Estimates of Direct Medical and Indirect Costs Associated With COVID-19 Among U.S. Active Duty Army Soldiers

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ABSTRACT

Introduction: This study estimated the direct medical and indirect costs associated with coronavirus disease 2019 (COVID-19) diagnoses among U.S. active duty (AD) Army service members (SMs). These cost estimates provide the U.S. Military with a better understanding of the financial burden of COVID-19 and provide a foundation for cost-effectiveness estimates.

Materials and Methods: The study was approved as Public Health Practice (#17-605) by the U.S. Army Public Health Center, Public Health Review Board. U.S. AD Army SMs with COVID-19 were identified using an Army COVID-19 testing and surveillance database. Encounters for these SMs were captured from medical record where International Classification of Disease Tenth Revision, Clinical Modification code U07.1 was in the first or second diagnostic position. Analyses were conducted on SMs with COVID-19 who either had no healthcare encounters in the Military Health System (MHS); at least one MHS COVID-19 inpatient hospitalization; or at least one MHS outpatient COVID-19 encounter. Coronavirus disease 2019 (COVID-19) costs captured from the encounters were used to develop direct medical cost estimates. Literature on COVID-19 recovery post-hospitalization, along with the number of COVID-19 hospitalizations and outpatient visits from encounters were used to describe the intensity of COVID-19 care. Estimates of the indirect cost of lost duty were based on SMs salary information, along with recovery time, bed days, or outpatient visit time. The indirect cost of limited duty was estimated using the time associated with the Department of Defense (DoD) COVID-19 pandemic mitigation strategies in place when these SMs were identified as positive for COVID-19.

Results: Coronavirus disease 2019 (COVID-19) cost estimates were developed for the Army using data from 19,086 SMs identified as positive for COVID-19 between June 1, 2020, and December 31, 2020. Direct medical costs, or the amount paid by the DoD to facilities for COVID-19 care, averaged $606 per SM with an encounter. Indirect costs for lost duty or the cost for recovery and the time taken to seek care for COVID-19 averaged $319 per SM, while indirect costs for limited duty or isolation associated with COVID-19 averaged $4,111 per SM or $411 per day. Service members (SMs) with an inpatient hospitalization averaged 4.8 bed days (range 1-43) and 266 recovery hours while SMs who sought outpatient care for COVID-19 averaged two outpatient visits (range 1-60 visits).

Conclusions: The direct medical costs of a COVID-19 encounter in the MHS ($606) are a small portion of the costs for a SM with COVID-19. Indirect costs of lost and limited duty associated with COVID-19 averaged seven times higher ($4,331) and accounted for the vast majority of costs. Recognition of these costs is important especially given that soldiers in the hospital or in quarters being quarantined are complete losses of manpower to the Army. While the COVID-19 pandemic is ongoing and prevention, treatment, and mitigation efforts continue to evolve, having reliable estimates of direct medical and indirect costs from this study allows the U.S. Army and MHS to better account for the cost of this pandemic for its population.
COVID-19.\(^2\) Global cases increased significantly throughout 2020, with community transmission continuing through the present day. As of August 29, 2022, over 596 million confirmed cases of COVID-19 have been diagnosed globally, with over 93 million occurring in the USA.\(^3,4\) There have been more than 441,000 cases of COVID-19 diagnosed among military personnel, as of August 19, 2022, with Army personnel constituting more cases than the other services (>143,000).\(^5\) In terms of healthcare intensity, there have been over 2,700 COVID-19 hospitalizations among military personnel as of August 19, 2022.\(^5\)

While COVID-19 incidence, prevalence, clinical outcomes, and comorbidities have been extensively tracked for service members (SMs) since the beginning of the pandemic, reliable estimates of direct medical and indirect costs are less well known.\(^2,6-9\) The purpose of the analysis was to characterize the COVID-19 care received by SMs in the Military Health System (MHS), to estimate direct medical costs, in terms of the average cost paid for an inpatient or outpatient encounter, and indirect costs, including lost duty time and limited duty time. Having reliable estimates of these health-related costs provide additional information on the true burden of COVID-19 among an otherwise healthy population.

**METHODS**

To develop MHS COVID-19 cost estimates, all SMs with COVID-19 along with all of their available health encounters in the MHS were first identified. Coronavirus disease 2019 (COVID-19) care intensity and cost (direct and indirect) were developed from the subset of these soldiers with at least one MHS COVID-19 encounter or no MHS encounters occurring during the study period. Methodology details are provided in the following sections.

**Identification of AD Army SMs with a Diagnosis of COVID-19**

U.S. active duty (AD) Army soldiers and recruits, referred together as SMs, with COVID-19 were identified through a review of an Army database containing both positive SARS-CoV-2 test results obtained from a Navy and Marine Corps Public Health Center’s feed of Health Level 7 (HL7) laboratory data and confirmed or probable COVID-19 medical event report submissions from the Disease Reporting System internet (DRSI). This database, as opposed to a query of medical records for COVID-19 care, was the starting point for the study because it was considered complete for COVID-19 cases in the Military (there was mandatory reporting per Department of Defense [DoD] of COVID-19 to DRSI) and the captured data had gone through a rigorous process to ensure its accuracy.\(^8,9\)

Since they would not be among soldiers in these two sources, SMs without a diagnosis for COVID-19 that quarantined following an exposure to a COVID-19-positive patient are missing. The resulting file was refined to exclude National Guard Soldiers due to inconsistent capture of care for COVID-19 outside the MHS. The file was further refined to retain data between June 1, 2020, and December 31, 2020, because during this period the International Classification of Disease, Tenth Revision, Clinical Modification (ICD-10 CM) code for COVID-19, U07.1 was available and in use by all DoD clinical sites; the number of SMs being tested for COVID-19 was high, with more than 400,000 SMs being tested during this period; military isolation and quarantining protocols for positive and negative cases were standardized; and COVID-19 vaccines, which likely alter the course of illness and productivity, had not been fully implemented. The resulting file contained 29,477 AD SMs with COVID-19.

**Medical Encounter and Demographic Data**

All available medical encounters occurring in the MHS were obtained for the 29,477 AD SMs. Inpatient and outpatient encounters were extracted from the Standard Inpatient Data Record, Comprehensive Ambulatory/Professional Encounter Record, TRICARE Encounter Data Institutional, and TRICARE Encounter Data Non-Institutional files in the MHS Data Repository using the MHS Mart (M2) interface. Military Health System (MHS) facilities using MHS GENESIS to capture encounters were not available for review and, as a result, data from select facilities, including the Army facilities (Joint Base Lewis Mc Chord, Presidio of Monterey, Ft. Irwin, Ft. Wainwright, and Joint Base Elmendorf Richardson) were not included in this study.

Coronavirus disease 2019 (COVID-19) medical encounters occurring between June 1, 2020, and December 31, 2020, were identified. A medical encounter was considered a COVID-19 encounter if the ICD-10 CM code of U07.1 was listed in the first or second diagnostic position (DX1 or DX2) of the medical encounter data. Coronavirus disease 2019 (COVID-19)-positive SMs receiving care in the MHS during the study period, but where none of their encounters were for COVID-19 (based on DX1 and DX2) were removed from the analysis (n = 10,391). The final study population included 19,086 SMs positive for COVID-19. This group consisted of 16,996 SMs positive for COVID-19 and their MHS medical encounters for COVID-19 and 2,090 SMs positive for COVID-19, but with no medical encounters (no care paid by the MHS).

Medical encounter data provided the amount paid for an encounter that could be attributed to the MHS (regardless of testing location), the number of bed days for each inpatient hospital stay, and, for outpatient encounters, the number of minutes scheduled for an outpatient visit. Demographic information was retrieved from three sources. Duty status (e.g., AD, National Guard, or Reserve) was based on information from SMs’ HL7 or DRSI COVID-19 record. The Defense Enrollment Eligibility Reporting System, located on the MHS Data Repository, was queried using the M2 interface to obtain the SMs’ rank, pay grade, sex, race, and age as of December
31, 2020. Salary data were obtained from the calendar year 2020 Defense Finance and Accounting Service pay charts.

**Direct Medical and Indirect Costs**

For the purpose of this study, direct medical costs refer to the cost of an encounter attributable to the MHS for COVID-19 inpatient and outpatient care received at MHS institutions, including Military Treatment Facilities (MTFs) and private care sector facilities contracted by the DoD to provide care to beneficiaries.

This study considered two types of indirect costs: lost duty time and limited duty time. Lost duty time was defined as the actual time away from duty associated with a COVID-19-related hospital stay or the time assigned to a COVID-19 outpatient visit. Limited duty time was defined as the time when an SM could not participate in their regular military occupational and physical training tasks due to the workplace restrictions set by the DoD in “Force Health Protection Guidance Supplement 8 - Department of Defense Guidance for Protecting Personnel in Workplaces During the Response to the Coronavirus Disease 2019 Pandemic” (e.g., mandatory isolation when considered COVID-19 positive).

**Analysis and Report**

The data analysis was generated using SAS (previously “Statistical Analysis System”) software, Version 9.4 of the SAS System for Windows. Copyright © 2016 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.

All demographic reviews, descriptions of care intensity, and the development of cost estimates were based on data from the final study population of 19,086 SMs. Descriptive statistics, including percentage distribution for age, gender, and rank, were computed and reported for each strata and the overall study population.

Direct care cost estimates were based on SMs with an inpatient or outpatient COVID-19 encounter in DX1 or DX2. Data from the cost attributed to the MHS for inpatient hospitalizations and outpatient visits were summed and averaged to provide estimates of costs by encounter and SM. Results were reported overall and separately for inpatient and outpatient encounters.

The indirect cost estimates, lost duty time, were based on SMs with an inpatient or outpatient COVID-19 encounter in DX1 or DX2 and were reported overall and separately for inpatient and outpatient encounters. For inpatient hospitalizations, 8 hours of lost time were assumed for each bed day, and a conservative estimate of 30 days (240 hours) of recovery time were assumed to occur post discharge for every hospitalization.

The hours of lost duty time were multiplied by each SM’s respective salary, and the sum overall and averaged per SMs were calculated to provide the inpatient indirect, lost duty cost estimate.

Lost duty time for COVID-19-related outpatient care was based on the amount of time assigned to an appointment in the MHS record. No appointment time data were available for TRICARE Encounter Data Non-Institutional medical records, and the average length of appointment time from the Comprehensive Ambulatory/Professional Encounter Record data was used as a substitute for the missing data. The hours were multiplied by each SM’s respective salary, and the sum overall and averaged per SMs were calculated to provide the outpatient indirect, lost duty cost estimate.

**Ethics**

The Public Health Review Board of the U.S. Army Public Health Center approved this study as Public Health Practice (17-605).

**RESULTS**

The information in this section is based on COVID-19 medical encounters for 19,086 SMs diagnosed with COVID-19, including 16,996 SMs with at least one inpatient or outpatient MHS medical encounter for COVID-19 and 2,090 SMs with no MHS medical encounters (no care paid by the MHS). Demographic characteristics of SMs, along with estimates of the intensity of care and direct and indirect care-related costs, are presented in the following sections.

**Demographic Characteristics**

Table 1 provides demographic characteristics of AD Army SMs. Overall, 19,086 SMs were identified; 83% of these SMs were male and 85% were enlisted (E1-E9); 70% were less than 30 years of age.

Among these SMs, 299 (2%) had at least one inpatient hospitalization for COVID-19. While SMs with at least one inpatient hospitalization were similar to the overall group in...
TABLE I. Characteristics of U.S. Active Duty (AD) Army Service Members (SMs) with Coronavirus Disease 2019 (COVID-19)

| Characteristic                  | Total COVID-19-positive AD Army SMs in the analysis | SMs with at least one MHS inpatient hospitalization | SMs with at least one MHS outpatient visit | SMs with no MHS encounters |
|--------------------------------|-----------------------------------------------------|----------------------------------------------------|-------------------------------------------|-----------------------------|
| Total COVID-19-positive AD soldiers | 19,086                                              | 299                                                | 16,697                                     | 2,090                       |
| Age group                      |                                                     |                                                    |                                            |                             |
| 17-19                          | 2,110                                               | 28                                                 | 1,772                                      | 310                         |
| 20-24                          | 6,396                                               | 90                                                 | 5,623                                      | 683                         |
| 25-29                          | 4,691                                               | 56                                                 | 4,114                                      | 521                         |
| 30-44                          | 5,181                                               | 98                                                 | 4,610                                      | 473                         |
| 45-66                          | 708                                                 | 27                                                 | 578                                        | 103                         |
| >66                            | 6                                                   | 0                                                  | 0                                          | 2                           |
| Sex                            |                                                     |                                                    |                                            |                             |
| Female                         | 3,311                                               | 67                                                 | 2,912                                      | 332                         |
| Male                           | 15,775                                              | 232                                                | 13,785                                     | 1,758                       |
| Rank                           |                                                     |                                                    |                                            |                             |
| E1-E4                          | 9,861                                               | 157                                                | 8,596                                      | 1,108                       |
| E5-E9                          | 6,265                                               | 103                                                | 5,513                                      | 649                         |
| O1-O9                          | 2,452                                               | 39                                                 | 2,123                                      | 290                         |
| WO1-WO5                        | 465                                                  | 0                                                  | 422                                        | 43                          |
| Unknown                        | 9                                                    | 0                                                  | 9                                          | 0                           |

Abbreviation: MHS, Military Health System.

terms of rank (e.g., the percentage of enlisted and officers), one in four of the SMs with an inpatient hospitalization was female (as compared to 17% in the overall population) and 44% were 30 years of age and older as compared to 31% of the overall population.

A total of 16,697 SMs (87%) had at least one outpatient encounter for COVID-19 visit and 2,090 (11%) had no MHS encounters. These SMs were similar to the overall population in terms of their age distributions (68% and 72%, respectively, were less than 30 years of age), sex (82% and 84%, respectively, were male), and rank percentages (83% and 84%, respectively, were enlisted).

**Intensity of COVID-19 Encounters**

Estimates for the intensity of COVID-19 medical encounters among SMs are shown in Table II. The 299 SMs with at least one COVID-19 inpatient stay averaged 1.1 hospitalizations each (322 hospitalizations overall). The average length of a stay was 4.8 days (range 1-43 days) per SM. Post-hospitalization recovery averaged 266 hours per SM. The 16,697 SMs with at least one outpatient COVID-19 visit averaged 1.8 visits per SM (30,339 visits overall), and the number of visits ranged from 1 to 60 visits.

Limited duty time was examined for the 16,996 SMs with at least one outpatient COVID-19 encounter or no MHS encounters. Based the Army’s COVID-19 isolation policy in effect during the study period, there were a total of 169,960 limited duty days experienced by these SMs (data not shown).

**Cost Estimates for COVID-19 Care**

Direct medical and indirect (lost and limited duty) cost estimates for inpatient hospitalizations, outpatient visits, and overall care (inpatient and outpatient) are shown in Table III.

Based on information from the 299 SMs with at least one inpatient hospitalization, the average cost of a stay was $34,987 per SM (overall $10,461,110; SD: $40,780; median: $26,236; range: $8,267 to $594,437). The larger percentage of COVID-19 hospitalization costs for these SMs (54%) were due to the direct medical cost of care ($5,678,320) and averaged $18,991 per SM (SD: $33,538; median: $12,101; range: $1,152 to $493,182). Indirect costs for lost duty associated with bed days and recovery for the 299 SMs totaled $4,782,790. Bed days averaged $2,076 per SM (SD: $3,576; median: $1,086; range: $230 to $4,518), while recovery post-hospitalization was $13,973 per SM (SD: $7,322; median: $11,788; range: $6,885 to $55,737).

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**Table II.** Estimates of the Intensity of Care for U.S. Active Duty (AD) Army Service Members (SMs) with Coronavirus Disease 2019 (COVID-19)

| Characteristic                  | SMs with encounters |
|--------------------------------|---------------------|
| Inpatient hospitalizations      | 332                 |
| Number of hospitalizations      | 299                 |
| SMs with a hospitalization      | 1.1                 |
| Hospitalizations per SM         | 1.1                 |
| Bed days, total                 | 1,446               |
| Bed days per SM                 | 4.8                 |
| Bed day range                   | 1-43                |
| Bed day hours, total            | 11,568              |
| Recovery hours                  | 79,680              |
| (30 days following discharge × 8 hours) | 266                 |
| Recovery hours per SM           |                     |
| Outpatient visits               | 30,339              |
| Number of visits                | 16,697              |
| SMs with a visit                | 1.8                 |
| Encounters per SM               | 1.8                 |
| Encounter range—SM              | 1.60                |
| Encounter hours, total          | 12,116              |

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**Table III.** Direct Medical and Indirect Cost Estimates for COVID-19 Care

| Characteristics                                      | SMs with at least one MHS inpatient hospitalization | SMs with at least one MHS outpatient visit | SMs with no MHS encounters |
|------------------------------------------------------|-----------------------------------------------------|-------------------------------------------|-----------------------------|
| Smaller percentage of COVID-19 hospitalization costs  | 54%                                                 |                                           |                             |
| Direct medical cost of care                          | $5,678,320                                           |                                           |                             |
| Indirect costs                                       | $4,782,790                                           |                                           |                             |
| Lost duty                                            | $13,973 per SM (SD: $7,322)                         |                                           |                             |
| Limited duty                                         | $2,076 per SM (SD: $3,576)                          |                                           |                             |
| Recovery post-hospitalization                         | $13,973 per SM (SD: $7,322)                         |                                           |                             |
| Characteristic                                      | Cost          | Percentage of total cost |
|----------------------------------------------------|---------------|--------------------------|
| Inpatient hospitalizations                          |               |                          |
| Direct medical cost estimates                       | $5,678,320    | 54%                      |
| Cost per hospitalization (n = 322)                  | $17,103       |                          |
| SD: $22,035 median: $11,962; range: $1,152 to $222,166 |               |                          |
| Cost per SM (n = 299)                               | $18,991       |                          |
| SD: $33,538 median: $12,101; range: $1,152 to $493,182 |               |                          |
| Indirect cost (overall) estimates                   | $4,782,790    | 46%                      |
| Cost per SM                                        | $2,076        |                          |
| SD: $3,576 median: $1,086; range: $230 to $4,518   |               |                          |
| Indirect cost—lost duty (bed days)                  | $4,164,060    |                          |
| Cost per SM                                        | $13,973       |                          |
| SD: $7,322 median: $11,788; range: $6,885 to $55,737 |               |                          |
| Total direct medical and indirect cost estimates    | $10,461,110   |                          |
| Cost per hospitalization                            | $31,509       |                          |
| SD: $25,561 median: $25,478; range: $8,267 to $493,182 |               |                          |
| Cost per SM                                        | $34,987       |                          |
| SD: $40,780 median: $26,236; range: $8,267 to $594,437 |               |                          |
| Outpatient visits                                   |               |                          |
| Direct medical cost estimates                       | $4,622,634    | 88%                      |
| Cost per encounter (n = 30,339)                     | $152          |                          |
| SD: $1,200 median: $79; range: $1 to $271          |               |                          |
| Cost per SM (n = 16,997)                            | $277          |                          |
| SD: $1,706 median: $145; range: $7 to $160,316      |               |                          |
| Indirect cost estimate—lost duty time (encounter time) | $639,137     | 12%                      |
| Cost per SM                                        | $38           |                          |
| SD: $99 median: $13; range: $1 to $2,372            |               |                          |
| Total direct medical and indirect cost estimates    | $5,261,771    |                          |
| Cost per encounter (n = 30,339)                     | $173          |                          |
| SD: $1,205 median: $90; range: $1 to $155,413       |               |                          |
| Cost per SM (n = 16,697)                            | $315          |                          |
| SD: $1,728 median: $157; range: $1 to $160,862      |               |                          |
| Overall, Army SMs with COVID-19                     |               |                          |
| Direct medical cost, inpatient and outpatient       | $10,300,954   | 11%                      |
| Direct cost per SM (n = 16,997)                     | $606          |                          |
| Indirect cost, lost duty (bed days, recovery, and appointment time) | $5,421,927 | 6%                      |
| Indirect cost per SM (n = 16,997)                   | $319          |                          |
| Indirect cost, limited duty                         | $77,234,771   | 83%                      |
| Limited duty cost per SM w/ outpatient care or no MHS care (n = 18,787) | $4,111 |                          |
| SD: $1,749 median: $3,230; range: $2,293 to $15,263 |               |                          |
| Overall total direct medical and indirect cost      | $92,957,652   |                          |

The total cost of outpatient care for the 16,697 AD Army SMs was $5,261,771 or $315 per SM (SD: $1,728 median: $157; range: $1 to $160,862). The majority of costs were due to the direct medical costs of care ($4,622,634) and averaged $277 per SM (SD: $1,706 median: $145; range: $7 to $160,316). Indirect costs for lost duty associated with the COVID-19 outpatient visit accounted for 12% ($637,986) of the SMs' total outpatient costs and averaged $38 per SM (SD: $99 median: $13; range: $1 to $2,372).

During the study period, the total estimated direct medical and indirect costs of COVID-19 care to the MHS for the 19,086 SMs with COVID-19 were $92,957,652. The cost per SM for COVID-19 direct care paid by the DoD was $606 per SM. The total cost of this care was $10,300,954. Indirect costs for COVID-19-related lost duty totaled $5,421,927 or $319 per SM. Indirect costs for limited duty or isolation associated with COVID-19 made up 83% ($77,234,771) of the total costs, for an average of $4,111 per SM (SD: $1,749 median: $3,230; range: $2,293 to $15,263). The average cost per day for limited duty was $411.

**DISCUSSION**

This public health investigation provided direct and indirect estimates of COVID-19-related medical costs for SMs with COVID-19. Costs were estimated based on health-related COVID-19 data gathered from 19,086 SMs positive for COVID-19 between June 1, 2020, and December 31, 2020.
Based on the medical record data gathered from these SMs, the overall direct cost of care paid to providers was $606 per SM (total $10,300,954). While only 22% of the study population had an inpatient hospitalization, the total cost of these hospitalizations ($10,461,110) was nearly two times the cost of all outpatient encounters ($5,261,771) and averaged $34,987 per SM. Indirect costs from lost and limited duty for the 19,086 SMs accounted for 89% of the total cost of care or $82,656,698.

Some study limitations are noted. First, the asymptomatic nature of many cases of COVID-19 precluded the identification of all SMs using the HL7 laboratory data and the DRSi system. This could have led to underestimates of the true prevalence and, therefore, the loss of data that may have been relevant to the estimation of the health-related cost of COVID-19 to the U.S. Army. Second, this study depended on proper coding practices to capture the ICD-10 CM diagnosis code used to identify care provided to the study population. Improper coding could have led to the undercounting of COVID-19 medical encounters. Additionally, any care paid for by insurers outside the MHS, as well as informal care (e.g., care by family members), were not included. Next, MHS GENESIS data were not available for this study. As a result, encounter data from MTFs after they switched over to MHS GENESIS were not available, including the Army facilities (Joint Base Lewis Mc Chord, Presidio of Monterey, Ft. Irwin, Ft. Wainwright, and Joint Base Elmendorf Richardson). While this fact may have led to an undercounting of COVID-19-positive SMs in the HL7 laboratory data, the researchers believe most positive COVID-19 cases from MHS GENESIS MTFs were captured in DRSi, as all MTFs are required to report cases of COVID-19 to DRSi. Finally, this study did not estimate the costs of the death of an SM due to COVID-19. While the proportion of SMs who died from COVID-19 was less than that of the general U.S. population (92 AD military personnel as of February 8, 2022), the inclusion of this information would provide a more comprehensive view of the cost of this pandemic to the U.S. Army.

Using these estimates as a foundation, future studies may want to develop cost estimates for encounters where the SM received alternative medical care, such as monoclonal antibodies or other antiviral medication such as Remdesivir. The assignment of lost and limited duty days may need to be adjusted as U.S. Army COVID-19 isolation policies evolve. While limited duty days were based on DoD policy, a medical chart review would likely provide the information necessary to vary the time so it better captures the different levels of illness likely experienced by an SM. Additionally, as military-specific administrative data (e.g., eProfile) become available for use in surveillance, estimates of limited duty may be better refined.

CONCLUSIONS
The direct medical cost of a COVID-19 encounter in the MHS ($606) is a small portion of the cost for an SM with COVID-19. Indirect costs of lost and limited duty associated with COVID-19 averaged seven times higher ($4,331) and account for the vast majority of costs. Review and inclusion of these costs are especially relevant given that SMs in the hospital or in quarters being quarantined are complete losses of manpower to the Army. These cost estimates can be used to project the cost burden of COVID-19 to the U.S. Army throughout the pandemic. The use of the COVID-19 ICD-10 CM diagnosis code to identify encounters, along with the calculations of estimates for both medical direct and indirect costs, lends value to the use of the results from this study as a foundation for cost estimates for new COVID variants, as well as cost-effectiveness studies of alternative COVID care for AD SMs.

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