibushi, Tōnosu, Kami-Kawarabayashi, and Hanakuma, years with measles epidemics had on average a higher number

of deaths than years when these villages were afflicted by other epidemics. In Ishibushi and Tōnosu, influenza epidemics also appear to have caused significant increases in the average number of deaths, whereas in Kami-Kawarabayashi and Hanakuma dysentery also played a major role. In Komatsukawa, years with cholera epidemics saw the largest increase in average deaths followed by years with measles epidemics. In Kuwabara, years with influenza and unidentified epidemics saw the largest increases. Finally, in Nakatō years with influenza epidemics saw the largest increase. While it, therefore, appears that measles caused more deaths per outbreak in Ishibushi, Tōnosu, Kami-Kawarabayashi, and Hanakuma than other epidemics, it is unclear whether these differences (which accounting for population size are rather small) would have been felt by the individual populations especially when considering the infrequency of measles epidemics. In a community of a few hundred people does a person really feel a difference between three deaths and six deaths? I imagine that it would not be significant enough for people to take note of. Rather, observing the spread of the diseases and their visual symptoms would have likely been key in the lives of ordinary people.

Village	Average deaths (per annum)	Average deaths (per measles epidemic year)	Average deaths (per cholera epidemic)	Average deaths (per dysentery epidemic)	Average deaths (per influenza epidemic)	Average deaths (per rubella epidemic)	Average deaths (per smallpox epidemic)	Average deaths (per unidentified epidemic)
Ishibushi	2.96	6	N/A	3	5.33	3	2	2.75
Tōnosu	4.37	7.75	4.67	3.4	6.21	5	4	4.4
Komatsukawa	1.47	2.4	2.8	1.4	1.82	0	1.5	1.17
Kuwabara	2.13	2.33	2	2	2.56	1	1	2.5
Nakatō	5.32	0	3.75	N/A	6.75	N/A	N/A	3.33
Kami-Kawaraba-yashi	6.17	9	N/A	8.3	6.4	3	5	6.2
Hanakuma	6.63	8.4	5.4	7.2	6.69	2	8	7.8

Table 5:
Average deaths in different epidemic years. Compiled by the author.

A simple cumulative analysis of the number of deaths in epidemic years (Table 6) also appears to confirm the comparative severity of measles outbreaks. The data indicate that across each locality, years with influenza epidemics saw the most deaths. Of 1,962 deaths included in the data, 408 occurred during years with influenza epidemics accounting for 20.8% of the overall deaths. In comparison, years with measles epidemics saw a total of 150 deaths accounting for 7.65% of the overall deaths representing the second largest number of deaths during years with epidemics. Of course, influenza outbreaks were much more frequent than measles outbreaks with 20 epidemics occurring between 1750 and 1869 in comparison to eight measles epidemics. The data again indicate the severity of measles outbreaks in Aizu-gun where years with measles accounted for 67 of 595 deaths or 10.92%. The data also indicate that other diseases could have a cumulatively larger effect than measles. For example, in Komatsukawa more

overall deaths are recorded in years of cholera outbreaks than years of measles outbreaks, and in Kuwabara and Hanakuma years with unidentified epidemics accounted for more deaths. Sadly, since the *shūmon aratame-chō* do not include information on the cause of people's deaths, it is not possible to estimate with great accuracy how many deaths that occurred in these years were actually caused by the epidemics. Nevertheless, alongside the foregoing discussion this visualization of data helps to illustrate that *shūmon aratame-chō* potentially include information that point to the effects of epidemics.

Unidentified epidemic year deaths	11 (6.25%)	22 (7.19%)	7 (6.19%)	20 (8.93%)	10 (8.55%)	31 (6.37%)
Smallpox year deaths	2 (1.34%)	8 (2.61%)	3 (2.65%)	2 (0.89%)	0 (0%)	5 (1.03%)
Rubella year deaths	3 (1.7%)	5 (1.63%)	0 (0%)	1 (0.45%)	0 (0%)	3 (0.62%)
Influenza year deaths	48 (27.27%)	87 (28.43%)	29 (25.66%)	46 (20.54 %)	27 (23.08%)	64 (13.14%)
Dysentery year deaths	3 (1.7%)	17 (5.56%)	7 (6.19%)	10 (4.46%)	0 (0%)	25 (5.13%)
Cholera year deaths	0 (0%)	14 (4.58%)	14 (12.39%)	4 (1.79%)	15 (12.82%)	0 (0%)
Measles year deaths	24 (13.64%)	31 (10.13%)	12 (10.62%)	10 (4.46%)	0 (0%)	32 (6.57%)
Total number of deaths	176	306	113	224	117	487
Village	Ishibushi	Tōnosu	Komatsu-kawa	Kuwa-bara	Nakatō	Kami-Kawara-bayashi

	117 (5.96%)	36 (1.83%)	14 (0.71%)	408 (20.8%)	98 (4.99%)	74 (3.77%)	150 (7.65%)
Totals	1962	539	41 (7.6%)	27 (5.01%)	36 (6.68%)	107 (19.85%)	2 (0.37%)
Hana-kuma	47 (8.72%)	16 (2.97%)					

Table 6:
Number of deaths in epidemic years. Compiled by the author.

Although *shūmon aratame-chō* do not contain details of the cause of death or on the deaths of infants prior to the registration of their birth (usually at the age of two in the case of the documents used here), they do provide information that can help us to analyze mortality further. I will focus briefly on the villages of Ishibushi, Tōnosu, and Komatsukawa in Aizu-gun where measles epidemics appear to have had the greatest effect or severity. The average age of death in Ishibushi between 1752 and 1812 was 57.66, in Tōnosu between 1790 and 1859 it was 50.29, and in Komatsukawa between 1792 and 1868 it was 56.86. During years with measles the average age of death was slightly lower: 54.33 in Ishibushi, 44 in Tōnosu, and 50.25 in Komatsukawa. This is important since, as explored earlier in this paper, measles primarily affected people under the age of 30, and therefore, if measles was causing deaths amongst a population, we would expect to see increased deaths amongst the under 30s and related to this a lowering of the average age of death. Furthermore, the increase in the average number of deaths can be observed not only amongst the entire population (including those over the age of 31), but specifically amongst the under 30s (Table 7). For the under 30s the increase ranged from 1.57 to 1.75-fold, depending on the village. Considering the prevalence of overall excess deaths in these years, excess deaths amongst the under 30s, and the lower average age of death during years with measles outbreaks, we can confidently determine that measles-related deaths are captured within the data that can be extracted from these *shūmon aratame-chō*.

Year	Ishibushi (no. of deaths) over 31	under 30	Tōnosu (no. of deaths) over 31	under 30	Komatsukawa (no. of deaths) over 31	under 30
1753	2	0	N/A	N/A	N/A	N/A
1776	9	1	N/A	N/A	N/A	N/A
1782	4	2	N/A	N/A	N/A	N/A
1803	2	4	4	6	0	1
1823	N/A	N/A	4	0	2	0
1824	N/A	N/A	6	6	3	0
1836	N/A	N/A	3	2	1	0
1862	N/A	N/A	N/A	N/A	1	3
Average (epidemic years)	4.25	1.75	4.25	3.5	1.4	0.8
Average (all years)	2.25	0.68	3.03	1.34	1.16	0.29
Percentage increase	88.89%	157.35%	40.26%	161.19%	20.69%	175.86%

Table 7:
Deaths in different age groups. Compiled by the author.

Although there are limitations to using *shūmon aratame-chō* to explore epidemics, the data included in *DANJURO* can be used to show that in most of the villages there were excess deaths, an increased average number of deaths, and increased crude mortality rates during years with measles epidemics. By looking at the excess deaths amongst the under 30s it appears possible to affirm that at least some of the deaths recorded in *shūmon aratame-chō* were likely caused by measles. The data can also be used to make inferences about the difference in the severity of measles outbreaks in different localities. All this suggests that measles may have been more severe than has been observed in some secondary literature, although, as Yamazaki notes, the infrequency of measles epidemics may have meant that it had less influence on the general population than other epidemic diseases (394). Using *DANJURO* to explore measles epidemics, therefore, provides two challenges—a challenge to the assumption that *shūmon aratame-chō* do not contain valuable information related to epidemics and a challenge to the assumption that measles epidemics lacked severity.

Humanizing data

Shūmon aratame-chō provide opportunities not only to look at the macro-context of village demographics, but also to explore the lives of individuals. A "close reading" of *shūmon aratame-chō* is facilitated by *DANJURO*, which allows users to easily search for individuals and extract information about them and their families. This has the potential to humanize the data we work with and thus runs counter to the trends of datafication and the "distant reading" approach adopted in the first part of this paper, which risks dehumanizing our historical research subjects. By way of an example, I would like to briefly explore the background of one infant who died in a measles epidemic year. In 1803, a three-year-old girl named San (さん) (DANJURO Web, individual no. 261) died in Ishibushi. Her birth had been registered the previous year. San's father was born around 1774, and his birth was registered in 1775 when the family headed by his grandfather Sakuemon (作右衛門) consisted of 7 members (4 male and 3 female). His name was Tajirō (多次郎). Sakuemon died in 1781 at the age of 53, so Tajirō's 34-year-old father Chōemon (長右衛門) became the family's patriarch. In 1782, Tajirō's older sister Man (まん), formerly known as Yoshi (よし), aged 15, married and moved to the nearby Tadami village. The following year, Chōemon's grandfather died at the age of 80, and in 1784 his mother died at the age of 53 both potentially due to the effects of the Great Tenmei famine 1781–1789. Thus, in 1785, the once large household had only three members: Chōemon, his wife (unnamed in the documents), and their son Tajirō. The rendering of Tajirō's name changed several times in 1778: at the age of four the name Tajirō (多四郎) was adopted, and then in 1788 at the age of 14 he became Tajirō (太四郎). In 1794, Tajirō (19 years old) married a 17-year-old girl whose name and village of origin are not recorded in the documents, but who had clearly moved from another village, which can be deduced by the fact that she was not previously featured in any of the *shūmon aratame-chō* from Ishibushi. Chōemon died in 1799 at the age of 51, and Tajirō therefore took the family helm. At the same time, he changed his name to Zenbē (善兵衛) and then in 1801 he appears in the *shūmon aratame-chō* under another new name Zenzō (善蔵). Around the same time San was born.

During the second half of the eighteenth century, the family's fortunes appear to have taken a turn for the worse. When Sakuemon (formerly Matsutarō (松太郎)), an adopted son-in-law (*mukoyōshi* 婿養子),

took over the family in 1756, they held 6.128 *koku* (a measure of land value referring to how much rice could be produced), meaning that they were producing approximately enough rice to feed six adults per year. At that time, the family home measured 5 *ken* (a measure of length) by 3 *ken* or approximately 9 meters by 5.5 meters. From 1757 to 1772 they also owned a horse. Nevertheless, from 1759 onwards the family held only 3.064 *koku* (half of their former holdings), and under Zenzō this dropped further to 2.192 *koku* in 1803, 2.064 *koku* in 1805, and 1.924 *koku* in 1808 before increasing back to 2.118 *koku* in 1809, 2.064 *koku* in 1810 and 2.118 *koku* in 1811 and 1812. In around 1805 Zenzō's wife gave birth to a boy named Jirō (次郎) (later Shirō (四郎)) whose naming potentially indicates that the couple had had other children who had passed away before reaching the age of two. The name Jirō was usually given to the second son of a family, while Shirō would often indicate the fourth male child.

Although the story of San's family does not tell us about her death, whether it was caused by measles or just coincidentally fell in a year with a measles epidemic, it allows us to look beyond the numbers to discover the real people who lived in these villages. We can see that San's family had a tumultuous life during the second half of the eighteenth century. Three members died in a period of four years with the deaths of San's great-great-grandfather and great-grandmother likely accelerated if not caused by the Great Tenmei famine. This likely radically changed family dynamics as the family quickly shrunk from a 7-person to a 3-person household. Meanwhile their wealth shrunk over several generations, meaning that by the beginning of the nineteenth century the family was only producing enough rice to feed approximately two adults. San's mother and father had lived through previous epidemics. Zenzō was born a few years before the 1776 epidemic, and both he and his wife may have experienced the epidemic of 1782. Nevertheless, in 1803 both were still under the age of 30 and statistically still at risk from catching measles. That year San died, and observing the naming choices related to their son who was born two years later, it might be possible to infer that the couple had other children who died in infancy though it is not possible to ascertain when. This is the sort of human story that exists beyond our data and which we can begin to reconstruct by piecing together the evidence found on *DANJURO*.

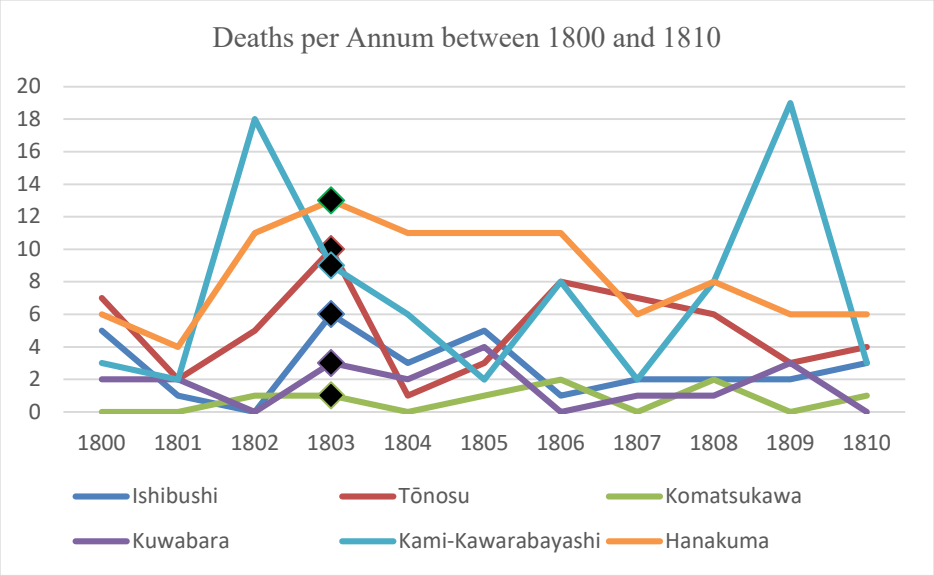
Limitations

There are a number of limitations to using data from *shūmon aratame-chō* and the *DANJURO* platform that extend beyond the criticisms offered

earlier in this paper. Since the data do not record the causes of death, it only allows for a comparison of the number of deaths during different years. In some cases, this can be misleading since years with measles epidemics do not always represent peaks in the numbers of deaths in a given timespan. This has already been illustrated in Table 4 which shows that some measles epidemic years saw a mortality deficit, that is, a lower number of deaths than the average year in the preceding decade. Nevertheless, some further exploration is potentially warranted. Table 8 and Graph 1 show the number of deaths in each village from 1800 to 1810. During this period, there were two influenza epidemics. The first spanned 1801–1802 and the second occurred in 1807, and in addition to this, there was a measles epidemic in 1803 (Jannetta 48–49). While 1803 represents the largest number of deaths for Ishibushi, Tōnosu, and Hanakuma, years with measles epidemics do not always display a significant difference in the number of deaths compared to years without measles epidemics. Note, for example, that while there were six deaths in Ishibushi in 1803, there were five in both 1800 and 1805. In Komatsukawa, on the other hand, there was only one death in 1803. Kami-Kawarabayashi had a much greater number of deaths in 1802 and 1809, while Hanakuma consistently saw more than 11 deaths each year between 1802 and 1806 with 1803 marking a small peak of 13 deaths. While it is important to observe that the average number of deaths recorded in years with measles outbreaks are higher than the average number of deaths overall, there is a potentiality that this sort of analysis misses other patterns happening on a micro-contextual level and within smaller timeframes.

Year	Ishi-bushi	Tōnosu	Komatsu-kawa	Kuwabara	Kami-Kawaraba-yashi	Hanakuma
1800	5	7	0	2	3	6
1801	1	2	0	2	2	4
1802	0	5	1	0	18	11
1803	6	10	1	3	9	13
1804	3	1	0	2	6	11
1805	5	3	1	4	2	11
1806	1	8	2	0	8	11
1807	2	7	0	1	2	6
1808	2	6	2	1	8	8
1809	2	3	0	3	19	6
1810	3	4	1	0	3	6

Table 8:
Deaths per annum (1800–1810). Compiled by the author.



Graph 1:
Deaths per annum (1800–1810). Compiled by the author.

In addition to issues with the sort of information that can be garnered from *shūmon aratame-chō* in regard to epidemics and the potential risks of overlooking patterns at a smaller level, there are also limitations created by *DANJURO* as a platform. *DANJURO*'s analysis program allows users to quickly download pre-sorted data by village including the population, the number of births, the number of deaths, the crude mortality rate, comparisons of age of death, comparisons of gender of death, and so forth, and as explored above, its search functions allow users to access data on individuals and their families. I wonder to what extent the ways that the developers have decided to sort the data contained in *DANJURO* and the functions that they have built into the platform shape our research questions and whether they cause us to potentially overlook others. Although the user interface is dated, it is functional and easy to use. The primary problem with *DANJURO* is that it no longer contains any photographic data of the sources that it uses. The user can still access the pages where photographs were stored, but the photographs no longer appear (with the exception of Komatsukawa village). This creates a potential barrier since sometimes it is necessary to interact with the source itself or its textual content rather than just the data that are taken from it. Indeed, if the full textual data for the information included in *DANJURO* were available for download, other sorts of analyses would also become possible. In any case, these small issues aside, *DANJURO* provides a useful tool for exploring demographic trends during the Edo period in the villages that it features.

Conclusion

In this paper, I have utilized data from *shūmon aratame-chō* accessible through *DANJURO* ver. 7.0 to attempt to see whether these population registers have any utility for studying epidemics in Edo period Japan. Although other types of population registers such as *kakochō*, which as noted record deaths, are likely more useful than *shūmon aratame-chō* for exploring the effects of epidemics, it is still possible to observe the influence of epidemics within these documents. The influence of epidemics can primarily be observed through excess deaths, higher than average crude death rates, and higher than average numbers of death amongst the young. As such, while *shūmon aratame-chō* certainly have limitations for studying epidemics, they should not be completely overlooked particularly since large amounts of data stored on platforms such as *DANJURO* are becoming publicly available. Another observation garnered from the data is that

measles epidemics appear to have been more severe than other epidemics. Nevertheless, due to their infrequency and the small sizes of village populations, increased death rates likely went unnoticed by villagers. It was likely the other aspects of epidemic diseases, such as their symptoms and virulence, that caught people's attention. Further research might be able to employ *DANJURO* to explore new questions about the influence of epidemics by utilizing its large range of analytical tools.[4] Indeed, *DANJURO* is a criminally underused resource with much more potential for research not only on diseases, but also other demographic trends.

One of the most exciting developments that arises from the use of *DANJURO* is the ability to humanize data through a "close reading" of the texts. Usually, it is difficult to find large collections of *Shūmon aratame-chō* that point to yearly changes in a community, but *DANJURO* provides these data and makes them easily accessible. We can use *DANJURO* to look at the changes experienced on an individual and a familial level using our external knowledge of Japanese history to interpret what was happening. In other words, *DANJURO* facilitates historical storytelling that can help to humanize data that are usually reduced to impersonal numbers when a "distant reading" or demographical approach is taken.

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Notes

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1 Amongst the sources used here the 1670 epidemic is only referred to by Suzuki ("Edo jidai no mashin to iryō—Bunkyū ninen mashin sōdō no haikei o kangaeru" 502).

2 In addition to Jannetta's source, this is also noted in Katsushika's *Hashika hitsuyō* (37). It states:

> 年三十歳頃の医師は八歳九歳の時にはしかを見たることなれば名家の子といへとも療治の仕方は習練なかるべし六十七十の老医も麻は僅に両度手かけたるなるべし疱瘡とちがひ連年なき病ゆへゆるかせにすべからず.
>
> [A doctor at the age of 30 would have seen measles at the age of eight or nine, so even if he belonged to a famous family, he would not have learned how to treat it. An old doctor of sixty or seventy years old will have only treated measles twice.

This is not like smallpox, it is not a disease that lasts for years, and therefore must not be neglected]. (Translation is mine).

3 See Kawaguchi and Nakayama "'Shūmon aratame-chō' dētabēsu (DANJURO) no kaihatsu" [Development of the 'Shūmon aratame-chō' Database (DANJURO)] 125–34; Kawaguchi "'Shūmon aratame-chō' dētabēsu shisutemu (DANJURO) no kairyō" [Improvements to the 'Shūmon aratame-chō' Database System (DANJURO)] 1–8; Kawaguchi "Konpyūtā o mochiita Edo jidai no jinkō bunseki hōhō" [Computer-based Methods for Edo Period Population Analysis] 54–58; Kawaguchi et al. "'Edo jidai ni okeru jinkō bunseki shisutemu (DANJURO ver. 2.0)' no kōchiku" [Development of the 'Edo Period Population Analysis System (DANJURO ver. 2.0)'] 17–24; Kawaguchi "'Edo jidai ni okeru jinkō bunseki shisutemu (DANJURO ver. 2.0)' no kōchiku unyō riyō" [Construction, Operation, and Usage of the Edo Period Population Analysis System (DANJURO ver. 2.0)] 1–28.

4 Eugenio Paglino, et al. note that in the case of COVID-19 the number of excess deaths can also reflect deaths indirectly caused by the disease including those "associated with reductions in access to health care, hospital avoidance due to fear of COVID-19 infection, increases in drug overdoses, and economic hardship leading to housing and food insecurity" (1). We might also assume that the excess deaths recorded in *shūmon aratame-chō* were not only deaths directly from measles, but also related to societal changes during the epidemic period.

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