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Smallpox in the Punjab: The Role of Indigenous Vaccinators, 1900-1928

Olusola Bamidele Ojo[1], Huma Pervaiz[2] and Tahir Kamran[3]
[1]*Health Care Agency, Ministry of Health, Seychelles*
[2]*Department of History, Institute of Global and Historical Studies, Government College University, Lahore, Pakistan*
[3]*Department of Liberal Arts, Beaconhouse National University, Lahore, Pakistan*

Corresponding Author: Olusola Bamidele Ojo E-mail: ojoolusola302@gmail.com

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ABSTRACT

Variola virus causes smallpox characterized by debilitating scarring, pustules, and deaths with a mortality rate of 30%. It has shaped the trajectory of kingdoms, cultures, and economies. It has ravaged mankind for 3000 years and was responsible for over 300million deaths globally in the 20th century. In 1980, smallpox became the only human disease eradicated through widespread vaccination. It is an innovative adaptation of the epic discovery of Dr. Edward Jenner's cowpox vaccine in 1798. In most colonies, smallpox campaigns were marked by local resistance, negotiation before final acceptance. Thus, this historical research highlights the role of Indigenous vaccinators during smallpox campaigns and their engagement with local populations in early 20th-century Punjab. By deploying archival sources from Punjab Archives and Punjab Central Library, this piece discovered that some Indigenous vaccinators exhibited unprofessional conduct, which contributed to local resistance to vaccinations and shaped outcomes of smallpox vaccinations in early twentieth-century Punjab. This study highlights the intersection between vaccination procedures and vaccinators in the context of endemic and epidemic management. This research could help to assess and critique the contemporary vaccination procedures and processes to enhance efficient and effective disease management and prevention.

1. Introduction

Variola virus is the causative agent of smallpox and it is known to infect humans alone. It is the only disease eradicated in humans. The contagion spanned over 3000 years of human existence, killing over 300 million people in the 20th century before its eradication (Henderson, 2011). In 1980, the World Health Organization (WHO) declared the eradication of smallpox following an intense and effective vaccination campaign from the mid-20th century (Henderson, 2011). However, we can learn some lessons from smallpox campaigns in the early twentieth century which culminated in its eradication in the 1980s (Smith, 2013). One, it was the smallpox vaccination that initiated the concept of vaccination against infectious diseases drawing from the epic works of Edward Jenner in 1798 (Ochmann et al., 2024; Fenner et al., 1988). Given the COVID-19 catastrophe and the recent global mpox diffusion, pathogen studies including smallpox research can help the world prepare for future pandemics (Gostin et al. 2024). Since the discovery of the smallpox vaccine, subsequent vaccines have been effective in stemming several infectious diseases. Such ailments include measles, tetanus, polio, yellow fever, and even coronavirus in the post-modern world.

However, there are concomitant threats of bioterrorism ascribed to the variola virus. It could result from accidental spillage or intentional deployment as a lethal weapon in postmodern warfare. Contextually, one of the earliest documented biological weapons was smallpox virus deployed by the British against native Americans in the late eighteenth century (Christopher et al., 1997; Henderson et al. 1999).

In the contemporary era, the lingering war between Russia and Ukraine brings to the fore the conversation of biological warfare. Moreover, the ever-present hostilities in the Middle East between Israel and its Arab neighbors resuscitate the unending discourse on biological weapons. Given that the Russian Federation and the United States of America are the only countries having smallpox in their laboratories, the threat of bio-weaponization would always be realistic. As of 1984, variola virus has been kept in US and Russian Laboratories (Muula, 2022; Atkinson et al. 2007). These superpowers have been embroiled in global geopolitical conflicts indirectly since the Cold War. Hence, the possibility of using smallpox virus in political combats exists in the future, especially in a contemporary world riddled with geopolitical wars and tensions. Therefore, a plausible deployment of a biological weapon such as smallpox could portend a global health catastrophe. Moreover, in recent times, the incessant rate of monkeypox, a similar disease, has brought smallpox conversation to the fore. Smallpox vaccines are effective in the vaccination against monkeypox and some experts believe monkeypox could threaten regional and global health in the future (Gostin et al. 2024). In this regard, we examine the operational challenges of smallpox campaigns in the early 20th century. We set out to highlight the role of Indigenous vaccinators regarding the containment and subsequent eradication of smallpox on a regional basis. According to Falola and Heaton (2006) to understand the peculiarities of global diseases, they should be studied within the specific cultural contexts. In this regard, we deploy Punjab as our study area. It is one of the most smallpox-plagued regions in colonial India. The contagion killed over 850,000 people between 1868 and 1947. Between 1875 and 1919, Punjab encountered nine major epidemics occurring in 27 districts, killing almost 2.5 lakh victims (Tandon, 2014). We intend to evaluate the role of local vaccinators to the implementation and success of vaccination in early twentieth-century colonial Punjab. This research highlights the intersection of indigenous workers and colonial medicine in the context of epidemic management. This historical research argues that local vaccinators were not merely passive instruments of colonial medical policy rather, their conduct, reputation, and interaction with local populations critically influenced public reception and the ultimate effectiveness of vaccination campaigns between 1900 and 1928 in Punjab.

2. Literature Review

Despite its eradication over 45 years ago, the terrorist attacks that occurred on September 11, 2001, in the US have triggered renewed interest in scholastic discourses on smallpox, particularly regarding the plausible weaponization of the virus. Hence, newer themes are focusing on the development of newer vaccines to combat the scourge in case of resurgence. In this regard, scholars such as Simonsen & Snowden (2023) and Milton (2012) focus on the viral characteristics of variola virus, its epidemiology, and the clinical features. They describe the smallpox virus as a DNA virus belonging to the family of poxviruses, genus of orthomyxovirus, and a species of variola virus. The dispersal of the virus occurs via respiratory droplets, secretions, and direct contact with contaminated vomites. The early clinical manifestations include fever, rigors, headache, backache, abdominal pain, and vomiting. The feverish episode occurs one to three days before the appearance of the skin lesions. The case fatality ratio is about 30 %. Regarding vaccination against smallpox, many researchers highlight and explore modalities of developing newer vaccines to curb smallpox scourge in case of accidental spillage from the laboratories and the need to provide newer and more effective vaccines for other poxviruses (Voigt et al., 2016; Breman, 2021; Petersen et al. 2015; Noyce et al. 2018; Shchelkunov, 2011). Shchelkunov (2011) had initially stressed the need for the development of a new generation of smallpox vaccines to enhance disease preparedness for smallpox in case of accidental spillage into local populations. He suggested renewed vaccinations to combat poxviruses-associated infections. In the US, in advancement of this scholastic trend, Petersen et al. (2021) outline the various recommendations and steps involved in taking smallpox vaccinations in case of exposure. They also state that severely immunocompromised patients such as those on bone marrow transplants and on antiretroviral would not benefit from smallpox vaccinations. Contrastingly, in China, Liu et al. (2024) showed that the smallpox vaccine is effective and safe for monkeypox infections, and they are specifically advantageous for high-risk groups such as HIV patients and other immunocompromised subjects.

Regarding the threat of accidental spillage of smallpox virus, in the US, Cohen (2024) highlights the threat of reemergence of smallpox and emphasizes the need for improved vaccines and medications to combat the scourge including the recent global monkeypox outbreak in 2022. Likewise, Meyer et al. (2020) underscore the risk of resurgence of smallpox citing waning immunity to smallpox because the last vaccinations were undertaken more than four decades ago, hence the rationale for heightened preparedness. In a similar vein, Noyce et al. (2018) explore the formation of horsepox virus vaccine from DNA fragments to counter the risks of pox infections including smallpox and monkeypox. This underscores the significance of recombinant DNA technology in the production of newer, faster, and more reliable vaccines that could be produced in large quantities. In the Republic of Korea, Shin et al. (2024) revealed that the ELISA method is reliable and effective in detecting antibodies after smallpox vaccinations in a selected study group. This study contributes substantially to the dynamic themes regarding the evaluation of diagnostic methods in preparation for plausible weaponization and the resurgence of the deadly disease. In the African clime, recent focus is on the African origin of the virus and the impacts of discontinuation of smallpox vaccinations on the heightened incidence of monkeypox, especially in sub-Saharan Africa in 2022. Bremen (2021) discussed the African origin of smallpox and elaborated on the link of the first victim to Ramses V circa 1157BCE, and the efficacy of African solutions to her inherent challenges of infectious diseases. In a retrospective assessment of post post-smallpox vaccination period in an endemic area of Africa, Mungmunpuntipantip & Wiwanitkit (2022) found no relationship between the cessation of smallpox vaccinations and the incidence of monkeypox infections.

Concerning the theme of this study, there is a deficiency of research highlighting the role of Indigenous vaccinators in the local resistance and outcomes of smallpox campaigns in early twentieth-century India including Punjab. Even though Bhattacharya et al. (2006) and Lahariya (2014) highlighted the operational and institutional challenges that plagued smallpox vaccination in colonial India, their thesis did not comprehensively analyze the impacts of local vaccinators regarding local acceptance and the outcomes of smallpox campaigns. In the contemporary Indian context, newer themes concentrate on the smallpox eradication strategies and the resistance and challenges encountered during the campaigns. For example, Luke et al. (2017) and Palanki (2023) assert that the somewhat intrusive smallpox campaigns largely disregarded ethics and particularly hurt the cultural sanctity and liberties of Indians. It provoked resistance and shaped outcomes of initial smallpox campaigns in colonial India. Their findings align with the perspectives of notable medical discourses in colonial contexts of India. For instance, Arnold (1993) highlights that the colonialists deploy epidemics campaigns to purposely keep local populations under hegemony in colonial India. In colonial South India, Brimnes (2004) threw light on the local popular resistance and the colonial ideologies that shaped interactions with local populations and vaccinators. This dynamic emanated from the replacement of smallpox variolation by vaccination in the early nineteenth century. He also highlighted the significance of local vaccinators in this regard. Specifically in colonial Punjab, Tandon (2014) exposed the epidemiological patterns of the contagion, and the dynamics of their campaigns as well as local responses to colonial medical institutions. Relatedly, Sohal (2015) revisited the historical trajectory of smallpox and highlighted the challenges of smallpox campaigns in the late eighteenth and early twentieth-century Punjab. However, in these studies, the influences of Indigenous vaccinators on the outcome of vaccination campaigns remained largely untouched in the Indian context including Punjab. Hence, we set out to deploy early twentieth-century colonial Punjab to achieve this lofty objective. A study of this caliber exposes the significant contribution of vaccinators to the outcomes of epidemic control in local populations.

3. Methodology

This research delves into the social history of medicine and the dynamics of colonial medical policies regarding smallpox control in early twentieth-century Punjab. This historical article focused on the impacts of Indigenous vaccinators between 1900 and 1928 in the Punjab. Local resistance, negotiation, and subsequent acceptance defined this era. It culminated in the subsequent eradication of the disease in the late twentieth century globally. Given that Jenner's vaccines had permeated most Asian and African climes from the mid-19th century, however, it was not until the turn of the twentieth century that most coordinated smallpox vaccination campaigns commenced in most colonised climes including India. Since 1928, smallpox vaccinations have largely demonstrated their clear leverage over the traditional variolations in combating smallpox, and colonial India including Punjab has an established and more functional vaccination architecture to cater for epidemic and endemic diseases including smallpox. Hence, the emphasis on the time frame in this study. The historical research deployed archival sources from the Punjab Archives and Punjab Central Library in Lahore, such as Home, Medical and Sanitary Proceedings and Notes of Vaccinations in the Punjab, and relevant secondary sources. We cross-referenced and correlated archival sources with established reliable primary data, and secondary sources to ensure reliability and reduce bias in data analysis and conclusion in this study.

4. Findings and Discussion

4.1 Global Historical Epidemiology of Smallpox

Smallpox has afflicted humanity since the prehistoric era. Its origin as an infectious disease remained lost in prehistory. It is believed to have emerged around 10,000 BC in Egypt, around the era of the first agricultural settlements (Hopkins, 1983; Barquet &Domingo, 1997). It was probable that it spread from there to India through the ancient traders. The original evidence of smallpox-like skin lesions was found on Egyptian mummies between the 18th and 20th Dynasties (1570-1085BC). For instance, an Egyptian pharaoh, Ramses V who died in 1156BC had maculopapular lesions similar to those of smallpox, and similar lesions were described as early as 1122BCE in China (Lyons & Petrucelli, 1987). The ancient Sanskrit text of India also reported related lesions around the same era. In this ancient text, it was known as *masurika* and associated with the Hindu goddess *Sitala Mata* (Belongia & Naleway, 2003) Another account claimed smallpox was probably introduced into China from the southwest in the first century CE – a narrative, which contradicted earlier assertions. It was claimed that smallpox infected China in the first and sixth centuries and from there, it diffused into Japan (Fenner, 1988). The smallpox epidemic of 735-737CE was said to have decimated about one-third of the Japanese population (Duggan et. al., 2016). Some scholars felt smallpox only emerged as recently as 1588CE in Asia and that earlier reports were incorrect (Hays, 2015).

The timing of smallpox entry into Europe was unclear. There is no clear mention of the contagion in the Bible or any of the Greek or Roman literature. Some claimed it coincided with the plague of Athens, which was said to originate from Egypt or Ethiopia, or the plague that lifted Carthage's siege of Syracuse in 396BCE (Fenner, 1988). However, many refuted this assertion because Hippocrates could not have missed an epidemic of such proportion in the Mediterranean region in his era (Dixon, 1962). The first reliable evidence of smallpox in the ancient era coincided with the plague of Antonine from 165 -180 CE. In the ancient Roman Empire, the plague of Antonine killed roughly seven million people (Belongia & Naleway, 2003). It also appeared in Europe between the fifth and seventh centuries.

There are other vital accounts of smallpox in the Middle Ages. Some historians claim that smallpox originated in Africa. According to them, the Arabian armies first conveyed this contagion from Africa into Southwestern Europe during the seventh and eighth centuries (Fenner, 1988). The Arabic expansionist drive of the era might have enhanced the dispersion of smallpox into Western Europe. Its preponderance in Arabia must have prompted notable physicians to delve into its extensive research. Rhazes, a Persian physician among other notable healers, provided a clear differentiation between smallpox, measles, and chicken pox in his book, *Kitab fi al-jadari wa-al-hasbah*(The Book of Measles and Smallpox) in the ninth century (Otri et al., 2008). The disease permeated the social spaces of Europe in the medieval era but did not assume epidemic proportions until populations had risen and the frequency of movement increased during the era of the Crusades. By the sixteenth century, smallpox became a significant disease in Europe because of its devastating mortality and morbidity (Fenner, 1988). From here, it appeared to disperse into other regions of the world starting from the expedition era in the late fifteenth century. In the dark ages of the medieval era, smallpox was thought to impede Western civilisation but its role in the late Middle Ages was equally devastating. The Arab expansion, the expedition of the Crusaders as well as the exploration into the New World all enhanced the diffusion of this disease globally.

The early European explorers such as the Spanish and Portuguese explorers introduced smallpox into the New World in the fifteenth century. There were no recorded accounts of smallpox in the Americas before the advent of the European explorers (Li et al., 2007). According to Alfred Crosby's virgin soil theory, local populations are usually bereft of immunity to ailments that are alien to them (Crosby, 1976). Therefore, they usually suffer more mortality if such contagion is transmitted to them. In the context of Americans, it led to the annihilation of local populations. This phenomenon aptly explains the unwholesome effects of European incursion into the New World. Europeans introduced new diseases such as malaria, smallpox, yellow fever, and influenza into territories like the Americas, the West Indies, Australia, and the Pacific Islands. Earlier examples of the virgin soil theory included the Romans diffusing smallpox in Europe and the Middle East in the second century CE via new populations and the Mongols dispersing Bubonic plague into Europe in the fourteenth century..

In the first half of the 16th century, the virgin soil theory also describes the widespread smallpox epidemics that contributed to the extermination of the Aztec and Incas empires by the Spaniards in the Americas (Henderson et al., 1999). In North America, smallpox introduced by early settlers led to a significant decline in local populations. It was introduced into the Caribbean Island of Hispaniola in 1509 and the mainland by 1520 (Fenner, 1988). In 1633, devastating outbreaks of smallpox erupted among Native Americans in Plymouth and Massachusetts, and later among the native-born colonizers (Koplow, 2003). The mortality rate was exceedingly high among Native Americans; about eight to nine out of ten patients died (Koplow, 2003). These devastating effects of smallpox arguably inspired one of the earliest documented biological warfare in history. During the British War against Native Americans from 1754 to 1769, the Commander of British forces, Sir Jeffrey Amherst sanctioned the conscious deployment of smallpox virus in the wars against indigenous Indians (Barquet and Domingo, 1997).

Smallpox also had a similar effect on the socio-demographic landscape of Native Aborigines in Australia. Smallpox was introduced into Australia in 1789 and later in 1829 via European incursions (Fenner, 1988). Although smallpox disease was not known to be endemic on the continent, it largely accounted for high mortality among the Aborigines between 1780 and 1870 (Glynn & Glynn, 2004). The trans-Atlantic slave trade that occasioned the conveyance of many slaves from Africa also contributed to the escalation of the disease in the Caribbean and America (Henderson & Moss, 1999).

In the eighteenth century, it permeated all facets of nationalities. By the middle of the eighteenth century, it had become an endemic disease in most regions of the world except Australia and some small islands. It became a dominant cause of fatalities in Europe in the eighteenth century. In Europe, 400,000 lost their lives to smallpox outbreaks (Belongia & Naleway, 2003). In England, the average mortality rate was comparatively higher – it drew close to 90 percent in London and Berlin in the nineteenth century (Koplow, 2003, p.10). In Sweden, about 10 percent of infants died from smallpox yearly (Hays, 2015) and smallpox infant mortality rate was probably higher in Russia (Hopkins, 2002).

4.2 Historical Epidemiology of Smallpox in Punjab

In India, even though smallpox dates back to the Sanskrit era, it only assumed a disease of epidemiological significance in the mid-eighteenth century. It transformed from a malady to a catastrophe in colonial India, and unfortunately became a means of social identification in Punjab (Sohal, 2015). The revenue and judicial documents deployed pockmarks created on smallpox victims to identify persons in Punjab. For instance, in the sale of deeds in 1748, the mortgagors documented *Gur Sahai* and *Karam Chand* as pockmarked (Grewal, 1975). Another mortgagor, *Godaria* had pockmarks in 1752 (Singh, 2010). In the late eighteenth century, *Maharaja Ranjit Singh* suffered a virulent attack of smallpox with consequent loss of his left eye vision and deep pitting of his face (Sohal, 2015). There were also statistical pieces of evidence of smallpox in northern India in the nineteenth century. Delhi encountered devastating outbreaks of smallpox in 1842, 1846, and 1849. In 1864, roughly 90 percent of prison inmates in Lahore, Amritsar, and Ambala contracted smallpox (Fenner et al., 1988).

Concerning smallpox mortality in Punjab, the contagion killed 850,591 people between 1868 and 1947. It peaked from 1875-1919. Nine major epidemics affected twenty-seven districts, which accounted for 250, 000 deaths. The case fatality rate was 10 percent while 25percent of sufferers were pockmarked (Tandon, 2014). The average annual smallpox mortality of Punjab exceeded other regions in British India (Arnold, 1993, 118-9). The northwest and southeast areas of Punjab were the worst hit because vaccination was unpopular and natives preferred variolation to vaccination. In addition, people living near the shrines of a goddess, *Sitala* in Gurgaon preferred visiting the shrines to taking vaccination (Punjab Proceedings, 1887).

4.3 Indigenous Vaccinators and Smallpox Campaigns in Punjab, 1900-1928.

Smallpox vaccination campaigns entailed a huge deal of planning, implementation, and evaluation processes. In Punjab, they involved an intricate institution of a superintendent general, a sanitary commissioner, a deputy sanitary commissioner, district medical officers, and Indian vaccinators. In 1856, the provincial government divided each province into two circles to ease vaccination campaigns. The colonial medical administrators engaged a superintendent general for each circle with a retinue of Indian vaccinators working with him. Sanitary commissioners subsequently took over the charge of the vaccination department in 1868. As a result, each circle has a deputy Sanitary Commissioner saddled with overseeing sanitary, vaccine operations, and the duties of District Medical Officers (DMOs). The DMOs implement various vaccination policies at the district level – they partake in vaccination campaigns at local levels and usually supervise local Indian vaccinators (Punjab Proceedings, 1881). However, as of

1906, local Indian vaccinators came under the administrative control of local intermediaries ((Punjab Proceedings, 1907). The significance of this on the outcome of smallpox campaigns would be apparent later.

The process of vaccinations also underwent appreciable changes at the beginning of the twentieth century. The hitherto arm-to-arm vaccination was gradually replaced with calf lymph-to-arm vaccination. Before this era, specifically in 1890, buffalo, donkey, and sheep were deployed to make vaccines (Punjab Proceedings, 1891). Six years later, calf lymph preserved with Vaseline was introduced in India. The newer technology of vaccination is expected to require a new form of training to ensure mastery of the new craft.

In India including Punjab, however, many local vaccinators were reluctant to embrace the new technology of using lymph mixed with preservatives. It was either that they resisted change or did not fully comprehend the new system. Most reverted to the old system of cutting deep into the skin, which they were accustomed to in the arm-to-arm vaccination system. They continued to use this painful, unsafe, and often potentially dangerous system of vaccination on the natives. According to the annual report of vaccination in 1925, '' most of them have a tendency to revert to the use of pure humanised or animal lymph under stress'' (Annual Report of the Public Health Commission, 1925). Even though it was generally considered less safe than lymph mixed with preservatives. These actions were often inimical to the outcomes of smallpox campaigns in Punjab. The incidence of post-vaccination complications remained high, which often provoked uprisings against vaccinations in rural Punjab. These problems were compounded by the fact that natives were often compelled to pay for a procedure, which was painful and sometimes unreliable (Annual Report of the Public Health Commission, 1901). In some instances, local vaccinators often ignored guidelines concerning sterilisation of instruments or the arms of the subjects either due to a seeming dislike for a new system or inadequate supervision. In Ambala district, different civil surgeons dismissed a local vaccinator on three occasions for churning out ''bad works ''but kept being reinstated by the committee''. Consequently, the civil surgeon refused to accept the credibility of the vaccination exercises carried on in the district during the 1924 -25 vaccination season (Notes on Vaccination in the Punjab for 1924-25, 1925, p.9).

In some places in India including Punjab, there were reported cases of extortion from hapless natives. Apart from the issue of the wrong technique of vaccination applied by some vaccinators, others see it as a means of extorting local populations. The General Department of Health in India commented on the problems caused by local administrative corruption as follows:

> The people of this country as a whole appreciate and welcome vaccination as protection from smallpox, but they have the greatest objection to the taking of lymph from the children's arm, which destroys vesicles or applies substance which causes great irritation and not infrequently (sic) ulceration of the child's arm. The most troublesome part of a vaccinator's duty is the selection of a good vaccinator and the obtaining of parent's consent – a duty which moreover provides opportunities for petty oppression and extortion. (General Department of Health of India Memorandum, 1903).

In some instances, some indigenous vaccinators undermined the outcome of smallpox campaigns by manipulating the ''records''. As initially discussed, as of 1906, local organizations began managing the affairs of vaccinators. Consequently, local vaccinators were paid based on productivity. Sometimes, because of the technicalities and patience involved in vaccinating young children, especially under five years, many prefer to vaccinate adults and older children to make up the statistics for a specific vaccination area. In 1914, the Deputy Sanitary Commissioner of Punjab observed during one of his tours to Simla that people objected to children receiving the second operation unless they were at least three or four years of age. His investigations into the matter revealed that the vaccinators performed numerous revaccinations on adults and older children in order to make up for the younger children they failed to vaccinate (Notes on Vaccination in the Punjab for 1914-15, 1915, p.3).

However, in other instances, some vaccinators in a bid to churn out appreciable statistics revaccinate underage children. It appeared the ideological thrust of some local vaccinators was to revaccinate irrespective of age group for increased remuneration. It seemed the availability of subjects also determined the frequency of revaccinations. For instance, Gurgaon, Amritsar, and Jhang districts had the highest revaccination statistics among other districts in

Punjab from 1927 to 1928 (Notes on Vaccination in the Punjab for 1927-28, 1928, p.2). The revaccination statistics increased substantially above previous years. However, a confirmatory inspection by the Director of Public Health in Gurgaon proved the revaccination data was overblown. He commented as follows

> During the course of my inspection of vaccination in this district, I found many children had been revaccinated at a too early age and were in consequence '' failures'', 5,668 young children whilst remained unvaccinated at the end of the year. The success of the campaigns was marred by the fetish of numbers. (Notes on Vaccination in the Punjab for 1927-28, 1928, p.2).

Perhaps earlier smallpox statistics, which showed a decrease in vaccination rates, were more reliable for further planning of control programs in Punjab. Smallpox control campaigns suffered a substantial dip in terms of the average number of vaccinations and revaccinations in the first decade of the twentieth century in Punjab. The total number of vaccination operations dropped by 45, 520 in 1906-07 in comparison with the preceding season. Altogether, the districts of Dera Ghazi, Ferozepur, and Multan had a fall of over 41, 000 cases (Annual Report of the Sanitary Commissioner of India, 1907, p.115-6). Even though Lahore and Amritsar recorded a mild increase in vaccination rates, it still represented a decline from the previous vaccination statistics. In his 1906-07 notes on Vaccination, the Sanitary Commissioner of Punjab attributed these deficiencies partially to neglect on the part of the operating staff (Annual Report of the Sanitary Commissioner of India, 1907, p.115-6).

5. Conclusion

Smallpox inarguably shaped the course of human history by annihilating millions of people in the Old and New World. Dr Edward Jenner's discovery of vaccination in the eighteenth century ranks among the greatest discoveries of humanity. It saved millions of souls from debilitating and harrowing scarring, pustules, and eventual death. The earliest effort at smallpox control dated back to eleventh-century China when physicians discovered that inoculating smallpox scabs into healthy subjects would sometimes confer immunity. This invention permeated into other parts of the world over the century. However, the safer technique of cowpox vaccination innovated by Jenner soon swept aside variolation to become the gold standard of prophylaxis of smallpox from the turn of the nineteenth century.

This research article has highlighted the role of local vaccinators in determining the outcome of smallpox vaccination campaigns in Punjab in the early twentieth century. It consequently argued that the underhanded tactics and other unprofessional misconduct exhibited by some local vaccinators contributed to local resistance to vaccinations and shaped outcomes of smallpox vaccinations in early twentieth-century Punjab. Nevertheless, this piece does not disparage or demean the institutions of local vaccinators in colonial Punjab. Contextually, the Indigenous vaccinators were instrumental to stemming the catastrophic trends of smallpox in colonial India and elsewhere, and were eventually pivotal in the eradication campaigns globally. However, it is a historical research detailing some of the human factors that constituted part of the initial institutional and operational challenges to smallpox vaccinations in colonized societies including Punjab.

Given the plethora of infectious diseases such as measles, poliomyelitis, diphtheria, tetanus, hepatitis B, and rotavirus in the contemporary era, there are lessons going forward. One, training, retraining and regular evaluation of vaccinators are fundamental to ensure optimal performance and guarantee disease control. Moreover, evaluators and supervisors are enjoined to supervise the vaccinators on the field to ensure maximal efficiency and effectiveness of the vaccination campaigns. Also, vaccination departments could deploy state-of-the-art technological devices such as drones to monitor the vaccination process and the vaccinators. It would mitigate the unprofessional conduct of some vaccinators and improve efficiency and epidemic and endemic disease management.

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