Washington COVID-19 Cases in the Healthcare Industry

March 2020 – March 2021

Darrin Adams

Dave Bonauto

SHARP technical report # 103-07-2021

July 2021

SHARP
Safety & Health Assessment & Research for Prevention

Washington State Department of Labor & Industries

Contents

Tables

Charts

ACKNOWLEDGMENTS Thanks to Naomi Anderson for her many thoughtful reviews and ideas on addressing demographic disparities

EXECUTIVE SUMMARY

COVID-19 case rates by detailed healthcare occupations are lacking. Linking state-level healthcare licensing credentialing data to state COVID-19 case reporting may provide such estimates. In Washington State, by linking active healthcare provider credentials to Washington Disease Reporting System files for the period from March 2020 through March 3, 2021, we identified 22,292 laboratory confirmed cases of COVID-19 among Washington's 435,504 credentialed healthcare providers or 5.12 cases per 100 providers.

COVID-19 case rates varied significantly by provider credential:

- The highest case rates were in Nursing Assistants (10.31 per 100 nursing assistants), Nursing Home Administrators (9.85 per 100 Nursing Home Administrators) and Licensed Practical Nurses (8.72 per 100 LPNs)—all well above the general population rate.

- Among the lowest case rates were Physicians (1.87 cases per 100 physicians), Dentists (1.87 per 100 Dentists), and Psychologists (1.76 per 100 Psychologists).

The observed higher rates in healthcare support occupations, e.g. Nursing Assistants and Medical Assistants, are likely due to more hazardous exposures from direct patient care and higher non-occupational exposures to COVID-19. These low-wage, low-status jobs have higher percentages of Black, Indigenous, and People of Color (BIPOC) workers.

Trends in case rates in healthcare occupations relative to the general population rate reflect much higher rates during the early phase of the pandemic, when exposure risk likely was magnified in healthcare settings, and a lower relative rate during the period when COVID-19 vaccines first became available and prioritized to healthcare workers.

Linking healthcare credential records to COVID-19 case records provide estimates of COVID-19 rates in detailed healthcare occupations. The broad range of case rates likely reflects the combined risk of COVID-19 exposure in the healthcare setting and non-occupational exposures.

INTRODUCTION

Healthcare workers face COVID-19 exposures in a variety healthcare settings, with those involving direct patient care likely at higher risk. With exposed healthcare populations, risk of COVID-19 infection depends on the controls in place to mitigate the exposure. The framework used in occupational safety and health and deployed in the COVID-19 pandemic is a hierarchy of controls. Briefly, the hierarchy relies on a) engineering controls to diminish exposure, such as building ventilation improvements, or placement of physical barriers, b) administrative controls, which typically modify how work is organized or done to lessen exposure, such as cohorting COVID positive patients, or modifying triage protocols to identify high risk patients, and finally c) use of personal protective equipment, such as respirators, facemasks, or eye protection, to lessen exposure of the healthcare worker to hazards.[1] Therefore, the risk of COVID-19 exposure and contracting the disease likely depends on exposure to COVID-19 infected patients in the healthcare practice setting coupled with the deployment of workplace controls to mitigate the hazard.

To date, there are few comparative assessments of COVID-19 infection rates among detailed healthcare occupations. Across US states, employment status and data collection detailing industry and occupation may not be collected in public health datasets, or, if collected, may not be codified into a useful format for analysis and inclusion in public health decision making. As a part of Washington State's public health response, local health jurisdictions and the state health department conduct contact tracing and follow-up on confirmed cases. To gain a better understanding of how protective rules and measures are working in various employment settings and support the quarantine and isolation strategy, data are collected on occupation, business type, and employer. Many of these data are incomplete. This impedes identification of workplace outbreaks and lessens informed public policy formation relative to prevention efforts.

This study aims to provide more detailed estimates of COVID-19 infection rates for healthcare workers by using publically available healthcare credentialing data linked to COVID-19 case data reported to the state health department. Such linkage allows for estimations of COVID-19 case rates by detailed healthcare occupations. It also allows us to contrast COVID-19 rates for healthcare support occupations relative their correlated healthcare practitioner occupations, e.g. nursing assistants to nurses, which reflect different work tasks and levels of involvement in direct patient care.

METHODS

DATA SOURCES

To estimate COVID-19 case rates in healthcare occupations, this report links Washington State healthcare provider credentialing data with laboratory confirmed cases of COVID-19 reported to the Washington State Department of Health.

Washington Healthcare Provider Credential Data[2]

In Washington, the state Department of Health provides information so the public may confirm their healthcare providers are currently licensed to practice in the state. These data include the provider's name, year of birth, credential

[1] NIOSH Hierarchy of Controls: https://www.cdc.gov/niosh/topics/hierarchy/default.html
[2] https://data.wa.gov/Health/Health-Care-Provider-Credential-Data/qxh8-f4bd

type, license number and expiration date. Most provider credentials expire on the provider's birthday,[3] although there are exceptions (Appendix A).

There are 131 provider credential types included in the public database. Individuals may have multiple credentials, and credentials may be active even if they are not presently practicing in that capacity (practicing under a different credential, live out of state, retired, or another reason).

For this report, all "active" status credentials (as of February 3, 2021) were included, yielding 433,979 individuals with 468,725 credentials. Fields to help discriminate whether someone is actively practicing in Washington are not part of the public data set and are not used in this analysis.

In the report, credential types have been grouped, for example, "nursing assistant certified" and "nursing assistant registered" were grouped together as Nursing Assistants (see Appendix B). These groups are clustered for elements of work context.

The Washington Disease Reporting System (WDRS)[4]

Washington healthcare providers, laboratories, and hospitals are required to report certain diseases to local health jurisdictions or the state department of health. Confirmed cases of COVID-19 are among these notifiable conditions. Once notified, local health jurisdictions or the state department of health begin case investigation and enter these cases into a centralized statewide database—the Washington Disease Reporting System (WDRS). A weekly extract of laboratory confirmed COVID-19 cases is provided by the Washington State Department of Health to the Washington State Department of Labor and Industries under a data sharing agreement. These extracts include various demographic data, of note for linking purposes: name and date of birth. This report is based on data provided through March 3, 2021 at which time there were 342,297 COVID case reports.

Employed Labor Force (ELF)[5]

The Employed Labor Force query tool is a product of NIOSH/CDC and uses data from the U.S. Bureau of Labor Statistics' Current Population Survey (CPS) to provide state and occupation specific estimates of workforce demographics including race, ethnicity, and sex.

O*NET[6]

O*NET is a U.S. Department of Labor product that describes occupations in terms of the knowledge, skills, and abilities required, as well as work context, tasks, activities, and how the work is performed. O*Net information was used to describe typical tasks performed by Nursing Assistants, Licensed Practical Nurses, and Registered Nurses.

LINKING

Three methods were used to link provider credential data to confirmed COVID-19 case data. The first link method attempted was to match lab-confirmed cases reported through the Washington State Disease Reporting System (WDRS)

[3] Washington Administrative Code Title 246 > Chapter 246-12 > Section 246-12-020
[4] Access and permissible use of the WDRS COVID subset under provisions of DOH contract No. GVS25301-2 and L&I Contract No. K4680.
[5] https://wwwn.cdc.gov/wisards/cps/cps_help.aspx
[6] https://www.dol.gov/agencies/eta/onet

with all active provider credentials using date of birth, last name, and first name. Positive links were found for 20,235 cases.

The second linking method addressed the credentialing data where date of birth was not used as the expiration date (Appendix A), matching on year of birth, last name, and first name. Using this approach, 1,133 cases matched a credential type. However, some were duplicate links to the first method, either because the individual had multiple credentials, or the expiration date fell on their birthday (n=95). The second linking method yielded 1,038 new cases to healthcare provider matches.

The final linking method addressed some observed variations between the reporting systems. The credential system tends to capture legal names, while, in some cases, WDRS captured preferred name. There were differences in field lengths and apparent spelling variations. Records were compared based on date of birth, last name, and partial-match first name with review. Using these methods, described in detail in Appendix C, an additional 1,019 matches were identified.

Table 1. Linking COVID-19 Cases to Provider Credentials: Links by Method

Method	Links	Net New Links	Cumulative Links
Method 1 [DOB, Last, First]	20,235	20,235	20,235
Method 2 [YOB, Last, First, Eligible Credential]	1,133	1,038	21,273
Method 3 [DOB, Last, Partial First w/ review]	1,235	1,019	22,292

GENERAL POPULATION RATE DETERMINATION

For an estimate of the COVID-19 case rate per 100 Washington residents, we used total cases reported to the Department of Health and used population estimates from the Washington State Office of Financial Management.[7]

For calculating rates by credential, a full case (1) was added to each numerator even if the individual had multiple active credentials (under this method n = 23,760 rather than the 22,292).

Linking and data analyses were conducted using SAS Version 9.4 and JoinPoint 4.9.0.0.

[7] https://ofm.wa.gov/washington-data-research/statewide-data/washington-trends/population-changes/distribution-washington-population-age-and-gender, last updated 9/9/2019.

RESULTS

As of March 3, 2021, the Washington Disease Reporting System (WDRS) contained 342,297 COVID-19 cases.

By linking active healthcare provider credentials to WDRS files, we identified 22,292 laboratory-confirmed cases of COVID-19 among Washington's 435,504 credentialed healthcare providers, or 5.12 cases per 100 providers (Table 2). The COVID-19 case rate for Washington's general population was 4.47 per 100 persons (342,297 cases per 7,656,200 persons). Observed case rates of COVID-19 were higher in younger age groups in the healthcare workforce relative to the general population (Table 2).

In reviewing the employment-related data entered into the WDRS, 10,860 of the 22,292 (48.7%) linked healthcare provider cases did not have employment information on the COVID-19 case reporting form, suggesting WDRS data are incomplete for occupation and industry coding in healthcare

Observed COVID-19 rates varied by healthcare provider credential (Table 2). Some fields, such as Optometry, Psychology, and Physicians, had rates well below the general population rate: 2.90 cases per 100 optometrists; 1.78 cases per 100 psychologists; and 1.87 cases per 100 physicians. Nursing Assistants (10.31 per 100 nursing assistants) and Licensed Practical Nurses (8.72 per 100 LPNs) were well above the general population rate.

In some cases, substantially different observed rates occurred in occupational groups where medical support occupations had higher case rates of COVID-19 than the healthcare practitioners. Some interesting examples include:

1. The rates for Nursing Assistants and Licensed Practical Nurses were 10.31 per 100 and 8.72 per 100, respectively, with each being more than twice the rate of Registered Nurses (4.25 per 100).
2. The combined rate for Dental Assistants and Dental Hygienists was 5.47 per 100, which was triple that of Dentists (1.87 per 100).
3. Medical Assistants had a COVID-19 rate of 6.95 per 100; more than three times that of Physicians (1.87 per 100).

Trends in COVID-19 reflect the course of the pandemic and the effect of vaccination. Trends in healthcare COVID-19 cases paralleled those of the general population with both case counts peaking on December 6, with 223 and 4,317 respectively (Chart 1). This commenced the 7-day period with the highest numbers of COVID-19 cases, with 1,341 cases for healthcare providers and 21,441 cases among the general population.

Comparing the relative case rates for COVID-19 in the healthcare workforce to the general population demonstrates elevated relative rates of COVID-19 in the healthcare workforce early in the pandemic from March through mid-May 2020, followed by a period of relatively stable but slightly elevated rates from mid-May 2020 through mid-December 2020, and decreased relative rates in the healthcare workforce after mid-December 2020 (Chart 2).

Finally, the relative rate of COVID-19 cases during the period of prioritizing healthcare workers for COVID-19 vaccination is presented in Chart 3 for Nursing Assistants, Registered Nurses and Licensed Practical Nurses relative to the general population. Each occupation has significant progressive declines in the relative rate of COVID-19 infections to the general population related to vaccine availability and likely administration to these priority populations.[8]

[8] Fieller's Theorem Dunlap and Silver Behavior Research Methods and Computers 1986, 18 (5) 469-471.

DISCUSSION

In this study, detailed occupational COVID-19 rates are calculated for credentialed healthcare populations. Rates varied from 1.45 to 10.31 per 100, while Washington State's population rate for the same period was 4.47 per 100. Linking healthcare provider credentialing data to COVID-19 reported case data gives more complete occupational data for healthcare workers than relying on employment information reported to the Washington Disease Reporting System.

Exposure to COVID-19 in the workplace elevates the overall risk of COVID-19 infection. Assessing workplace exposures and the effectiveness of controls is difficult and is further complicated by the occurrence of asymptomatic COVID-19 infection. Nevertheless, some occupations clearly have elevated rates of COVID-19. Nursing Assistants, LPNs, and Nursing Home Administrators far exceed general population rates of COVID-19, and there may be additional opportunities to improve training, communication about risk, and improve protective measures. Evaluation of infection control practices in nursing homes or other congregate healthcare and non-healthcare facilities may inform future strategies to control future pandemics or endemic infections such as influenza.

Specific healthcare populations will be at higher risk for multiple reasons, such as the nature of work including the tasks involved with direct patient care, and the presence or absence of hazard controls—among them ventilation, modifying work activities to diminish exposure, and the availability and use of PPE. Observed differences in RNs, LPNs, and Nursing Assistants certainly reflect variation in hazardous exposures, and possibly variation in utilization and effectiveness of different controls for COVID-19 exposure. A review of the work tasks provided in O*Net for Nursing Assistants, LPNs, and RNs supports work exposures involving more direct patient care in healthcare support occupations as a partial explanation for variation in COVID-19 rates (Table 4).

COVID-19 case rates reflect both occupational and non-occupational risk. In this study, there is little information to assess exposures in non-occupational settings. However, the observations that some healthcare providers have lower COVID-19 infection rates than the general population does not indicate that the workplace is protective or that there is an absence of an elevated risk of workplace exposure to COVID-19. Reduced rates of COVID-19 in specific subpopulations of workers likely reflects the availability of controls to limit non-occupational exposures to COVID-19.

Trends in COVID-19 case rates relative to the general population reveal the progression of the COVID-19 pandemic and the influences of workplace controls and public health interventions. The high relative rates in the early months of the pandemic may reflect higher occupational exposure through poor controls of COVID-19 exposure due to shortages of personal protective equipment and poor recognition of asymptomatic infection, but this may also reflect increased diagnosis of COVID-19 from preferential allocation of limited testing kits for healthcare and first responder professionals. By mid-May 2020, COVID-19 testing was more readily available, PPE supply lines had improved to healthcare workers, and relative rates stabilized. Starting the week of December 13th, 2020, high-risk healthcare providers were among the first priority groups to be offered vaccination. Progressive declines in COVID-19 rates were observed in healthcare occupations overall and for specific detailed occupations as exemplified for nursing assistants, licensed practical nurses, and registered nurses (Chart 3).

Observed higher rates in healthcare support occupations, which have higher percentages of Black, Indigenous, and People of Color (BIPOC) and are low wage and low status jobs, are likely due to more hazardous exposures from direct patient care and higher non-occupational exposures to COVID-19 (Table 5). Outside of the workplace, structural factors, such as poverty and poorer access to healthcare, contribute to health inequities for BIPOC communities and contribute to increased COVID-19 rates. Additionally, within the workplace, BIPOC employees in healthcare support occupations may be unable to avoid hazardous working conditions, hesitant to report unsafe work conditions, unable to overcome

employer resistance to improving COVID-19 protections, and lack sufficient power or authority to improve access to PPE and implement controls.

Employers have a responsibility to provide safe working conditions for all of their employees. These data demonstrate that several occupational groups need increased outreach regarding possible safety and health protections for COVID-19, PPE, vaccine accessibility, and additional protective measures.

This study is subject to a number of limitations. Occupational categories may be poor surrogates for COVID-19 exposure. Case-level information describing occupational and non-occupational contributions to COVID-19 exposure risk are missing and require contact tracing. The identification of cases, either through symptomatic presentation or screening asymptomatic workers, may influence and bias rates across occupations or demographic groups. Understanding the variation in the proportion of asymptomatic cases across occupations and what determines a symptomatic presentation of COVID-19 matters if poverty, health status, and other socioeconomic factors influence such, since these vary across healthcare occupations. Further, credentialing data doesn't characterize the practice setting or whether the provider is actively practicing in Washington State. However, even with challenges in estimating both numerator and denominator, the disparity in rates appears significant. If we assumed only half of the physicians with active credentials were practicing in Washington, their observed rate would still be low, while half the cases attributed to credentialed nursing assistants could be those working in other industries, and their observed rates would still be high.

In summary, there are significant observed variations in COVID-19 case rates across healthcare occupations. COVID-19 rates exceed general population rates for healthcare support occupations, while, generally, healthcare practitioner COVID-19 rates are below the general population rates. The differences in rates may be explained by occupational and non-occupational exposure risks. In the context of occupational health, variation in rates likely suggest higher exposure levels of healthcare support occupations with direct patient care, and lesser controls to mitigate exposure to COVID-19 in the workplace.

Chart 1. Washington State COVID-19 Case Counts for Healthcare vs. All Washington State

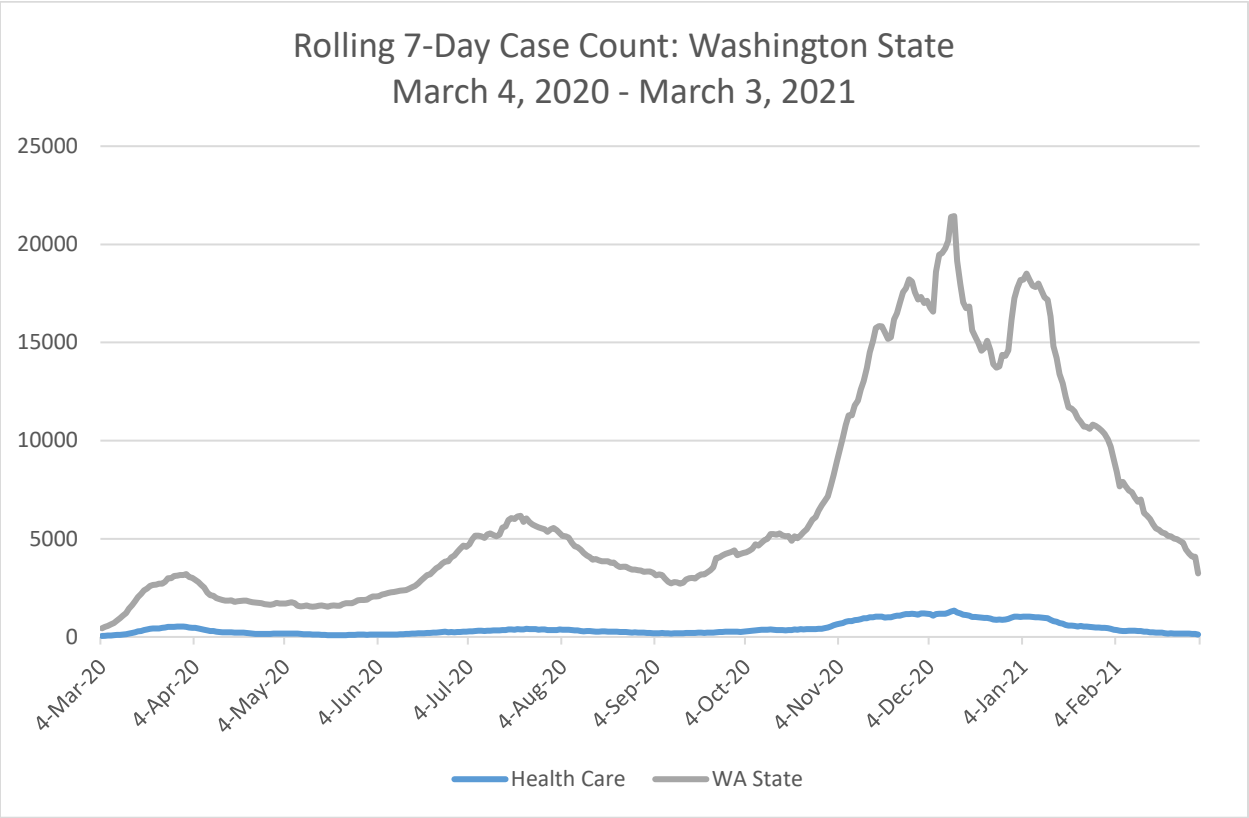

Chart 2. Healthcare COVID-19 Rates Compared to Statewide Population

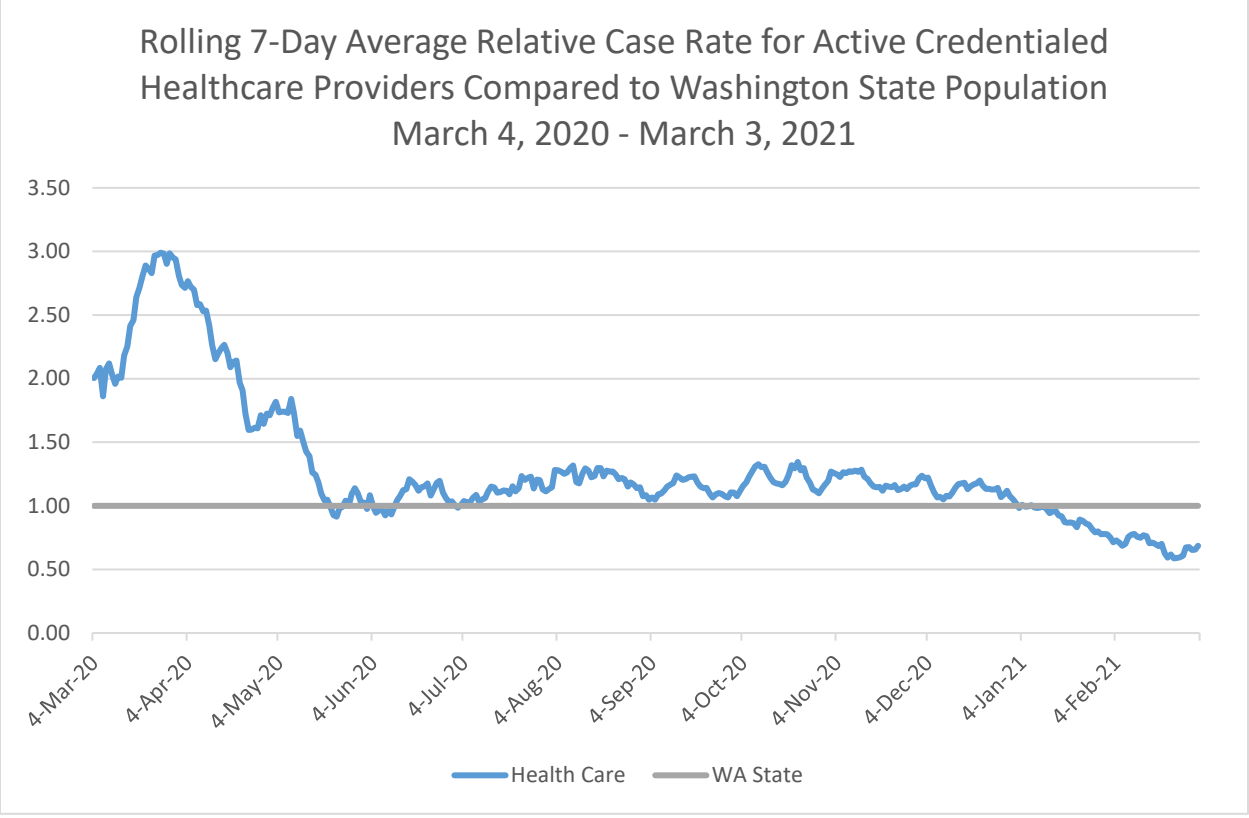

Chart 3. Impact of Vaccine Availability among Nursing Classes

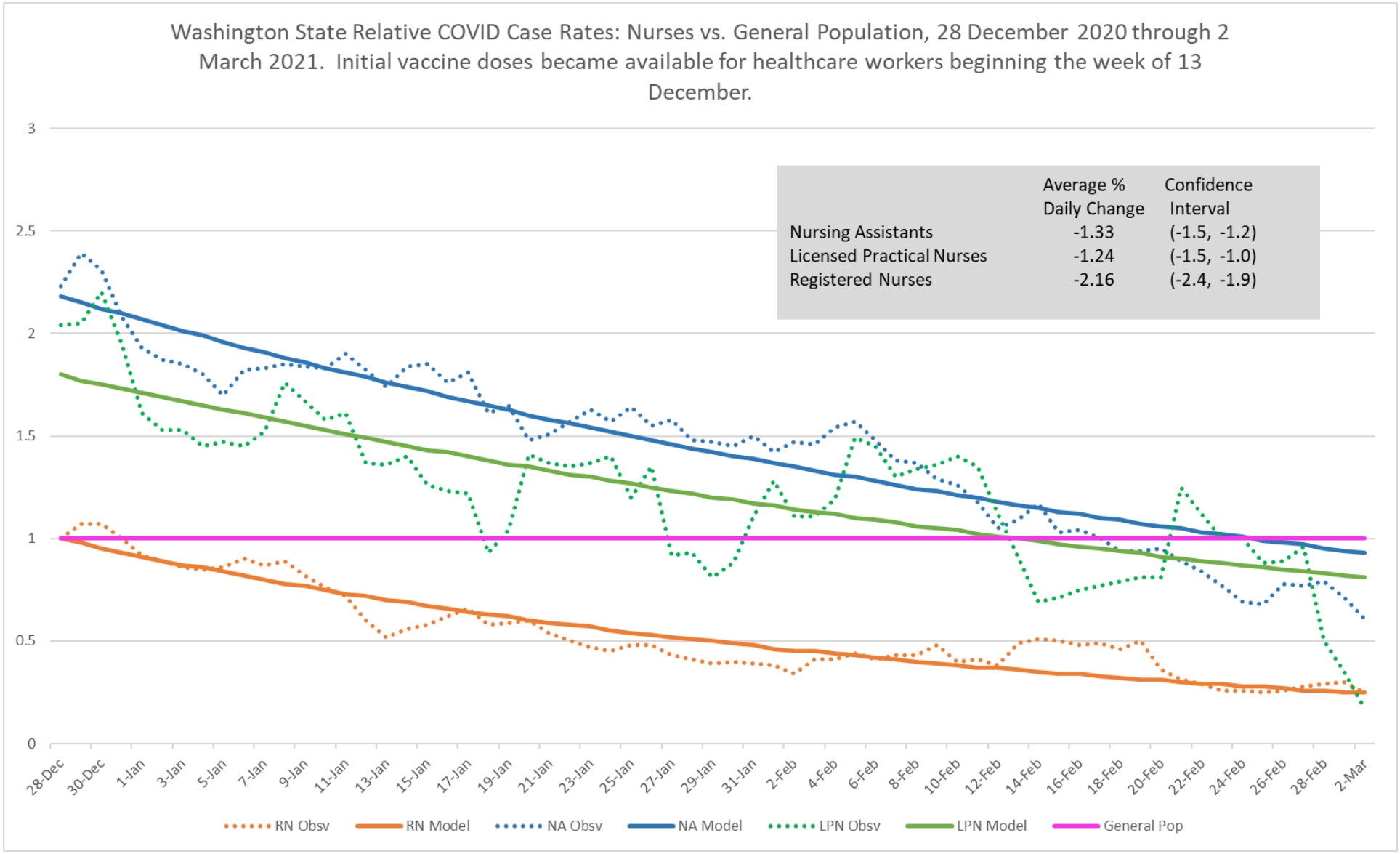

Table 2. COVID-19 Rates: Healthcare Providers Sorted by Rate

Credential Type	Cases	Population	Case Rate per 100 persons
Nursing Assistant	7,518	72,943	10.31
Nursing Home Administrator	40	406	9.85
Licensed Practical Nurse	934	10,717	8.72
Medical Assistant	2,531	36,405	6.95
EMS / EMT / Paramedic	1,104	19,148	5.77
Dental (Other than Dentist)	1,255	22,959	5.47
Credentialed Healthcare	22,292	435,504	5.12
Respiratory / Cardiovascular Specialist	176	3,521	5.00
Population (Non-Healthcare)	**342,297**	**7,220,696**	**4.74**
Physical / Occupational Therapy	693	15,560	4.45
Chiropractic	121	2,752	4.40
Registered Nurse	4,448	104,765	4.25
Medical Technologist	479	11,423	4.19
Pharmacy	1,092	28,173	3.88
Medical Marijuana Consultant	21	560	3.75
Physician Assistant	153	4,535	3.37
Audiology	27	826	3.27
Athletic Trainer	27	826	3.27
Massage Therapy	400	12,496	3.20
Speech Therapy	114	3,584	3.18
Counselor	1,131	37,920	2.98
Optometry	77	2,655	2.90
Adv. Registered Nurse Practitioner	291	10,346	2.81
Veterinary	213	8,003	2.66
Dietary	47	2,405	1.95
Physician	627	33,497	1.87
Dentist	139	7,445	1.87
Psychologist	56	3,142	1.78
Eastern Medicine	46	3,166	1.45

Table 3. COVID-19 Rates per 100 Workers by Age: General Population vs Healthcare; Washington State, March 2020 – March 2021

Age Group	General Population	Healthcare
15-19	5.04	9.32
20-24	7.36	9.47
25-29	6.42	6.82
30-34	6.12	5.39
35-39	5.64	4.96
40-44	5.65	4.80
45-49	5.40	4.94
50-54	5.08	4.60
55-59	4.26	4.45
60-64	3.61	3.77
65-69	2.88	3.03
70-74	2.66	2.56

Table 4. Select Work Tasks Associated with Nursing Occupations (O*Net)

Nursing Assistant Tasks	Licensed Practical Nurse Tasks	Registered Nurse Tasks
Turn / Reposition	Administer Medications	Administer Medications
Feed	Observe / Chart / Report	Maintain Reports
Undress / Wash / Dress	Measure Vital Signs	Monitor / Record Symptoms
Lift	Supervise Nurses' Aides	Supervise Healthcare Personnel
Empty Bedpans	Assemble Equipment	Modify Treatment Plans
Wash / Groom / Shave	Help Bathing, Dressing, Hygiene	Prepare Patients for Exams
Change Linens	Set Up Equipment	Prepare Rooms
Clean / Sanitize Rooms	Sterilize Equipment	Prepare Instruments and Equipment
Apply Dressings / Slings / Stockings	Apply Compress, Ice, Heat	Administer Anesthesia

Table 5. Demographics of Nursing Aides, Licensed Practical Nurses, and Registered Nurses; Washington State, 2019

Occupation	Estimated Workforce	Women	Hispanic	White	Black	American Indian/ Alaska Native	Asian	Other/ Multi
All Healthcare and Social Service	387,466	74%	8.0%	71.5%	7.8%	1.2%	15.0%	4.5%
Registered nurses	41,650	85%	9.3%	83.0%	8.3%	1.7%	5.7%	1.2%
Licensed practical and licensed vocational	1,693	70%	N/A	52.3%	17.4%	N/A	30.2%	N/A
Nursing, psychiatric, and home health aides	48,825	87%	6.2%	50.9%	23.7%	12.8%	1.4%	11.2%

Appendix A. Non-Birthday Expiring Credentials

Based on a review of the data, the following appear to be the non-date-of-birth expiring credentials:

[Credential Prefix] Credential Title

[DF] Dentist Faculty UW License

[DR] Dentist Resident Postdoctoral License

[ES] Advanced Emergency Medical Technician Certification

[ES] Emergency Medical Responder Certification

[ES] Emergency Medical Technician Certification

[ES] EMS Evaluator

[ES] Medical Program Director

[ES] Medical Program Director Delegate

[ES] Paramedic Certification

[ES] Poison Information Specialist Certification

[FE] Physician and Surgeon Fellowship License

[FX] Drug Controlled Substance Researcher Registration

[ML] Physician and Surgeon Residency License

[OL] Osteopathic Physician & Surgeon Limited License

Appendix B. Credentials and Grouping:

Group	Credential Type	Number
ARNP	Advanced Registered Nurse Practitioner Anesthetist License	1,127
ARNP	Advanced Registered Nurse Practitioner Clinical Specialist License	79
ARNP	Advanced Registered Nurse Practitioner License	8,664
ARNP	Advanced Registered Nurse Practitioner Midwife License	536
ARNP	Advanced Registered Nurse Practitioner Neurosurgical License	1
ARNP	Advanced Registered Nurse Practitioner Temporary Practice Permit	1
Athletic Trainer	Athletic Trainer License	826
Audiology	Audiologist License	489
Audiology	Hearing Aid Specialist License	337
Chiropractic	Chiropractic X-Ray Technician Registration	183
Chiropractic	Chiropractor License	2,569
Counselor	Certified Behavior Technician	3,191
Counselor	Counselor Agency Affiliated Registration	8,805
Counselor	Counselor Certified Adviser Certification	2
Counselor	Counselor Certified Certification	397
Counselor	Drug Controlled Substance Researcher Registration	327
Counselor	Genetic Counselor License	370
Counselor	Hypnotherapist Registration	676
Counselor	Licensed Assistant Behavior Analyst	144
Counselor	Licensed Behavior Analyst	924
Counselor	Marriage and Family Therapist Associate License	562
Counselor	Marriage and Family Therapist License	1,884
Counselor	Marriage and Family Therapist Probationary License	3
Counselor	Mental Health Counselor Associate License	2,176
Counselor	Mental Health Counselor License	7,990
Counselor	Mental Health Counselor Probationary License	7
Counselor	Sex Offender Treatment Provider Affiliate Certification	26
Counselor	Sex Offender Treatment Provider Certification	93
Counselor	Social Worker Advanced License	144
Counselor	Social Worker Associate Advanced License	278
Counselor	Social Worker Associate Independent Clinical License	2,219
Counselor	Social Worker Independent Clinical License	4,976
Counselor	Social Worker Independent Clinical Probationary License	1
Counselor	Substance Use Disorder Professional Certification	2,850
Counselor	Substance Use Disorder Professional Probationary License	1
Counselor	Substance Use Disorder Professional Trainee Certification	1,433
Dental	Dental Anesthesia Assistant Certification	234
Dental	Dental Assistant Registration	16,152
Dental	Dental Hygiene License	6,033
Dental	Dental Hygiene Renewable Limited License	533
Dental	Denturist Alternate Location	27
Dental	Denturist License	139
Dental	Expanded Function Dental Auxiliary	350
Dentist	Dentist Faculty UW License	16
Dentist	Dentist General Anesthesia Permit	219

Group	Credential Type	Number
Dentist	Dentist License	6,583
Dentist	Dentist Moderate Sedation Permit	291
Dentist	Dentist Moderate Sedation with Parenteral Agents Permit	273
Dentist	Dentist Resident Community License	29
Dentist	Dentist Resident Postdoctoral License	37
Dietary	Dietitian Certification	2,130
Dietary	Nutritionist Certification	289
Eastern Medicine	Acupuncturist or Acupuncture and Eastern Medicine Practitioner License	1,562
Eastern Medicine	Naturopathic Physician License	1,561
Eastern Medicine	Reflexologist Certification	247
EMS / EMT / Paramedic	Advanced Emergency Medical Technician Certification	342
EMS / EMT / Paramedic	Emergency Medical Responder Certification	303
EMS / EMT / Paramedic	Emergency Medical Technician Certification	13,869
EMS / EMT / Paramedic	EMS Evaluator	3,079
EMS / EMT / Paramedic	Medical Program Director	34
EMS / EMT / Paramedic	Medical Program Director Delegate	1,462
EMS / EMT / Paramedic	Paramedic Certification	2,941
EMS / EMT / Paramedic	Poison Center Medical Director	1
EMS / EMT / Paramedic	Poison Information Specialist Certification	23
EMS / EMT / Paramedic	Senior EMS Instructor Candidate	1
EMS / EMT / Paramedic	Senior EMS Instructor Recognition	162
Licensed Practical Nurse	Licensed Practical Nurse	10,717
Massage Therapy	Massage Therapist License	12,496
Medical Assistant	Medical Assistant Certification	17,836
Medical Assistant	Medical Assistant Hemodialysis Technician Certification	1,272
Medical Assistant	Medical Assistant Interim Certification	7
Medical Assistant	Medical Assistant Phlebotomist Certification	10,638
Medical Assistant	Medical Assistant Registration	8,319
Medical Assistant	Medication Assistant Endorsement	62
Medical Assistant	Radiologist Assistant Certification	9
Medical Marijuana Consultant	Medical Marijuana Consultant Certification	560
Medical Technologist	Radiologic Technologist Certification	6,921
Medical Technologist	Surgical Technologist Registration	3,283
Medical Technologist	X-Ray Technician Registration	1,384
Nursing Assistant	Nursing Assistant Certification	49,024
Nursing Assistant	Nursing Assistant Registration	23,978
Nursing Assistant	Nursing Technician Registration	235
Nursing Home Administrator	Nursing Home Administrator License	404
Nursing Home Administrator	Nursing Home Administrator Limited License	2
Optometry	Ocularist Apprentice Registration	1
Optometry	Ocularist License	9
Optometry	Optician Dispensing Apprentice Registration	6
Optometry	Optician Dispensing License	971
Optometry	Optometrist License	1,668
Orthotist / Prosthetist	Orthotist License	169
Orthotist / Prosthetist	Prosthetist License	170
Pharmacy	Pharmacist Intern Registration	1,453
Pharmacy	Pharmacist License	11,019

Group	Credential Type	Number
Pharmacy	Pharmacy Assistant License	7,564
Pharmacy	Pharmacy Technician Certification	8,637
Physical / Occupational Therapy	Occupational Therapist License	3,974
Physical / Occupational Therapy	Occupational Therapy Assistant License	1,199
Physical / Occupational Therapy	Physical Therapist Assistant License	2,482
Physical / Occupational Therapy	Physical Therapist License	7,558
Physical / Occupational Therapy	Physical Therapy Assistant Compact Privilege	25
Physical / Occupational Therapy	Physical Therapy Compact Privilege	175
Physical / Occupational Therapy	Recreational Therapist Registration	160
Physician	Osteopathic Physician & Surgeon License	2,548
Physician	Osteopathic Physician & Surgeon Limited License	206
Physician	Osteopathic Physician and Surgeon License Interstate Medical Licensure	113
Physician	Physician And Surgeon Fellowship License	19
Physician	Physician And Surgeon Institution License	6
Physician	Physician And Surgeon License	28,329
Physician	Physician and Surgeon License Interstate Medical Licensure Compact	680
Physician	Physician And Surgeon Residency License	1,143
Physician	Physician And Surgeon Teaching Research License	86
Physician	Podiatric Physician And Surgeon License	347
Physician	Podiatric Physician And Surgeon Limited License	20
Physician Assistant	Osteopathic Physician Assistant License	131
Physician Assistant	Physician Assistant License	4,503
Psychologist	Psychologist License	3,142
Registered Nurse	Midwife License	201
Registered Nurse	Registered Nurse License	104,552
Registered Nurse	Registered Nurse Temporary Practice Permit	19
Respiratory / Cardiovascular	Cardiovascular Invasive Specialist Certification	349
Respiratory / Cardiovascular	Respiratory Care Practitioner License	3,173
Speech Therapy	Speech Language Pathologist Interim Permit	2
Speech Therapy	Speech Language Pathologist License	3,340
Speech Therapy	Speech Language Pathology Assistant Certification	242
Veterinary	Animal Massage Certification for Large Animals	58
Veterinary	Animal Massage Certification for Small Animals	52
Veterinary	Veterinary License	3,905
Veterinary	Veterinary Medication Clerk Registration	1,593
Veterinary	Veterinary Specialty License	14
Veterinary	Veterinary Technician License	2,415

Appendix C. Rules for Manual Review Acceptance

The general rules for acceptance were:

1. A shortening of the name (Alex vs Alexandria, MK vs Mary K)
2. The first of two names in the other record field (Timothy vs Timothy James)
3. Recognizable “nick-names” (Liz vs Elisabeth)
4. Doubled consonants (n/m/t/r)
5. Substitution or Transposition (a/ah, a/e, a/o, c/ch, c/k, e/i, ey/y, i/y, o/u s/z)
6. Clear phonetic similarity

For Case to Credential pathing, there were 1,235 potential matches identified. Code to normalize both fields to same response length resulted in 554 matches. The remaining 681 were manually reviewed using the guidelines above. Four hundred and sixty five (465) were selected for inclusion, 216 were rejected [total 1,019 accepted for inclusion].

For the Credential to Case path, there were 1309 potential matches identified. An individual may have multiple credentials, and along this path, could link multiple times to an individual case record. For consistency, the same date-of-birth, name combinations accepted for Case to Credential linking were also accepted for this path. This resulted in 1,078 accepted, 231 rejected.