



The Impact of Telemedicine Policy Changes on Health First Colorado Utilization and Costs



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The Eugene S. Farley, Jr. Health Policy Center (FHPC) at the University of Colorado Anschutz Medical Campus strives to advance policy that overcomes fragmented systems and addresses the wholeness of a person – physical, behavioral, and social health in the context of family, community, and the health care system. The FHPC works with state agencies and policymakers to develop and translate evidence to advance achievable, equitable, and integrated policies that improve health and well-being for all.

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Acronyms

BH – Behavioral Health

CCS – Clinical Classification Software

ED – Emergency Department

FFS – Fee-For-Service

FHPC – Farley Health Policy Center

HCPCS - Healthcare Common Procedure Coding System

IBH – Integrated Behavioral Health

PC – Primary Care

PH – Physical Health

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Executive Summary

Introduction and Overview

Since March 2020, the COVID-19 pandemic has changed the delivery of health care in Colorado and across the country. One of the big shifts has been a rapid increase in services delivered via telemedicine, especially during the early days of the pandemic when strict stay-at-home restrictions were in place.

To support greater use of telemedicine, the Colorado Department of Health Care Policy and Financing (Department) expanded the number of Health First Colorado (Colorado's Medicaid program) services allowable for reimbursement and permitted more providers to be reimbursed for this modality. These changes were made, however, without the benefit of extensive research on telemedicine's efficacy, the services most suited for this modality, its effects on access to care, whether it ameliorates or exacerbates already existing inequalities, and its impact on costs.

Proponents have touted several benefits of telemedicine for both providers and patients including improved attendance at appointments (lower no-show rates), reduced non-urgent use of emergency department services, improved operational efficiencies, and lower health care costs. However, there are significant gaps in the evidence base supporting these perceived benefits. To begin filling these gaps and further enhancing the Department's understanding of the impact of the telemedicine policy changes on utilization, patient outcomes and its budget, as well as support the development of strategies and policies related to the provision of telemedicine post-pandemic, the Department entered into an Interagency Agreement with the Farley Health Policy Center (FHPC) at the University of Colorado Anschutz Medical Campus. The FHPC analyzed data from an integrated safety-net health system and the Department to address five sets of questions to inform future telemedicine policies.

Research Questions and Results

1 Did the shift to telemedicine increase appointment availability and completion rates while decreasing appointment no-show rates?

To assess the impact of COVID-19 and telemedicine policy changes on the availability of outpatient primary and specialty care, we analyzed data provided by Denver Health, an integrated safety-net health care system. Specifically, the analysis examined the number of available and scheduled appointments, completion rates of scheduled appointments, trends in no-show rates for in-person scheduled appointments prior to and after the COVID-19 initiated policy changes, and differences in no-show rates



between in-person and telemedicine modalities after the telemedicine policy changes. Combining these analyses, we assessed the extent to which longer-term changes to telemedicine delivery modes could improve operational efficiencies so that providers were able to schedule more appointments and/or see more patients because of lower no-show rates. If either or both of these changes occurred and persisted, patients' access to care would increase and providers would be able to bill more services, increasing their revenue. The latter would also increase Health First Colorado expenditures.

We assessed the extent to which COVID-19 and telemedicine policies affected the availability of appointments by examining trends in the number of unique appointment slots (defined as a combination of provider, clinic/department, date, and time) available for scheduling in primary care and outpatient specialty care clinics from March 2018 to March 2021. The results revealed increasing trends in the number of available primary care appointment slots starting in spring 2019 and continuing through the post-pandemic period and relatively stable specialty appointment slots over the entire 36-month period.

While trends in the number of available appointment slots suggest these were not impacted by the COVID-19 public health emergency or changes in telemedicine policies, the analysis of the number of scheduled and unscheduled slots revealed an impact of the public health emergency. The number of unscheduled slots increased substantially in March and April of 2020 and continued to increase through the summer of 2020. The number of scheduled slots declined in April and May 2020, particularly for specialty care, reflecting the Executive Orders restricting outpatient and elective inpatient services. By July 2020, the number of scheduled slots returned to its baseline pre-pandemic trend and the number of unscheduled slots began a gradual decline through March 2021.

Overall, with the exception of a temporary disruption at the beginning of the pandemic, these findings suggest that COVID-19 and the telemedicine policy changes have not substantially altered the trends in the availability of appointment

slots or the scheduling of available slots. Moreover, these findings suggest the transition to more telemedicine services did not result in improved operational efficiencies that would allow providers to increase the number of available appointment slots in these care settings.

It is still possible a shift to more telemedicine could improve operational efficiencies if no-show rates are lower for telemedicine compared to in-person scheduled appointments. If there were a differential, providers would be able to complete more appointments with a higher percentage of telemedicine appointments. We assessed no-show and completion rates for scheduled appointments for all patients and payers, as well as separately for Health First Colorado members. The latter would have a direct impact on the Department's budget; and individuals on Medicaid are generally considered to have higher no-show rates than individuals with commercial insurance. For all payers, the results showed a remarkable increase in telemedicine modalities (audio/video and audio only combined) reaching almost two-thirds of all scheduled appointments in April 2020. While telemedicine modalities decreased as a percentage of all scheduled appointments, the decline in use of telemedicine for behavioral health appointments was less pronounced. Comparing appointment completion and no-show rates for Health First Colorado members in the pre-pandemic and post-pandemic periods suggest that these rates essentially returned to pre-pandemic levels by the fall of 2020 for scheduled in-person appointments. After completion and no-show rates stabilized, the no-show rate for telemedicine appointments were lower than the no-show rate for in-person appointments. These results suggest that overall (in-person and telemedicine) completion rates for scheduled appointments will be slightly higher compared to pre-pandemic levels absent any changes in telemedicine policies. Absent changes in policies, behavioral health will likely have relatively higher appointment completion rates given current trends in the percentage of telemedicine appointments improving delivery of these services to Health First Colorado members.

Telemedicine has been hypothesized as one way to reduce health disparities by increasing access to care and improving patient outcomes. To this end, we analyzed no-show rates for in-person and telemedicine scheduled appointments by Health First Colorado member demographics and their health status. The results showed that non-Hispanic Black members had higher no-show rates for in-person appointments in both the pre and post periods, with the exception of behavioral health specialty care. Non-Hispanic Other/Multiple races tended to have lower no-show rates in all service groups. The race/ethnicity differences were less pronounced for telemedicine appointments supporting the hypothesis that telemedicine may be a promising tool for decreasing disparities among racial/ethnic groups. Finally, using a measure of health status developed by Denver Health, we found that the most complex patients (Tier 4) had higher no-show rates for in-person visits than those in the other three tiers, but rates were comparable for telemedicine suggesting telemedicine may also alleviate some access to care issues faced by medically complex Health First Colorado members.

2 Did the COVID-19 pandemic change trends in utilization of emergency department and primary care services for Health First Colorado members?

While the COVID-19 pandemic disrupted health care, along with all other aspects of society, the stimulated changes in telemedicine policies may have also altered longer-term trends in health care utilization. For example, proponents have suggested telemedicine can reduce non-urgent emergency department (ED) visits by shifting these health concerns to a telemedicine visit, thereby increasing use of more cost-effective primary and urgent care services. We used Health First Colorado fee-for-service (FFS) claims data for the period March 1, 2017 to March 31, 2021 to assess the preliminary evidence of any changes in utilization of ED and primary care services associated with the changes in telemedicine policies. For more accurate comparison, we limited our scope to primary care services that could be reimbursed using telemedicine – referred to as index PC visits. Our analyses align with the Department's

telemedicine evaluation providing additional months of data after the pandemic; however, the Department's evaluation considered a broader range of services.¹

There was a large decline in utilization of ED services in March and April 2020 followed by a partial recovery from July through October 2020 until the COVID-19 surge in November 2020, when utilization dropped again through February 2021. Overall, the decline in ED utilization persisted one-year after the start of the pandemic with ED utilization 25% lower in March 2021 than it had been at the beginning of the pandemic. By age, ED utilization dropped more for children and reversed more for adults following the pandemic's nadir in April 2020. Index primary care service trends were similar to the ED patterns though utilization of these services rebounded more quickly. By the summer of 2020, adults were essentially utilizing these services at pre-pandemic rates, although children and members with disabilities were still only about 90% of their pre-pandemic levels. The greater reductions in utilization for children of both ED and primary care may be a function of reduced exposure to other infectious diseases with restricted recreational activities and on-line schooling, or it may be a result of increased concern from parents about bringing their children into health care facilities. The more rapid recovery of utilization by adults suggests that utilization trends may return to pre-pandemic levels as schools and other regular activities for children resume.

Disaggregating trends in utilization of index primary care services by modality (in-person and telemedicine) showed that the decline in index primary care utilization would have been even steeper without the rapid growth in telemedicine facilitated by Department policy changes. The utilization rate for telemedicine visits peaked in April 2020 as in-person utilization plummeted: the same month percentage change for in-person utilization in April 2020 was -58% for in-person index PC visits but -33% for all index PC visits. Our findings also revealed that adults and members with disabilities used telemedicine for index PC services more than children did, which is in contrast to the Department's evaluation that showed children used telemedicine at

higher rates compared to adults (driven primarily by therapy services). This finding of lower telemedicine usage for children relative to adults for primary care may be attributed to the lack of coverage for well child checks until November 2020.

3 Did the COVID-19 pandemic change trends in the primary diagnosis associated with emergency department and primary care services for Health First Colorado members?

To contribute to the evidence base needed to develop and refine telemedicine policies involving the long-term changes in utilization of ED and primary care services, we examined trends in the primary diagnoses for ED and index PC services before and after the public health emergency declaration. If, as proponents allude, telemedicine shifts non-urgent ED visits to primary care or urgent care settings, we would expect to find a subset of diagnoses less prevalent for ED visits over time with a corresponding increase in these diagnoses in primary care visits.

Not surprisingly, for all groups of Health First Colorado members there was a higher percentage of ED visits for exposure/encounter with infectious diseases and the emergence of visits for COVID-19 starting in March 2020. The rates of influenza and other respiratory infections were much lower for all members post-pandemic compared to pre-pandemic levels. In addition, visits with diagnoses of acute bronchitis, otitis media, and other respiratory symptoms also represent smaller percentages of visits for children after March 2020 with a corresponding increase in the percentage of ED visits related to injuries.

Trends in the top diagnoses categories for index PC visits were very similar to the trends seen in ED visits with increases for exposure/encounter with infectious diseases and COVID-19 along with decreases for influenza and other respiratory infections. For adults there was also an increase in the prevalence of anxiety and depression-related disorders suggesting an increased incidence of behavioral health issues associated with the pandemic that were being addressed in primary care settings. The top diagnoses for in-person

index PC visits tracked with those for all index PC visits as most of these visits were in-person. The small number of pre-pandemic telemedicine index PC visits obscured trends in the top diagnoses for these visits. The most prevalent diagnoses in the post-period mirrored those for in-person visits with the exception of behavioral health diagnoses where there was a proportional increase in telemedicine visits at the same time there was a decrease in in-person visits. Overall, these findings suggest telemedicine index PC visits were being used more frequently in place of in-person visits and not as a substitute for non-urgent ED visits.

4 Are there differences in the effectiveness of telemedicine and in-person index primary care visits?

While there is some evidence from prior studies that address this question, much of this research was pre-pandemic and either analyzed a small subset of diagnoses, only examined direct-to-consumer models and/or covered commercially insured populations. For this analysis, we assessed the effectiveness of a telemedicine index PC visit by comparing the likelihood a telemedicine visit was followed by another primary care or ED visit to the likelihood of these outcomes following an in-person index PC visit. The analysis focused on measuring the differences between in-person and telemedicine index PC visits in the first three months following the public health emergency declaration (first post-period) and in the last half of 2020 (second post-period). If telemedicine primary care visits are not as effective in addressing the reason for the appointment, the likelihood of a subsequent primary care or ED visit would increase, and this would also increase the Department's budget if payment parity is maintained.

The results of this analysis indicated that Health First Colorado members were more likely to have a subsequent primary care visit in the second post-period following a telemedicine index PC visit compared to an in-person index PC visit. This suggests that some fraction of telemedicine index PC visits were additive to the number of primary care visits for Health First Colorado members, and if a substantial number of

telemedicine index PC visits continue beyond the public health emergency total Health First Colorado expenditures for primary care services will increase. In contrast, the results for ED usage were not statistically significant meaning Health First Colorado members were no more likely (nor less likely) to have an ED visit during the second post-period following a telemedicine index PC visit than if the visit had been in-person. Thus, if these findings continue to hold as ED utilization trends evolve, greater use of telemedicine in primary care will have little impact on ED costs component of the Department's budget.

5 Are there budget implications in maintaining telemedicine policies introduced during the COVID-19 public health emergency?

Our findings have a number of fiscal implications for the Department's budget. To explore these implications, we developed two simple budget simulation models and conducted a number of "what-if" scenarios. The first set of models calculated additional costs resulting from differences in the no-show rates for telemedicine appointments. Specifically, the model compares expected expenditures if 100% of appointments were for in-person visits with expected expenditures if up to 15% of primary care and 50% of behavioral health appointments were using telemedicine modalities. The second set of models illustrated the potential fiscal implications of differences in the likelihood an index PC visit was followed by a subsequent primary care or ED visit based on the modality of the index PC visit. Similarly, this model compares expected expenditures if 100% of index PC visits were in-person visits with expected expenditures if up to 15% of index PC visits were telemedicine.

The results from the first set of models suggest that the higher the percentage of telemedicine scheduled appointments the higher the additional cost for both primary care and behavioral health services. For example, if 15% of scheduled primary care appointments were telemedicine, the estimated increase in costs would be close to \$645,000 per month because of the different no-show rates for telemedicine visits. This drops to just under \$215,000 per month when 5% of scheduled primary care appointments are telemedicine. For behavioral visits, assuming 50% of visits are telemedicine, the expected monthly increase in costs would be just over \$409,000 per month. Reducing the percent of visits that were telemedicine to 25% drops the increased costs to less than \$205,000 per month.

Results from the second model suggest that shifting from 100% in-person index PC visits to a mix of in-person and telemedicine increased the estimated monthly expenditures for primary care services. As subsequent ED visits were no more likely following a telemedicine index PC visit compared to an in-person index PC visit we did not calculate any changes in monthly expenditures for ED services. The smaller the percentage of index PC visits that are telemedicine, the closer the estimated additional costs are to zero. For example, if 15% of index PC visits were telemedicine for members, the estimated increase in primary care costs would be close to \$373,000 per month. This drops to just under \$125,000 per month in increased primary care costs when 5% of index PC visits are telemedicine. These simulations also highlight that the modality of index PC visits for children have the largest budget implications; if 15% of index PC visits for children were telemedicine, the estimated increase in primary costs would be close to \$287,000 per month.

Discussion and Next Steps

In the wake of COVID-19 the use of telemedicine has exploded. In the early months — during the strict stay-at-home order and patient and provider anxiety about visiting health care facilities — telemedicine enabled people to continue to receive care in the safety of their homes. The policy changes expanding the services able to be reimbursed via telemedicine and the providers able to provide the services were necessary in the public health emergency. They were done, however, without the benefit of extensive research on telemedicine's efficacy, the services most suited for the modality, its effects on access to care, whether it ameliorates or exacerbates already existing inequalities, and its impact on costs. The findings from our analysis add to this research and serve to help the Department make policy decisions about the future of telemedicine for Health First Colorado members and their health care providers.

Overall, the integrated safety-net system (Denver Health) that provided data for our analysis, increased the number of primary care appointment slots available (perhaps due to clinic and provider expansion), and maintained the number of available slots for outpatient specialty care. However, this appears unrelated to the pandemic and telemedicine policy changes as these trends were present before March 2020. There was, however, a temporary increase in the number of unscheduled appointment slots and a reduction in slots with completed appointments at the beginning of the pandemic. The transition to telemedicine contributed to maintaining appointment completion rates post-pandemic because these rates are higher for telemedicine compared to in-person appointments. If scheduled appointments return to their pre-pandemic statewide levels and a substantial percentage of scheduled appointments continue to be telemedicine, the lower no-show rates for telemedicine appointment will result in a higher number of completed appointments and increased Health First Colorado expenditures. It is also possible, however, that clinics will adjust their scheduling practices to rebalance in-person and telemedicine appointments to pre-pandemic levels (or closer to them) offsetting any budgetary impact on the Department.

As documented in the Department's recent telemedicine evaluation report and shown here, there were significant reductions in utilization of ED and primary care services.¹ It is unclear if these lower rates of ED and primary care utilization will continue. While utilization rates have rebounded some for adults and members with disabilities, they have remained low for children who were less likely to have telemedicine primary care visits compared to adults. In addition, the definition of index PC visits did not include well-child checks (these were not eligible for payment until November 2020, later in our analysis period) and doing so would likely show more primary care visits for children. The overall declines in primary care were mitigated by the expansion of telehealth keeping access to these services higher than would have been the case without the telemedicine policy changes. During the periods between the surges in COVID-19, utilization of in-person primary care services increased and there was a corresponding decrease in the utilization of telemedicine primary care services for all Health First Colorado members. These patterns suggest that as the public health emergency ends, primary care services may return to pre-pandemic levels (or closer to them) in a predominantly in-person modality. To the extent the pandemic has clarified conditions that can be treated effectively in primary care or urgent care settings and which diagnoses are most effective for telemedicine, this could result

in longer-term lower utilization of ED services that could have a notable budgetary impact for the Department. Alternatively, lower utilization of primary care services could result in additional health complications in subsequent years that could increase expenditures for all categories of health care requiring increases in the Department's budget. These important factors warrant continued analysis and exploration of their implications for the health and well-being of Health First Colorado members, as well as for the Department's budget.

Conversely, the likelihood of a subsequent ED visit was no greater (e.g. not statistically significant) for a telemedicine index PC visit compared to an in-person index PC visit. These findings were based on member experiences while we were still in a public health emergency and require additional analyses once utilization trends for these services are more stable. In addition, other dimensions of the effectiveness and quality of telemedicine primary care visits need to be measured and analyzed. Building this evidence base will identify the circumstances where a telemedicine modality is appropriate and when a patient's needs are best met by an in-person visit.

While the budget simulations using the results of our analyses suggest that telemedicine will increase cost, these models are based on several assumptions that may not hold true as the health care system adjusts to a post-pandemic reality that looks more similar to the pre-pandemic world. For example, the primary driver of additional monthly cost is the percentage mix of telemedicine relative to in-person modalities for primary care and behavioral health visits; the percentage declines in telemedicine during the periods COVID-19 moderated suggest that use of telemedicine overall will decrease post-pandemic. Additionally, the impact of a reduction in no-shows may not affect the overall number of completed visits as patients reschedule and complete appointments resolving the concerns prompting the initial appointment they failed to complete. Finally, as patients, providers, payers, researchers and policy-makers gain experience with telemedicine, it is likely there will be improved understanding of what types of visits are most appropriate for telemedicine and which ones require in-person encounters with providers resulting in fewer subsequent primary care and ED visits.

Another important consequence of any reduction in use of telemedicine (in particular audio only) that needs to be considered as telemedicine policies are reviewed and revised is the potential negative impact on people of color and those with higher health needs. Given the current focus of Governor Polis and the Department on health equity, it is important to note that no-show rates for telemedicine (which were primarily audio only at Denver Health) for non-Hispanic Black members and the most complex individuals were similar to those for other groups but were much higher for in-person appointments compared to others. A return to predominantly in-person care could perpetuate or drive further exacerbations in inequities in access to care and overall health status that could increase costs in the long-term. Aligned with the prevailing thinking that these groups are more likely to face challenges with audio/video modes, this suggests that retaining the audio only option is important to improve equitable access to services. While there may be short-term impacts on cost, increased access is likely to lead to reductions in foregone care and more expensive intensive treatments.

The early evidence base, including the results reported in this report, has identified a number of key areas where there are remaining knowledge gaps confronting policymakers as they refine telemedicine policies. Some of the key evidence gaps include:

- Workflow changes and impacts of telemedicine on clinic efficiency;

- The role of telemedicine in promoting appropriate utilization of ED, primary care, behavioral health, specialty, and ancillary care services;

- The conditions, treatments, and other patient circumstances under which a telemedicine modality is appropriate and when a patient's needs are best met by an in-person visit; and

- Health equity and cost implications of appropriate utilization of telemedicine services.

These and other gaps should be resolved by continuing research and evaluations of telemedicine policies and implementation of telemedicine services.

Introduction and Overview

Since March 2020, the COVID-19 pandemic has changed the delivery of health care in Colorado and across the country. One of these changes has been a rapid increase in services delivered via telemedicine, especially during the early days of the pandemic when strict stay-at-home restrictions were in place.

To support greater use of telemedicine, the Colorado Department of Health Care Policy and Financing (Department) expanded the number of Health First Colorado (Colorado's Medicaid program) services allowable for reimbursement and permitted more providers to be reimbursed for this modality. Using rules and new federal authorities, the Department began allowing the use of audio only and live-chat as reimbursable telemedicine services whereas prior to the pandemic only audio/video services could be reimbursed. In addition, Federally Qualified Health Centers (FQHCs), Rural Health Clinics (RHCs), and Indian Health Services (IHS) are allowed to submit encounter claims and be reimbursed for services provided via telemedicine. In the past these providers were able to provide services for this modality but the costs of providing telemedicine services were incorporated into their Prospective Payment System (PPS) rate and not as a payment for a separate encounter. Other policy changes introduced at the beginning of the COVID-19 public health emergency included expansion of provider types able to be reimbursed for telemedicine service delivery to include physical therapy, occupational therapy, home health, hospice, and pediatric behavioral therapy. Finally, for all telemedicine visits a payment parity policy was adopted, meaning in-person, audio only and audio/visual encounters are reimbursed at the same rate. These changes have been codified by Senate Bill 20-212 and signed into law by Governor Polis in July 2020.¹

To build off the Department's recent evaluation and to further enhance the Department's understanding of the impact of the telemedicine policy changes on utilization, patient outcomes, fiscal implications, and to support the development of post-pandemic telemedicine strategies and policies, the Department applied for and received an evaluation grant from the Governor's Office of State Planning and Budget. The Department entered into an Interagency Agreement with the Eugene S. Farley Jr. Health Policy Center (FHPC) at the University of Colorado Anschutz Medical Campus to conduct an analysis of Health First Colorado members' access to care and utilization of emergency department (ED) and primary care (PC) services. This analysis sought to quantify trends in appointment availability and attendance to assess whether access to care improved with the changes in the Department's telemedicine policies. To assess whether these policy changes supported some of the benefits as posited by telemedicine proponents the analysis examines changes in the utilization of health care services before and during the first year of the COVID-19 public health emergency. The benefits advanced by telemedicine proponents include reduced non-emergent use of ED services and greater use of PC services, more effective use of resources, and ultimately lower cost of care. Assessing the potential cost savings of telemedicine will require long-term analyses. However, to obtain a very preliminary assessment of the effectiveness of telemedicine PC and to model budget implications, the analysis compares care utilization following in-person and telemedicine PC visits and estimates the cost of the relative effectiveness of these two modalities in PC.

This report presents the findings around five domains:

- 1 **Appointment Availability, Completion, and No-show Rates:** To assess the impact of COVID-19 on the availability of and access to outpatient primary and specialty care, the report examines the number of available appointments in an integrated safety-net health care system, completion and no-show rates of these appointments, differences in in-person visits prior to and after the COVID-19 initiated policy changes, and differences in no-show rates between modalities. Combining the analyses of these dimensions, the report assesses the extent to which longer term changes to telemedicine delivery modes may improve operational efficiencies such that providers would be able to schedule more appointments and/or see more patients because of lower no-show rates. If either or both of these changes occur, patients' access to care would increase and providers would be able to bill for more services increasing their revenue. The latter effect would also increase Health First Colorado expenditures.
- 2 **Time Trends in ED and PC Utilization:** To examine the potential for long-term changes in the utilization of ED and PC services, the report analyzes data on trends in utilization for both service types, including PC services delivered through in-person and telemedicine modes. Sustained changes in the utilization of these services would also have an impact on the Department's budget.
- 3 **Time Trends in ED and PC Diagnoses:** As noted above one of the hypothesized benefits of telemedicine is a reduction in non-emergent ED visits and a corresponding increase in telemedicine PC visits. To assess this potential benefit at the same time utilization patterns are changing because of the pandemic, the report analyzes data on trends in primary diagnoses for ED visits, all index PC visits, and index PC visits distinguished by modality. Index PC visits are telemedicine eligible (e.g. able to be reimbursed).
- 4 **Assessment of Subsequent ED or PC Visits Following an Index PC Visit:** To evaluate whether telemedicine-delivered PC services lead to increased utilization, the report compares the likelihood a telemedicine PC visit is followed by another PC or ED visit in the next 60 days to the likelihood of these patient outcomes following an in-person PC visit. If telemedicine PC visits are not as effective in addressing the reason for the appointment, the likelihood of a subsequent PC or ED visit would increase and this would also increase the Department's budget if payment parity is maintained.
- 5 **Budget Implications of Continuing Telemedicine Policies:** To gauge the potential budget impacts of the transition to telemedicine on utilization of ED, PC, and BH services, the report presents the results from several "what-if" scenarios on the cost of services. These comparisons focus on the additional cost of shifting visits from 100% in-person to a mixture of in-person and telemedicine modalities.

To provide context for the interpretation of our findings, we identified and reviewed relevant peer-reviewed research and non-peer reviewed literature that included reports, briefs, working papers, and blogs. This environmental scan helped identify where our findings are consistent or differ from the results in the literature. The literature also informed our "what-if" scenarios that explore the future budget implications of continuing the telemedicine policies introduced by the Department in response to the COVID-19 public health emergency.

Data Sources and Approach to Analysis

To address the first domain, Denver Health Ambulatory Care Services provided data from the scheduling component of their electronic health record (EHR).

To address the second, third and fourth domains, the Department provided data on Health First Colorado member enrollment and fee-for-service (FFS) claims.

The fifth domain used a combination of both data sources.

Denver Health Data

The data provided by Denver Health included information on all available outpatient appointment slots (date and time), all scheduled appointments for each slot, the mode of the scheduled appointment (in-person, audio/video or audio only), and the status of each scheduled appointment (completed, canceled or no-show). Additional data elements provided for each appointment slot included the name of the outpatient clinic/department and a unique non-identifying provider identification number. Each scheduled appointment included a unique non-identifying patient identification number, the patient's primary health insurance carrier, sex, age at visit, race/ethnicity, and Denver Health health risk tier. For analysis purposes, clinics/departments were grouped into four categories: (1) PC physical health (PH) services; (2) integrated behavioral health (IBH) services in PC; (3) specialty care PH services; and (4) behavioral health (BH) specialty care services. Audio/video and audio only appointments were analyzed together as telemedicine appointments because there were very few audio/video appointments at Denver Health, especially in the early months of the pandemic.

The analysis was done on a monthly basis to detect time trend patterns and facilitate the comparison across the pre-COVID and post-COVID periods as the pre-period included 24 months (March 15, 2018 to March 14, 2020) and the post period covered 12 months (March 15, 2020 to March 14, 2021). This also allowed for comparisons of trends over time for different patient demographic factors. By presenting the information graphically, we were also able to identify seasonal trends that helped explain fluctuations in appointment availability, such as increases in the number of appointment slots during flu vaccination season. We present results for completion and no-show rates —these two appointment outcomes made up most of all appointment statuses. A portion of unique appointment slots had multiple scheduled appointments and we used a hierarchical assignment rule to classify the status of these appointment slots in the analysis. Appendix 1 provides an explanation of the rule that assigned each appointment slot a status of completed, no-show, canceled or unscheduled.

Finally, as noted above, we received data starting March 15, 2018, and, to provide one full year of post-COVID data, we requested data through March 14, 2021. To facilitate the analysis of time trends, the number of appointment slots and scheduled appointments for these two months (March 2018 and March 2021) were extrapolated to monthly measures by calculating the daily averages and converting the daily averages to a full month value.

Health First Colorado Enrollment and Claims

Under an existing Interagency Agreement, the University of Colorado School of Medicine has established a data warehouse of Health First Colorado member enrollment, provider enrollment, and FFS claims. The Department provides monthly updates; this report used the May 2021 update. Member enrollment and medical FFS claims were used for the period March 1, 2017 through March 31, 2021 to provide data for a full year after the COVID-19 public health emergency started. To ensure sufficient claims run-out, some analyses were limited to claims data with dates of service through January 31, 2021. Other analyses included claims with dates of service in February and March 2021; however, caution should be used in interpreting results for these two months, as some FFS claims may not be included in the May 2021 data update.

For this report, ED visits included those that result in an inpatient admission as well as those ending without an inpatient admission. Usually these categories of ED visits are analyzed separately, however, for purposes of understanding trends in ED utilization and diagnoses associated with ED visits we examined them together. If future analyses examine costs of ED services these two categories will be analyzed separately.

There are multiple approaches to identify PC services in claims data and we implemented an algorithm that the Department recently adopted. This algorithm applied a set of specific Healthcare Common Procedure Coding System (HCPCS) codes, including Level I (Current Procedural Terminology™ codes) and Level II codes, in combination with specific provider type codes. The Department identified a subset of HCPCS codes that are eligible for payment using a telemedicine mode of delivery as part of the policy changes instituted in response to the COVID-19 public health emergency. The identification of PC services eligible for telemedicine payment used these specific HCPCS codes in combination with the PC algorithm. The PC services eligible for telemedicine payment are referred to as index PC visits in this report. The recently added HCPCS codes for well-child visits were not considered index PC visits as these codes were only added in November 2020 and involve complex rules for payments based on subsequent in-person PC visits with the same provider. Telemedicine-eligible PC services delivered by either audio/video or audio only are reported together based on information from Department staff confirming it is not possible to accurately differentiate the two modalities in the claims data.

Finally, we excluded from the analysis months in which Health First Colorado members were enrolled in a physical health capitated managed care plan and months when members were aged 65 years and older. The months in which a member was enrolled in a managed care plan were excluded because we did not have claims information to measure their utilization of services or the diagnoses for ED or PC visits. Individuals aged 65 years and older were excluded because Health First Colorado is rarely the primary payer for these members and the telemedicine payment policies implemented by the Department would likely have only a secondary effect on the utilization experiences for these members.

University of Colorado Health

The initial plan was to include data from the scheduling component of a second integrated health care system (University of Colorado Health), however, the data available lacked a key piece of information needed for the analysis. Specifically, while the mode (in-person or telemedicine) was available for completed appointments, this key piece of information was not consistently available during both the pre- and post-COVID periods for appointments where the patient canceled or did not arrive (i.e., no-showed) for the appointment.

Research Questions and Findings

The research questions and findings are presented in five major sections corresponding to the following domains:

- 1 Appointment Availability, Completion, and No-show Rates
- 2 Time Trends in ED and PC Utilization
- 3 Time Trends in ED and PC Primary Diagnoses
- 4 Effectiveness of Telemedicine Relative to In-Person PC Visits
- 5 Budget Implications of Continuing Telemedicine Policies

Appointment Availability, Completion, and No-show Rates

This section presents the findings from our analysis of the Denver Health appointment data. The pre-period includes data from March 15, 2018 to March 14, 2020, and the post-period includes data from March 15, 2020 to March 14, 2021. This analysis sought to answer the following research questions:

- 1 In an integrated health system, did the number of available appointment slots change after the COVID-19 public health emergency in March 2020? Did changes in the number of available appointment slots differ between PC and specialty care settings?
- 2 Did appointment slot utilization rates, defined as the percentage of available appointment slots with a scheduled appointment, change after the policy changes governing payments for telemedicine services were implemented in March 2020? Did changes in the number of available appointment slots differ between PC and specialty care settings?
- 3 To what extent did scheduled appointments with a telemedicine modality offset any changes in in-person scheduled appointments after the policy changes governing payments for telemedicine services were implemented in March 2020?
 - Did changes in the percentage of scheduled appointments with telemedicine and in-person modalities differ between PH and BH services?
 - Did changes in the percentage of scheduled appointments with telemedicine and in-person modalities differ between PC and specialty care settings?

- 4 Among scheduled appointments, did completion and no-show rates change after the policy changes governing payments for telemedicine services were implemented in March 2020?
 - To what extent were any changes in completion and no-show rates related to changes in appointment modality (in-person, telemedicine)?
 - To what extent were any changes in completion and no-show rates related to changes in cancellation rates by appointment modality?
 - To what extent were any changes in completion and no-show rates related to changes in the percentage of appointment slots without a scheduled appointment (unscheduled slots)?
 - To what extent were any changes in completion and no-show rates for Health First Colorado members associated with member characteristics, such as race/ethnicity, age, gender, and medical complexity?

Four sets of results are presented in a series of figures below that address these four research questions.

- 1 Available Appointment Slots: Figures 1-4 present the time trends for the number of available appointment slots and the percentage of available slots with a status of completed, no-show, and unscheduled for the pre and post period to answer research questions 1 and 2. For these figures, PC (physical and IBH) are reported together and specialty care (physical and specialty BH) are reported together. We combined the two PC categories because in-person appointments for PH and BH may use the same exam rooms in a clinic/department, meaning a scheduled appointment for PH in an exam room would preclude scheduling an IBH appointment in the same room at the same time. For consistency we combined specialty PH and specialty BH care even though these two categories are not likely to share common clinic/department space.
- 2 Telemedicine and In-Person Scheduled Appointments: Table 1 and Figures 5-8 show the total number of scheduled appointments for all payers differentiated by telemedicine and in-person (pre and post periods) for each of the four service categories to answer research question 3.
- 3 Telemedicine and In-Person Completion and No-Show Rates for Health First Colorado Members: Figures 9-12 present the completion and no-show rates differentiated by telemedicine and in-person for Health First Colorado members for each of the four service categories to answer research question 4 parts 1 - 3.
- 4 No-Show Rates by Patient Characteristics: To answer the last part of research question 4, Figures 13-20 show the no-show rates for in-person and telemedicine scheduled appointments by race/ethnicity, and Figures 21-28 show the no-show rates for in-person and telemedicine scheduled appointments by Denver Health health risk category. These results, reported for each of the four service categories, are limited to scheduled appointments where Health First Colorado is the primary payer.

ANALYSIS OF AVAILABLE APPOINTMENT SLOTS

Figures 1 and 2 present the trends for PC settings combining PH and IBH care. Figures 3 and 4 present the trends for specialty PH and BH care combined.

Figure 1 presents the number of PC unique available appointment slots, the number of these slots with one or more scheduled appointments, and the number of slots that were not scheduled. Figure 2 presents the percentage of unique available appointment slots in PC with a completed appointment, the percentage with a scheduled appointment where the patient failed to arrive (no-show), and the percentage without a scheduled appointment. Figures 3 and 4 present the same information for the combined PH and BH specialty care slots.

Figure 1: Available and Scheduled Slots for PC & IBH, Denver Health, March 2018 - March 2021

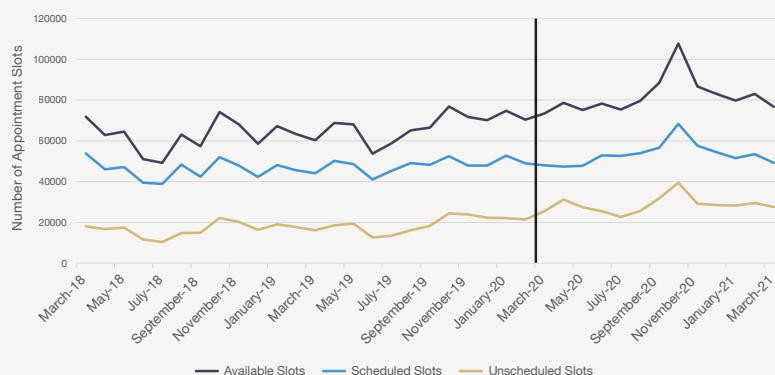


Figure 2: Completion and No-show Rates among PC & IBH, Denver Health, March 2018 - March 2021

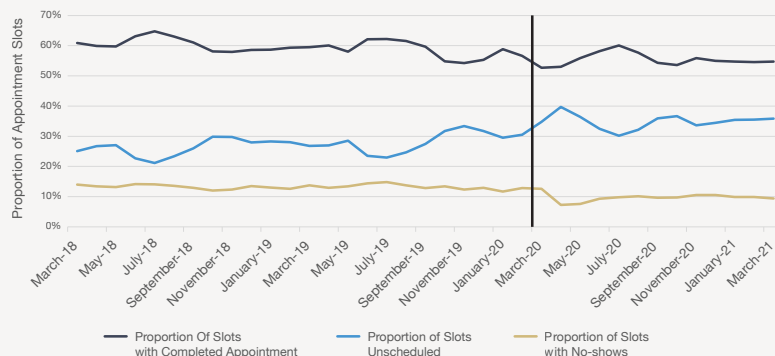


Figure 3: Available and Scheduled Slots for PH & BH Specialty Care, Denver Health, March 2018 - March 2021

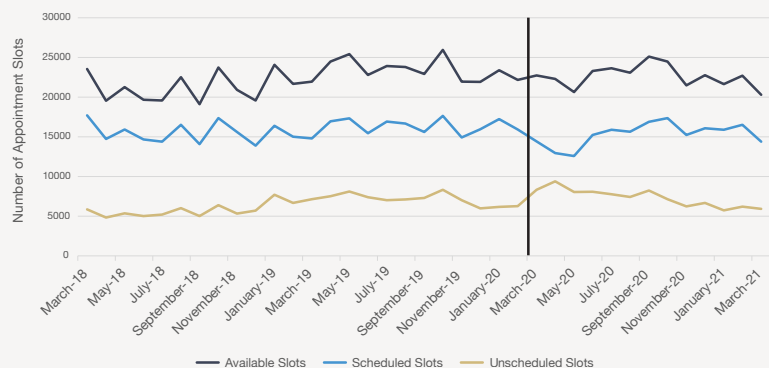
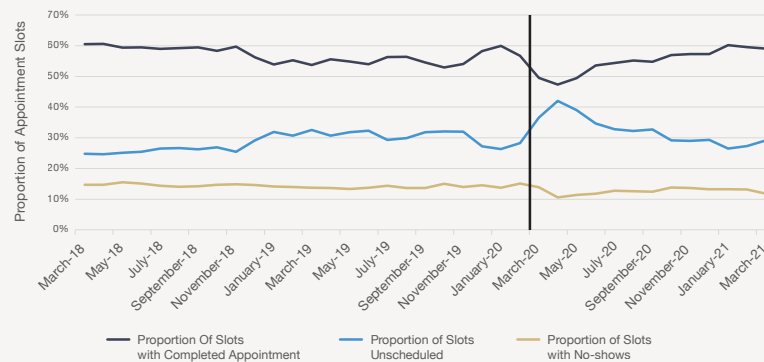


Figure 4: Completion and No-show Rates among PH & BH Specialty Care Appointments, Denver Health, March 2018 - March 2021



Overall, the analyses shown in Figures 1–4 suggest that the pandemic did not interrupt the trends in available appointment slots, and any changes in utilization of PC and specialty care were the result of changes in demand for these services. For example, there was an increasing trend in the number of PC (PC and IBH) slots over the 36-month period, with slightly more slots in March 2021 than there had been in March 2018 (Figure 1). This could reflect Denver Health’s expansion of clinics and hiring of more providers. The large spike in the number of slots in the fall of 2020 is attributed to a substantial increase in vaccination appointments. There were also similar, but less noticeable, increases in the fall of 2018 and 2019. The larger increase in 2020 aligned with national trends of increased flu vaccinations. The CDC reports 193.8 million doses of the flu vaccine were administered in 2020-21, the highest number in a single influenza season.²

Consistent with reduced demand for care, the trends in scheduled and unscheduled slots show a disruption beginning in March 2020, and not fully returning to trend until 2021. As an example, Figure 2 shows the percentage of available slots that were unscheduled increasing from about 25% in the spring of 2018 to approximately 30% by February 2020, followed by a sharp increase in March 2020 and peaking at 40% in April 2020. With the exception of July 2020, this remained around 35% through March 2021. This pattern for scheduled and unscheduled slots is also reflected in Figure 4 with a gradual increase in the percentage of unscheduled slots during the pre-pandemic period followed by a marked increase in March through May 2020 and a gradual decline back to pre-pandemic levels by March 2021. Further support for the reduced demand for care is shown in the trends for the percentage of completed and percentage of no-show appointment slots in Figures 2 and 4. For example, in March and April of 2020 there were simultaneous decreases in the percentage of both completed and no-show slots and a gradual recovery.

TELEMEDICINE AND IN-PERSON SCHEDULED APPOINTMENTS

The findings in Figures 1–4 indicate there were increases in the number of unscheduled appointment slots at the start of COVID-19 and while there was a gradual return to pre-COVID levels by October 2020 for specialty care the percentage of unscheduled slots for PC remained about five percentage points higher than pre-COVID levels, even by March 2021. These figures also suggest there were significant changes in completion and no-show rates at the start of the pandemic that may have returned to pre-pandemic levels by the summer of 2020. However, during this transition to telemedicine, appointment slots were not designated as in-person or telemedicine until an appointment was scheduled at which time it would have been identified as telemedicine or in-person. As such, to assess the extent to which the transition to more telemedicine appointments was related to completion and no-show rates, we examined these rates for scheduled appointments. It is possible that multiple appointments were scheduled for a unique appointment slot. In the Denver Health data approximately 8% of unique appointment slots had more than one appointment scheduled for the same provider, in the same clinic/department, at the same time.

As noted in the introduction, telemedicine proponents have emphasized the improved operational efficiencies resulting from lower no-show rates for telemedicine relative to in-person appointments. To assess the extent to which completion and no-show rates were lower for telemedicine appointments as Denver Health rolled out telemedicine, we analyzed these rates for all scheduled appointments by their modality (in-person or telemedicine). In this analysis, we distinguish PH and BH scheduled appointments for both primary and specialty care.

Denver Health had only a small number of telemedicine appointments scheduled in the pre-pandemic period, and rapidly increased the telemedicine modality for all types of care. Table 1 presents the percentage of scheduled appointments for an audio only and audio/video modality in the post-pandemic period per month combining all four categories of service for all payers.

Table 1: Percent of Scheduled Appointments for all Service Categories by Month and Break-out of Telemedicine

Month	Percent of Scheduled Appointments as Audio Only	Percent of Scheduled Appointments as Audio/Video
March 2020	19.9%	0.0%
April 2020	66.2%	0.3%
May 2020	57.5%	0.2%
June 2020	46.9%	0.3%
July 2020	38.9%	0.3%
August 2020	34.8%	0.2%
September 2020	33.2%	0.5%
October 2020	29.6%	0.6%
November 2020	33.4%	0.7%
December 2020	35.1%	1.0%
January 2021	32.4%	1.0%
February 2021	30.0%	1.1%
March 2021	26.7%	1.2%

The findings in Table 1 show the rapid increase in the audio only modality, going from essentially less than one percent of appointments before March 2020 to 19.9% in March and 66.2% in April 2020. The third column shows the very infrequent use of audio/video in March 2020 and only a gradual increase in its use a year later. This infrequent use of the audio/video modality required the analysis to combine audio/video and audio only modes into a telemedicine modality. Finally, this table also shows a continual reduction in scheduled telemedicine appointments through March 2021.

The trends at Denver Health are similar to other safety net clinics. A California Health Care Foundation-funded study of telemedicine use at 43 federally qualified health centers (534 physical locations) conducted by RAND researchers also found few pre-pandemic telemedicine visits, with a quick transition to telemedicine in March 2020. From March to August 2020, more than half of all PC visits were telemedicine with 48.5% by audio only and 3.4% by audio/video. For BH visits, even more were conducted by telemedicine, nearly 77%, with 63.3% by audio only and 13.9% by audio/video.³

This declining use of telemedicine following its rapid increase can also be seen in Figures 5–8. These figures present the number of scheduled appointments, the number of scheduled in-person appointments, and the number of scheduled telemedicine appointments for each service category using data for all payers.

Figure 5: Scheduled PC Appointments: All Payers, Denver Health, March 2018 - March 2021

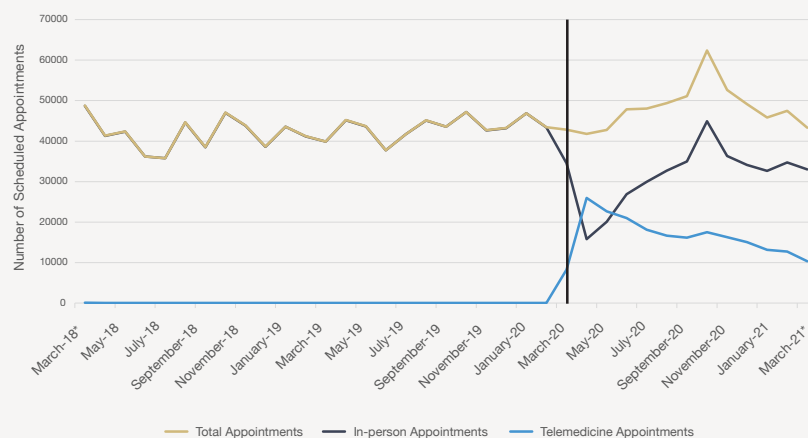


Figure 6: Scheduled IBH Appointments: All Payers, Denver Health, March 2018 - March 2021

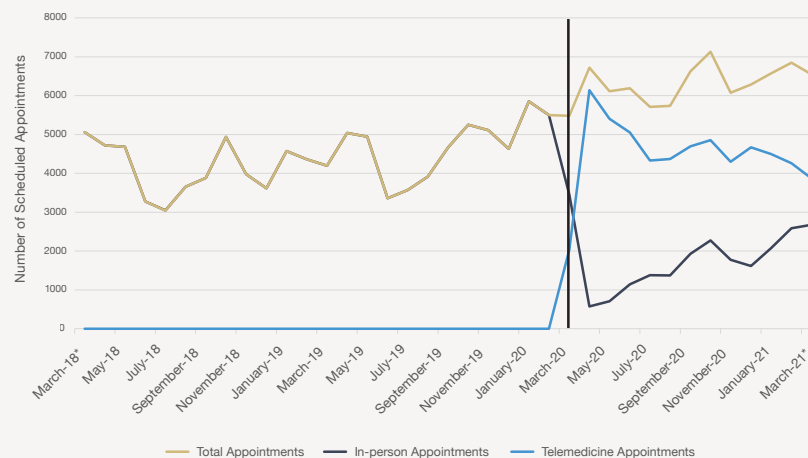


Figure 7: Scheduled Specialty Appointments: All Payers, Denver Health, March 2018 - March 2021

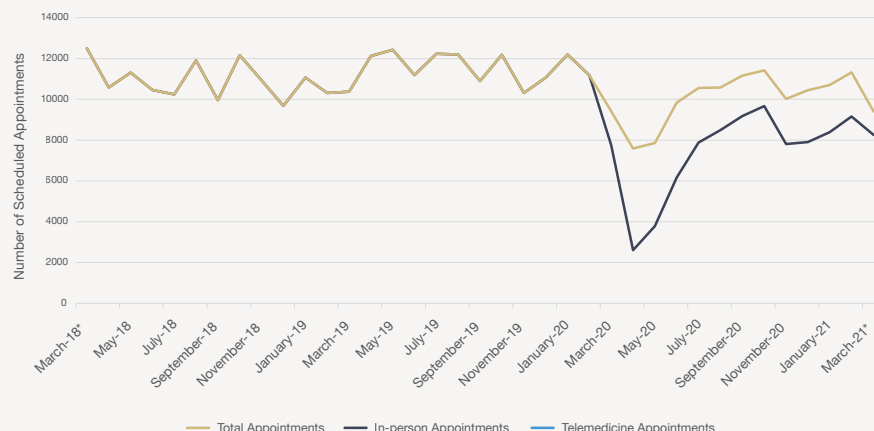
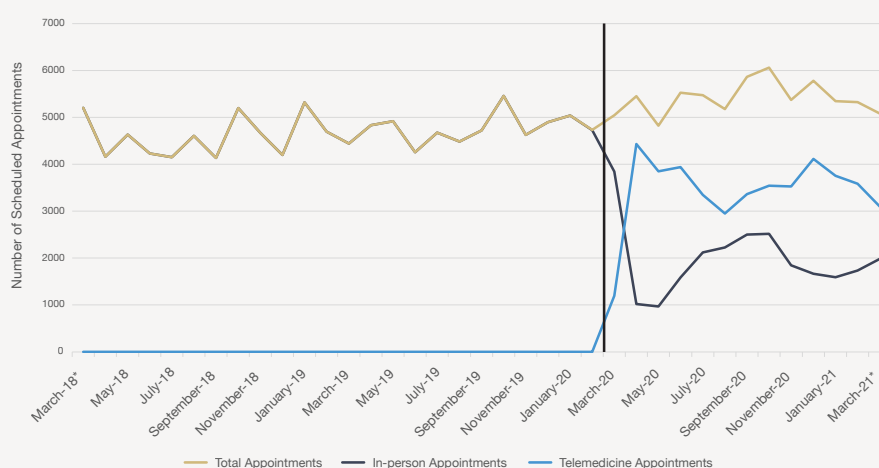


Figure 8: Scheduled Specialty BH Appointments: All Payers, Denver Health, March 2018 - March 2021



As shown above, the number of telemedicine appointments peaked in April of 2020 and has slowly declined for PC, IBH and specialty PH; however, specialty BH care did not decline as much and reached a level in December 2020 (during the second COVID-19 wave) that was almost as high as the April 2020 level. In addition, IBH use of telemedicine has declined more slowly than PC physical health telemedicine appointments. As a result of this slower decline, the number of telemedicine BH scheduled appointments still exceeded the number of in-person visits as of March 2021. While the number of scheduled appointments with a telemedicine modality fell below the number of in-person scheduled appointments by June 2020 for both PC and specialty services, this mode still makes up a considerable portion of all appointments in these two categories. In-person scheduled appointments have yet to return to their pre-pandemic levels. The reemergence of COVID-19 that occurred in the late fall of 2020 also led to an increase in telemedicine though this increase was smallest for PC. A national voluntary survey conducted by the Centers for Disease Control and the Health Resources & Services Administration of 245 health centers found a similar trend of telemedicine visits declining as COVID-19 cases were decreasing.⁴ These trends suggest that post-pandemic, the percentage of visits that are telemedicine is likely to be even lower. Finally, Figures 6 and 8 show that the total number of scheduled appointments at Denver Health increased for IBH and specialty BH compared to the pre-pandemic period.

TELEMEDICINE AND IN-PERSON COMPLETION AND NO-SHOW RATES FOR HEALTH FIRST COLORADO MEMBERS

While these all-payer results provide valuable context, to address the fourth research question in this series and provide information the Department can use to inform future telemedicine policies, Figures 9–12 present the completion and no-show rates for scheduled appointments distinguishing telemedicine and in-person for Health First Colorado members for the four service categories. Due to small numbers, these figures do not present completion rates or no-show rates for telemedicine prior to March 2020. The vertical line in all the subsequent figures mark the start of the COVID-19 public health emergency and distinguish between the pre- and post-periods.

Figure 9: Completion and No-show Rates among PC Appointments: Health First Colorado, Denver Health, March 2018 - March 2021

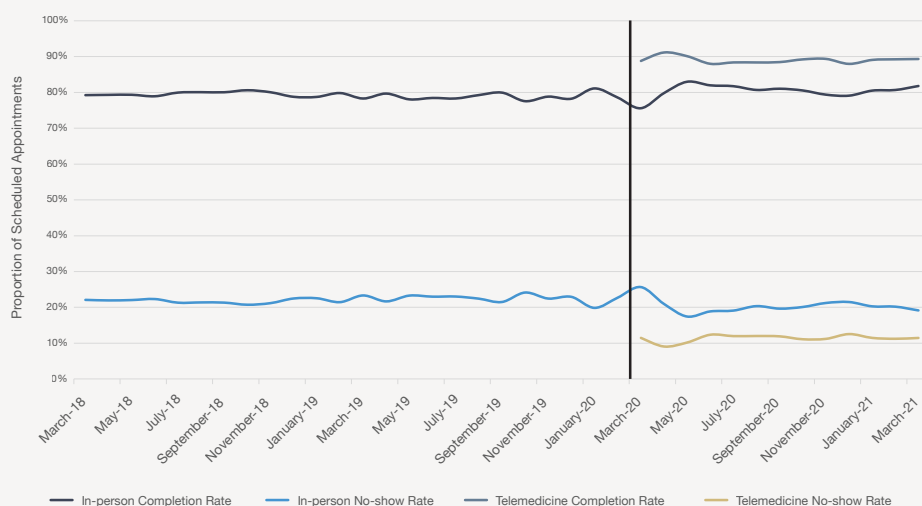


Figure 10: Completion and No-show Rates among IBH: Health First Colorado, Denver Health, March 2018 - March 2021

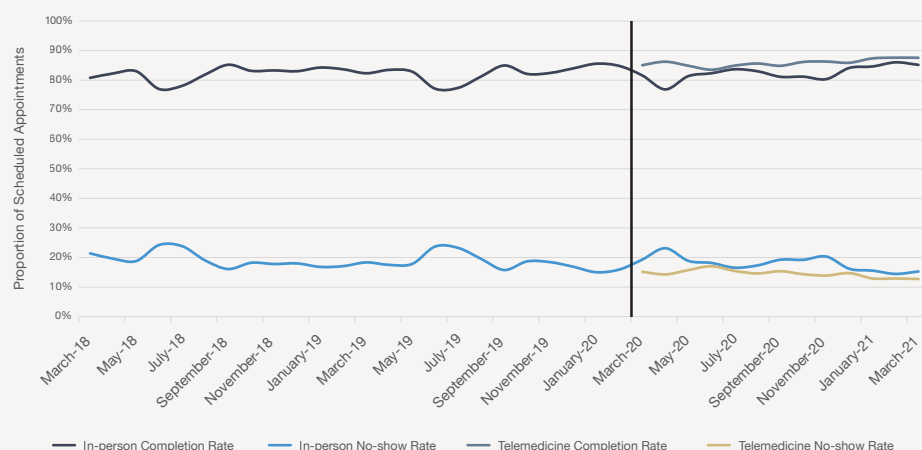


Figure 11: Completion and No-show Rates among Specialty Care: Health First Colorado, Denver Health, March 2018 - March 2021

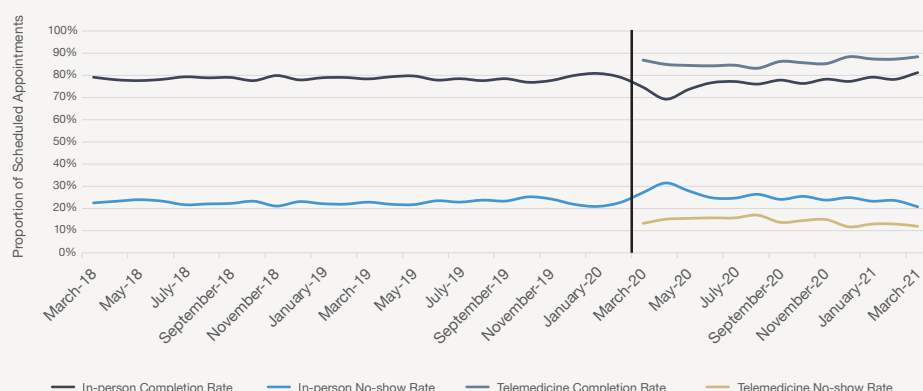
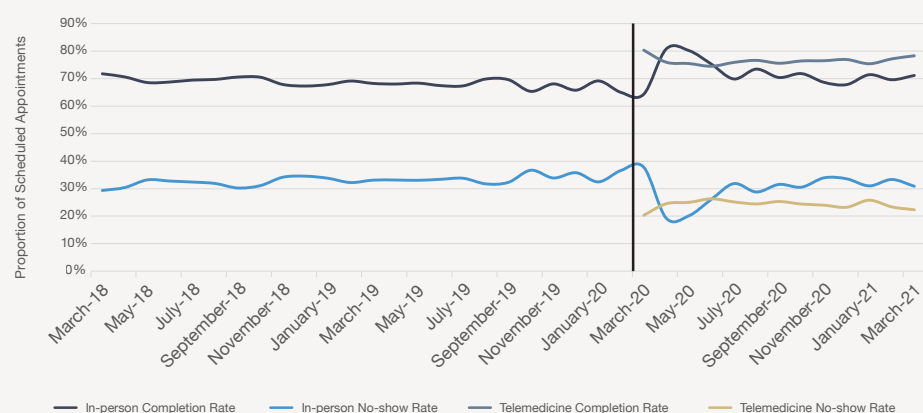


Figure 12: Completion and No-show Rates among BH: Health First Colorado, Denver Health, March 2018 - March 2021



For Health First Colorado members, the findings show a marked disruption in the completion and no-show rate trends in all four service categories immediately following the COVID-19 public health emergency declaration. In the pre-pandemic period, completion and no-show rates were relatively stable for all service categories, although the completion rates for in-person BH specialty were about 10 percentage points lower than for the other service categories (with corresponding no-show rates about 10 percentage points higher). Immediately following the public health emergency declaration, there were increases in no-show rates with the exception of in-person BH specialty appointments for which no-show rates dropped from near 40% in February 2020 to less than 20% in May 2020. This pattern for BH specialty appointments suggest increasing demand for these services in contrast to the other service categories possibly reflecting the pandemic's adverse effects on members' mental health status. As an example, in-person completion rates for specialty BH initially dropped in March 2020 followed by a 17 percentage-point increase in April 2020 with a gradual decline back to the pre-pandemic level of approximately 70% from July 2020 through March 2021. By July 2020 completion and no-show rates appear to have stabilized for the remainder of the post-pandemic period for both modalities.

After completion and no-show rates stabilized in July 2020, the completion rate for telemedicine appointments exceeded both pre- and post-pandemic completion rates for in-person care across all service categories. This pattern is consistent with the finding from the RAND study of California FQHCs — no-show rates were lower across all modalities (audio only, audio/video and in-person) in the post pandemic period and providers reported that in some cases they were able to convert in-person no-shows into a completed audio-only visit.⁵ The largest difference between in-person and telemedicine appointments at Denver Health was for PC, where approximately 90% of telemedicine appointments were completed compared with approximately 80% of in person appointments (Figure 9).

The findings presented in Figures 1–8 suggest that Denver Health was opening additional appointment slots in the fall of 2019 with a corresponding increase in the percentage of unscheduled slots; scheduled appointments were completed at essentially the same rates with the exception of the first few months of the COVID-19 public health emergency. Combining these findings with those from Figures 9–12 suggests that the transition to telemedicine contributed to maintaining completion rates because completion rates were higher for telemedicine compared to in-person appointments. Additionally, as completion and no-show rates stabilized for in-person appointments and if a substantial percentage of scheduled appointments continue to be telemedicine the number of completed appointments may increase, resulting in a budgetary impact for the Department. This outcome could be the result of increased efficiency in clinic operations, patients being more likely to complete an appointment when they do not have to travel to the clinic, or some combination of these two factors.

Our environmental scan of both peer-reviewed and non-peer reviewed literature and websites revealed many commercial products touting increased efficiency via telemedicine, but we were unable to find comprehensive studies supporting their assertions. Qualitative studies conducted during the past year found various views on efficiency of telemedicine appointments. The Colorado Health Institute reported that some providers said they saved time by not having to prep or clean clinical space (especially during a pandemic), others reported that fewer no-shows led to better time management and reduction in wasted clinical time and some identified improved patient outcomes, an ability to expand geographically or offer more flexible services, and potential for additional revenue resulting from a transition to more telemedicine visits.^{6,7} In contrast, stakeholders at an Office of eHealth Innovation-sponsored Telehealth Policy and Reimbursement meeting May 17, 2021, reported that costs for delivering telemedicine services are not lower (providers need to have the right technology which can be costly). One provider said costs are actually greater because they spend a lot of time helping patients with the technology. None of the stakeholders at this meeting reported being able to schedule more visits as a result of providing both in-person and telemedicine appointments. Researchers in California interviewed 15 providers during the spring of 2020 and several key themes coalesced that relate to the efficiency of telemedicine visits: (1) telemedicine visits tend to be shorter than in-person visits, (2) careful consideration of physician workflows is needed to avoid burnout, and, (3) mixing telemedicine and in-person appointments can result in providers falling behind and running late for scheduled appointments.⁸ The Department reported similar findings in their recent evaluation (technology creates roadblocks, staff are spending a lot of time helping patients with connectivity).¹

We also found sparse evidence in the environmental scan on lower, no-show rates for telemedicine from the patient perspective. A study of telemedicine in an integrated PC clinic primarily serving diverse racial and ethnic minority patients with public insurance found significant increases in number of mental health appointments attended and fewer canceled visits between the pre-pandemic period and pandemic period after some appointments shifted to telemedicine.⁹ However, the number of no-show appointments did not change. The authors state that telemedicine does help reduce some barriers to attending mental health services, such as physical illness, psychiatric symptoms or lack of motivation to receive treatment, often the cause of no-shows for outpatient mental health services. Additional research, particularly post-pandemic, is needed to understand the visit and condition types best suited to optimize the efficiencies of telemedicine.

NO-SHOW RATES BY PATIENT CHARACTERISTICS

Telemedicine has also been hypothesized as one way to reduce health disparities by increasing access to care and improving patient outcomes. To examine this, we analyzed no-show rates for in-person and telemedicine scheduled appointments in each of the service categories by patient demographics and a measure of health status.

Figures 13-20 present the no-show rates of each service category for four race/ethnicity groups: (1) Hispanic, (2) Non-Hispanic White, (3) Non-Hispanic Black, and (4) Non-Hispanic Other/Multiple races. For each service category, the first graph presents the no-show rates by these four race/ethnicity groups for in-person scheduled appointments from March 2018 through March 2021. The second graph presents the no-show rates for telemedicine scheduled appointments by the four race/ethnicity groups from March 2020 to March 2021 (there were too few visits to report during the pre-pandemic period). (Note, the y axis of these figures is truncated at 50%.)

Figure 13: No-show Rates among In-person PC Appointments by Race/Ethnicity, Denver Health, March 2018 to March 2021

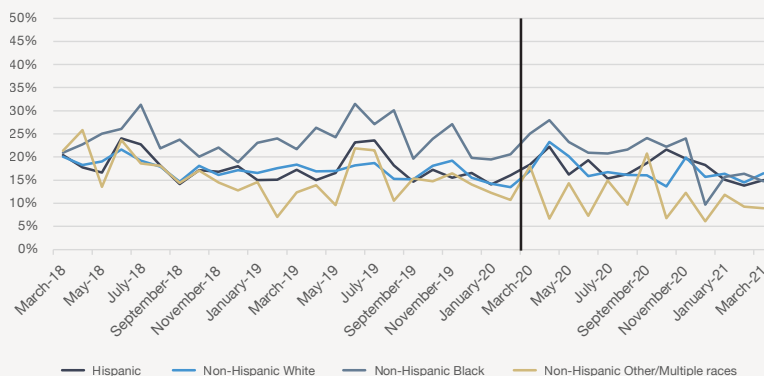


Figure 14: No-show Rates among Telemedicine PC Appointments by Race/Ethnicity, Denver Health, March 2020 - March 2021

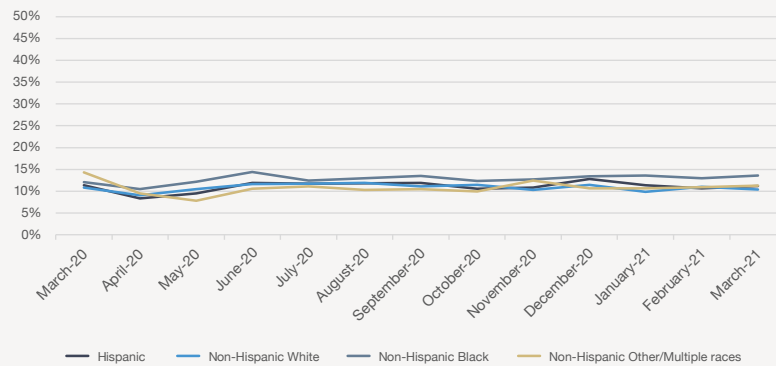


Figure 15: No-show Rates among In-person IBH Care Appointments by Race/Ethnicity, Denver Health, March 2018 - March 2021

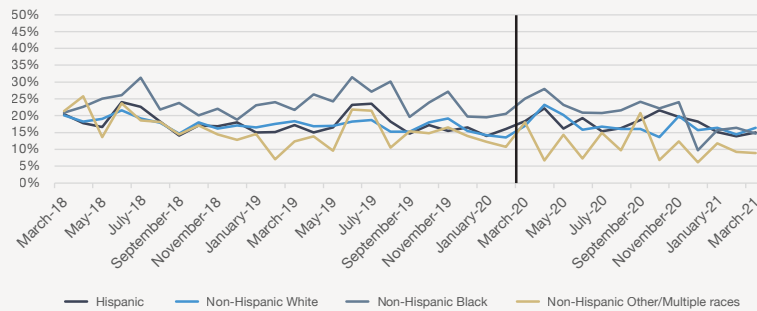


Figure 16: No-show Rates among Telemedicine IBH Care Appointments by Race/Ethnicity, Denver Health, March 2020 - March 2021

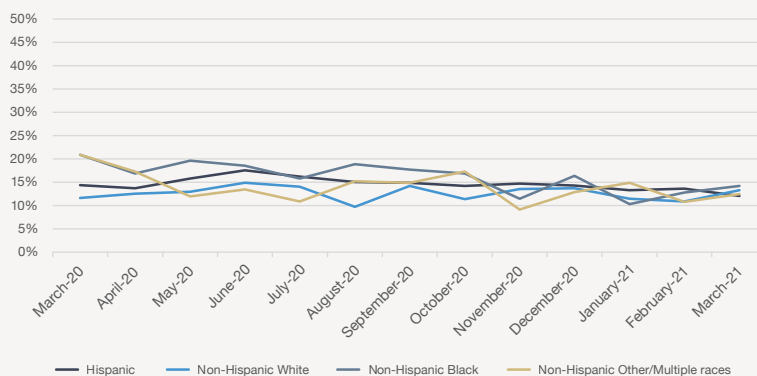


Figure 17: No-show Rates among In-person PH Specialty Care Appointments by Race/Ethnicity, Denver Health, March 2018 - March 2021

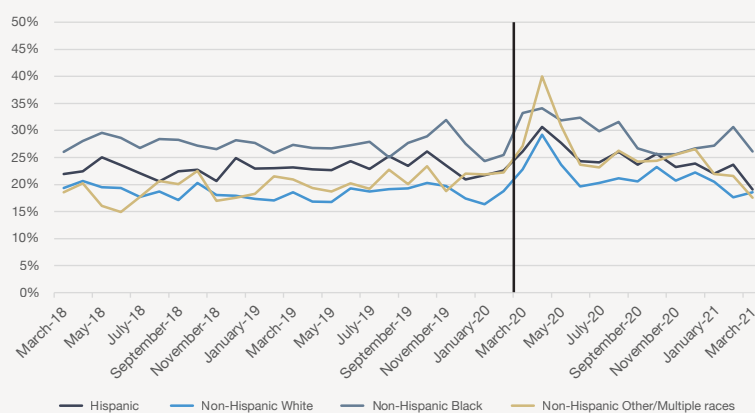


Figure 18: No-show Rates among Telemedicine PH Specialty Care Appointments by Race/Ethnicity, Denver Health, March 2020 - March 2021

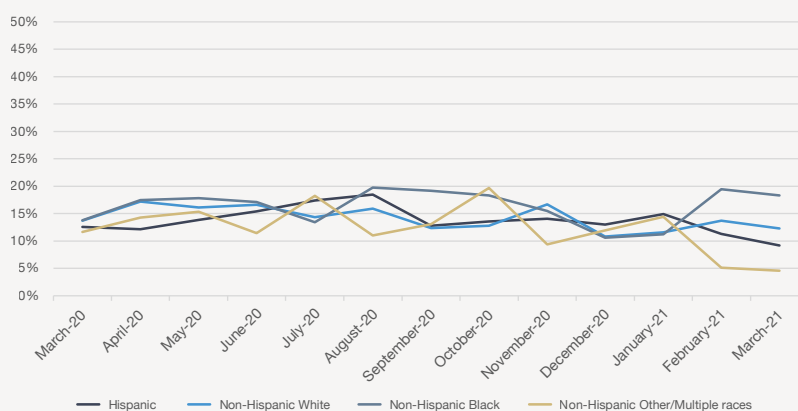


Figure 19: No-show Rates among In-Person BH Specialty Care Appointments by Race/Ethnicity, Denver Health, March 2018 - March 2021

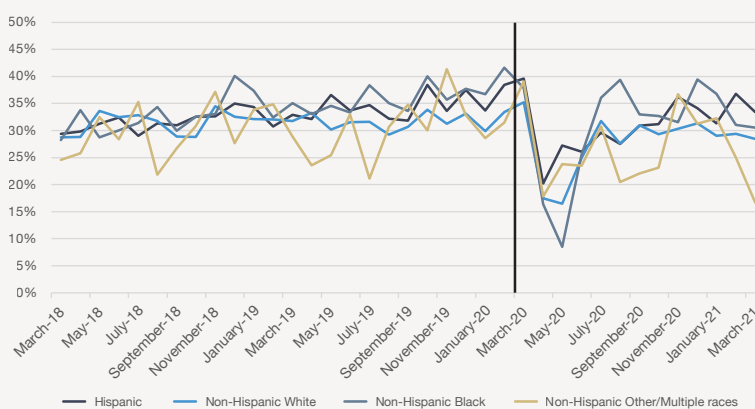
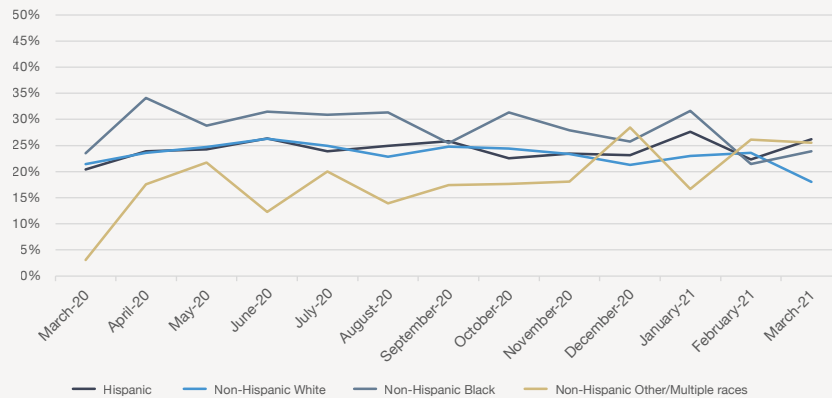


Figure 20: No-show Rates among Telemedicine BH Specialty Care Appointments by Race/Ethnicity, Denver Health, March 2020 - March 2021



The findings presented in Figures 13–20 show Non-Hispanic Black members had higher no-show rates for in-person appointments in both the pre- and post-periods in all service areas except BH specialty care. This trend was less pronounced for telemedicine appointments. The group of members categorized as Non-Hispanic Other/Multiple races tended to have lower no-show rates compared to other racial and ethnic groups, particularly for BH specialty care.

For the most part, telemedicine reduced the differences in no-show rates across racial/ethnic groups. That is, there was greater disparity across these groups for in-person scheduled appointments compared with the telemedicine appointments in the same service category. This finding supports the hypothesis that telemedicine may be a promising tool for decreasing disparities among racial/ethnic groups. In our environmental scan, we found that studies of telemedicine use during the COVID-19 reported increases in telemedicine visits to be similar among white and Black individuals;¹⁰ however, compared to white patients, Black and Latinx patients were less likely to use audio/video modalities suggesting that the modality of the telemedicine appointment will be critical to consider in potentially reducing these disparities.¹¹ Investment in technology, broadband, and training may increase access and utilization of audio/video telemedicine visits. However, if not addressed, these differences may amplify existing inequities in access to care.

Our analysis also examined no-show rates by sex and age. To keep the number of figures to a reasonable amount in the report, these findings are not presented in graphs. Generally, males were slightly more likely than females to no-show for appointments across all service categories in the pre-period but these differences disappeared in the post-period. By age, no-show rates were lower for telemedicine across the three age categories (0-17, 18-64 and 65+) but the older group had lower in-person rates prior to the pandemic and higher no-show rates for in-person post-pandemic. Older members also had higher no-show rates for telemedicine appointments in the post-pandemic period. These patterns for older members may reflect greater concern about visiting a health care setting among this more vulnerable population and also less comfort with telemedicine as a modality for receiving care. It should also be noted that there were fewer than 1,000 observations of telemedicine visits in this age group so caution should be used in interpreting this finding.

To examine the extent to which no-show rates differ between in-person and telemedicine modalities by members' health status, we used Denver Health's clinically actionable risk stratification of patients. This stratification is based on the 3M CRG™ core health status groups and is supplemented with utilization and other clinical criteria to recognize risk not identified via the CRG. The stratification results in a four category Risk Tier where 1 is the least complex and 4 is the most complex. Appendix 1 has more detail about this algorithm.

Figures 21–28 present the no-show rates for in-person and telemedicine scheduled appointments for Health First Colorado members by Risk Tier for the four service categories. As with Figures 13–20, there are two graphs for each service category. The first graph presents the no-show rates by Risk Tier groups for in-person scheduled appointments from March 2018 through March 2021. The second graph presents the no-show rates for telemedicine scheduled appointments by Risk Tier groups from March 2020 to March 2021 (there were too few visits to report during the pre-pandemic period).

Figure 21: No-show Rates among In-person PC Appointments by Health Risk Tier, Denver Health, March 2018 - March 2021

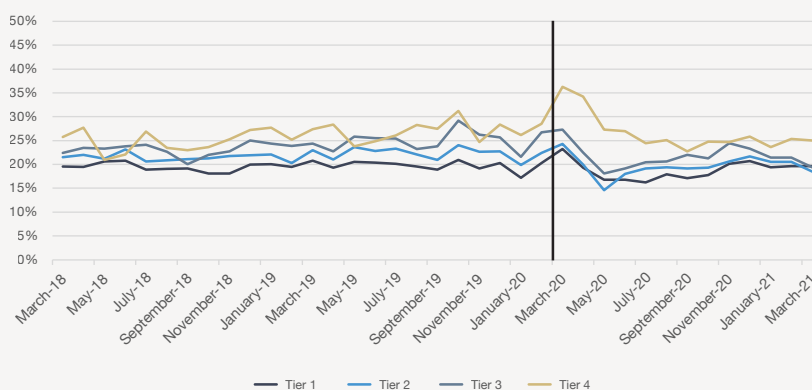


Figure 22: No-show Rates among Telemedicine PC Appointments by Health Risk Tier, Denver Health, March 2020 - March 2021

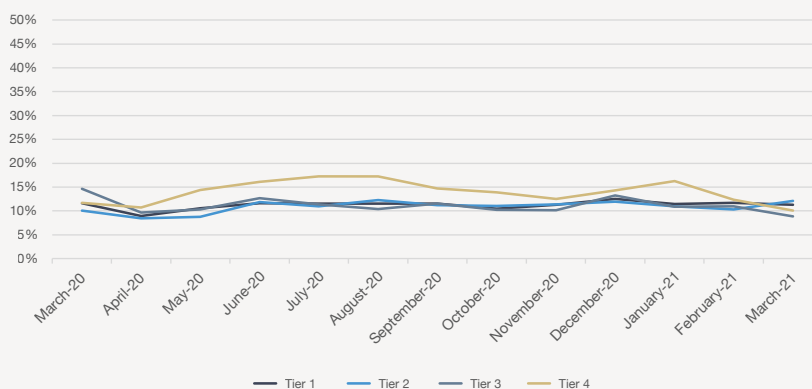


Figure 23: No-show Rates among In-person IBH Appointments by Health Risk Tier, Denver Health, March 2018 - March 2021

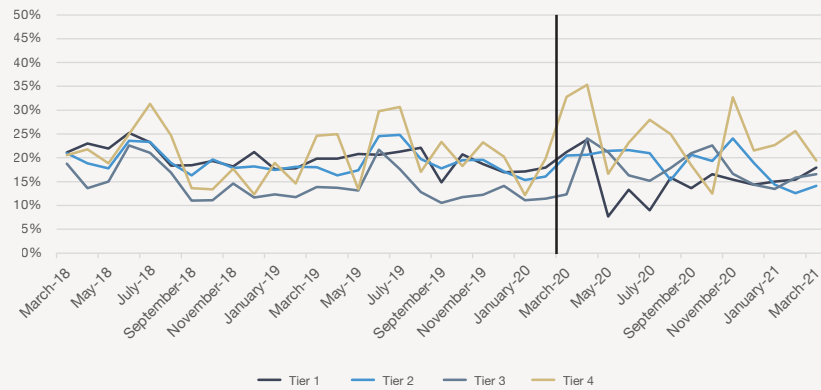


Figure 24: No-show Rates among Telemedicine IBH Appointments by Health Risk Tier, Denver Health, March 2020 - March 2021

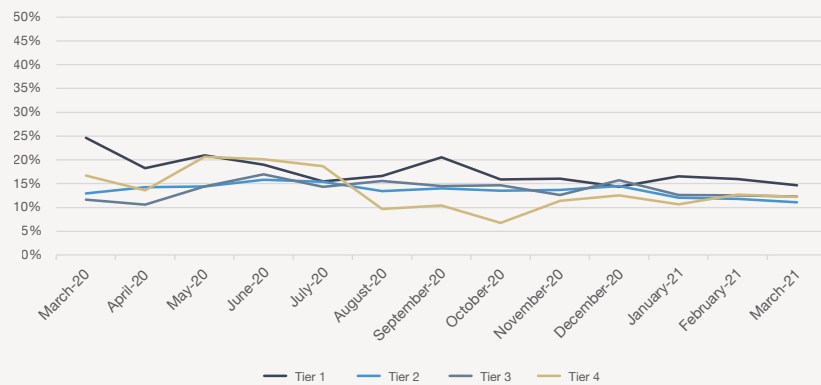


Figure 25: No-show Rates among In-person PH Specialty Care Appointments by Health Risk Tier, Denver Health, March 2018 - March 2021

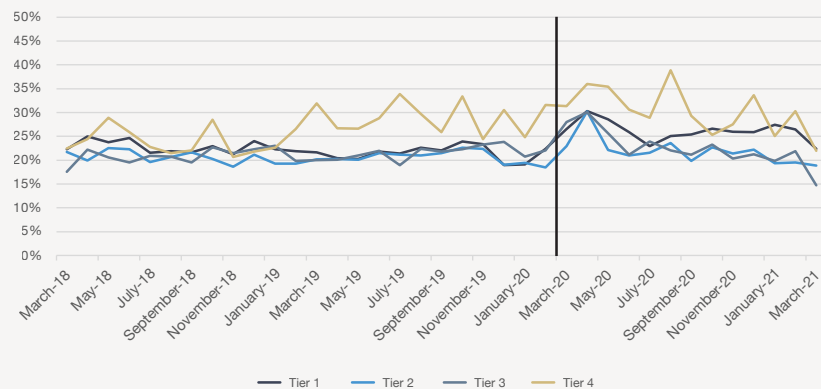


Figure 26: No-show Rates among Telemedicine PH Specialty Care Appointments by Health Risk Tier, Denver Health, March 2020 - March 2021

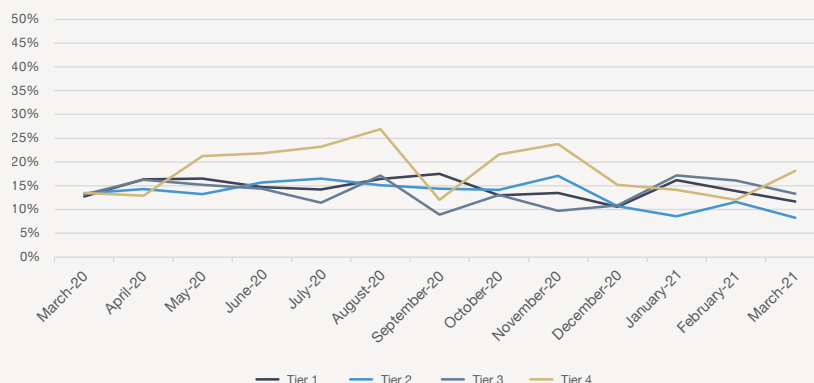


Figure 27: No-show Rates among In-person BH Specialty Care Appointments by Health Risk Tier, Denver Health, March 2018 - March 2021

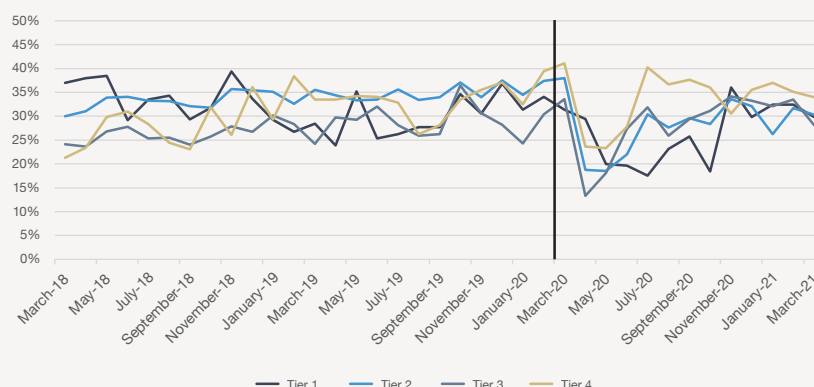
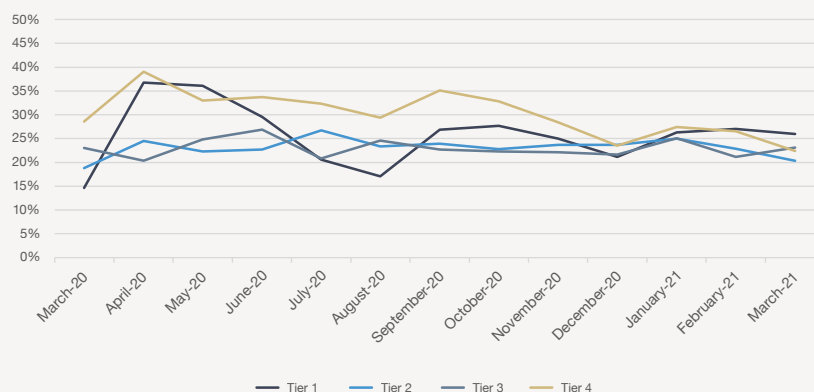


Figure 28: No-show Rates among Telemedicine BH Specialty Care Appointments by Health Risk Tier, Denver Health, March 2020 - March 2021



In general, individuals categorized as Tier 4 tended to have higher no-show rates for in-person visits, but have comparable no-show rates to others with different health statuses for telemedicine (particularly in the later months of the post-period). This is consistent with another study of one health system that found higher telemedicine completion rates among patients with higher Charlson Comorbidity Index score.¹¹ Maintaining access to telemedicine — in particular phone only — may improve access to care for complex individuals and could have a positive impact on the Department's budget if this access reduces ED and inpatient utilization. There is some evidence that telemedicine is an effective tool for managing patients with chronic conditions. The 15 California providers (referenced earlier) interviewed during the spring of 2020 also reported that many visits were well-suited for telemedicine including review of results, medication initiation for chronic conditions, and, if patients are able to check blood pressure or blood sugar, chronic management of hypertension and diabetes.⁸ Conducted prior to the pandemic, systematic reviews of telemedicine delivery modes relative to in-person visits found the greatest benefit for provider-patient interactions dealing with the management of chronic conditions (including diabetes and cardiovascular disease) and treatment of BH conditions.¹²

Emergency Department and Primary Care Utilization

To examine the potential for long-term changes in the utilization of ED and PC services following the telemedicine payment policy changes and patient and provider experiences during the public health emergency, we analyzed Department-provided data on trends in ED and PC utilization, including PC services delivered through in-person and telemedicine modes. This section presents findings from the analysis of Health First Colorado FFS claims covering the period from March 2018 through March 2021. As noted above, measures for February and March 2021 should be considered preliminary, as the amount of time for claims run-out is limited for these two months. However, we included these last two months in the analysis to provide a full year of information after the COVID-19 public health emergency declaration.

The analysis of ED and PC utilization trends sought to answer the following research questions:

- 1** Did utilization of ED services by Health First Colorado members change after the new telemedicine payment policies were implemented in March 2020? To what extent did changes in ED utilization rates for Health First Colorado members differ for adults, children, and members with disabilities?
- 2** Did utilization of PC services by Health First Colorado members change after the policy changes related to payments for telemedicine services in March 2020?
 - To what extent did changes in PC utilization rates differ between PC services eligible for reimbursement under the policy changes and other PC services?
 - To what extent did changes in PC utilization rates for Health First Colorado members differ for adults, children, and members with disabilities?
 - To what extent were changes in ED and PC utilization similar for all Health First Colorado members and for adults, children, and members with disabilities?

ED UTILIZATION

Figures 29–32 address the first research question. These figures present the percentage of Health First Colorado members with at least one ED visit in a month for the period from March 2018 through March 2021. To highlight changes in ED utilization, the secondary axis (right hand side) of the graph presents the percentage change in ED utilization compared to the same month in the prior calendar year. Figure 29 presents these trends for all members enrolled in Health First Colorado that were under age 65 and not covered by a managed care plan. Figures 30, 31 and 32 present these trends for the subset of members ages 19 - 64 and not disabled, members 18 years of age or younger in the month and not disabled, and members with a disability of all ages, respectively.

Figure 29: Utilization of ED Services and Same Month Percentage Change from Prior Year: All Members, March 2018 - March 2021

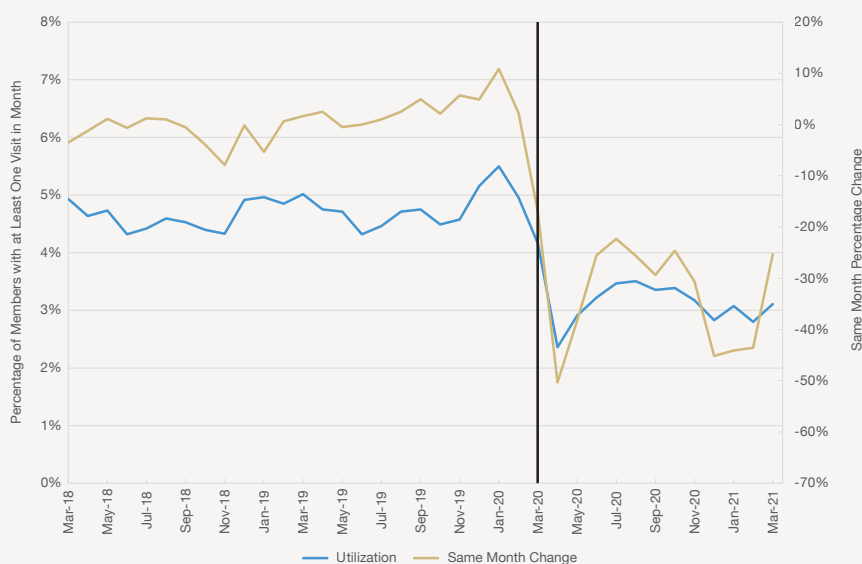


Figure 30: Utilization of ED Services and Same Month Percentage Change from Prior Year: Adults 19 – 64, March 2018 - March 2021

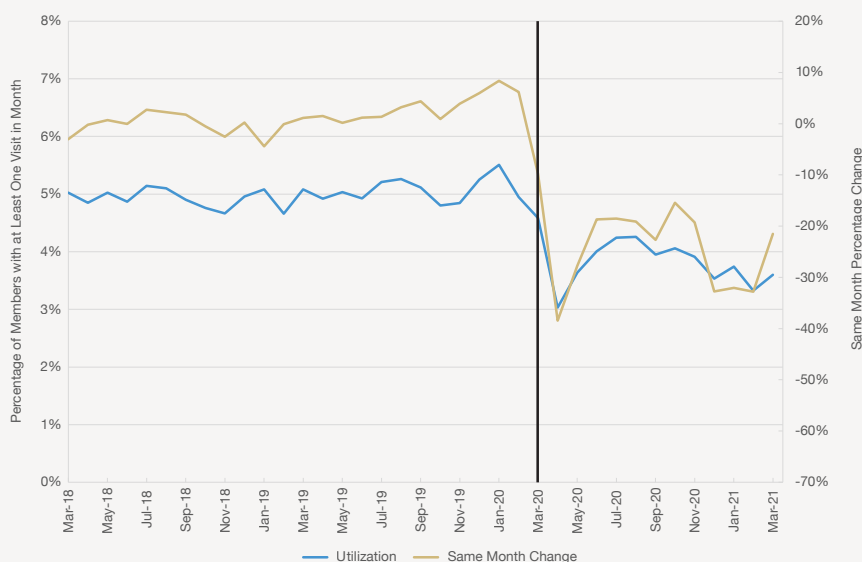


Figure 31: Utilization of ED Services and Same Month Percentage Change from Prior Year: Children 0 - 18, March 2018 - March 2021

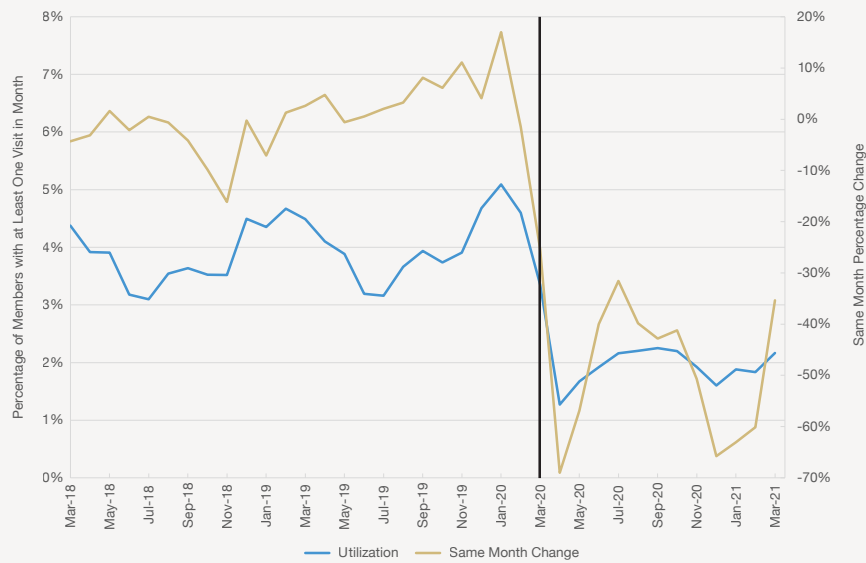
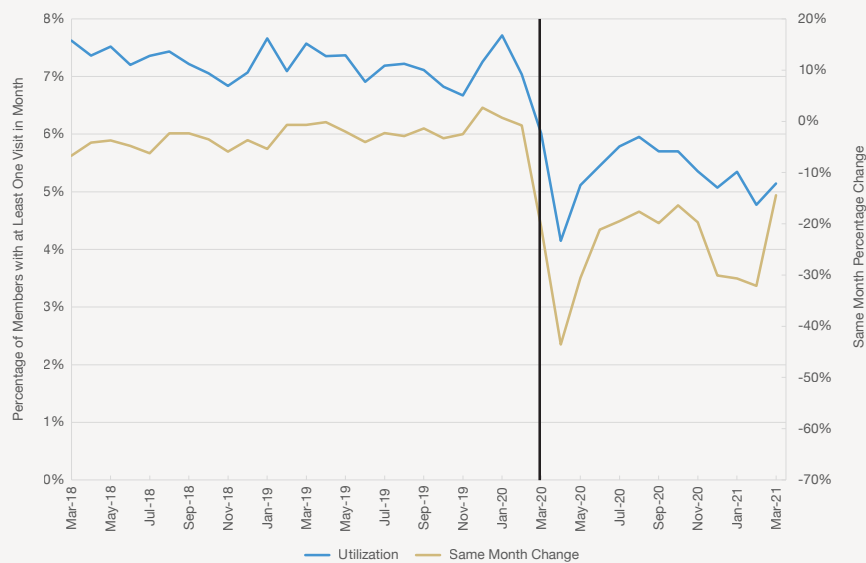


Figure 32: Utilization of ED Services and Same Month Percentage Change from Prior Year: Members with Disabilities, March 2018 - March 2021



In the pre-pandemic period, the results presented in Figures 29–32 show a relatively stable utilization of ED services from March 2018 through August 2019, and beginning in September 2019 through January 2020, ED utilization increased for Health First Colorado members with the exception of members with a disability. Examining the same year percentage change shows an average same month percentage change from September 2019 through January 2020 of approximately 5% for all members and adults, and a 9% increase for children. As shown in Figures 29–31, this same month percentage change peaks in January 2020 with a 10% increase for all members, an 8% increase for adults and a 16% increase for children relative to January 2019. In contrast, the results presented in Figure 32 for members with a disability shows an average same month percentage change from September 2019 through November 2019 of about -3% and an increase of almost 3% in December 2019. This figure also shows that members with a disability utilize ED services at a substantially higher rate during the pre-pandemic period with rates between 7% and 8% compared to rates in the 4% to 5% range in Figures 29–31.

Consistent with the results presented in the recent Department telemedicine report, there was a large decline in utilization of ED services beginning in March 2020 and persisting through March 2021 as shown by the same month percentage change becoming negative in March 2020 and remaining negative through March 2021. Figures 29–31 also show a significant decline in ED utilization corresponding with the winter surge of COVID-19 infections. All Health First Colorado members decreased ED utilization by 50% in April 2020 compared to April 2019 and decreased approximately 45% in December 2020 compared to December 2019. ED utilization was still 25% lower in March 2021 than it had been in March 2020. By age, ED utilization dropped more for children and reversed more for adults following the nadir in April 2020. Of particular note, the seasonal increase in ED utilization for children in November through February declined in the November 2020 through February 2021 period. Throughout the post-pandemic period children's ED utilization was at least 30% lower than it was in the prior year. Though not studied herein, the greater reductions in utilization for children may be a function of reduced exposure to other infectious diseases as many summer camps were cancelled and schools were largely online, a result of increased concern from parents about bringing their children into health care facilities, or some combination of both. Finally, adults and members with disabilities returned the closest to their pre-pandemic ED utilization rates in the summer and fall of 2020 with same month declines approximately 20% below rates for 2019.

PC UTILIZATION

In addressing research question 2 above, which includes a comparison of utilization between in-person and telemedicine, we wanted to ensure the visit types were similar. To this end, we analyzed PC visits that are eligible for payment with a telemedicine modality after the policy changes introduced in March 2020. Telemedicine-eligible PC visits were identified based on a set of HCPCS codes specified by the Department and included those that can be billed either in-person or via telemedicine modalities (audio/video or audio only). These telemedicine eligible visits are referred to as index PC visits. The recently added HCPCS codes for well-child visits were not considered as telemedicine-eligible for this analysis as these codes were not eligible for the full review period (they were added in November 2020).

Most PC visits (90%) are eligible for payment as telemedicine and the time trends in all PC visits and index PC visits were very similar with nearly indistinguishable same month percentage changes during most of this time period. Given these similarities, the results focus on index PC visits. We grouped audio/video and audio only telemedicine services after consulting with Department staff who informed us it is impossible to accurately differentiate the two modalities in the claims data.

Figures 33–36 present the percentage of the same four groups of Health First Colorado members (all, adults, children, and members with disabilities) with at least one index PC visit in a month and the percentage change in this percentage compared to the same month in the prior year. Figures 37–40 show the utilization of index PC visits by modality (in-person and telemedicine) and the same month percentage change for the in-person modality.

Figure 33: Utilization of Index PC Services and Same Month Percentage Change from Prior Year: All Members, March 2018 - March 2021

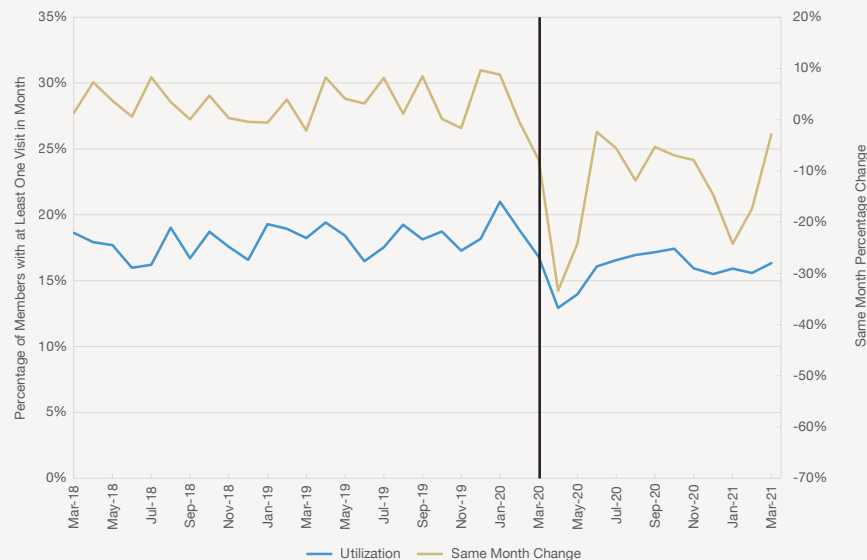


Figure 34: Utilization Index PC Services and Same Month Percentage Change from Prior Year: Adults 19 - 64, March 2018 - March 2021

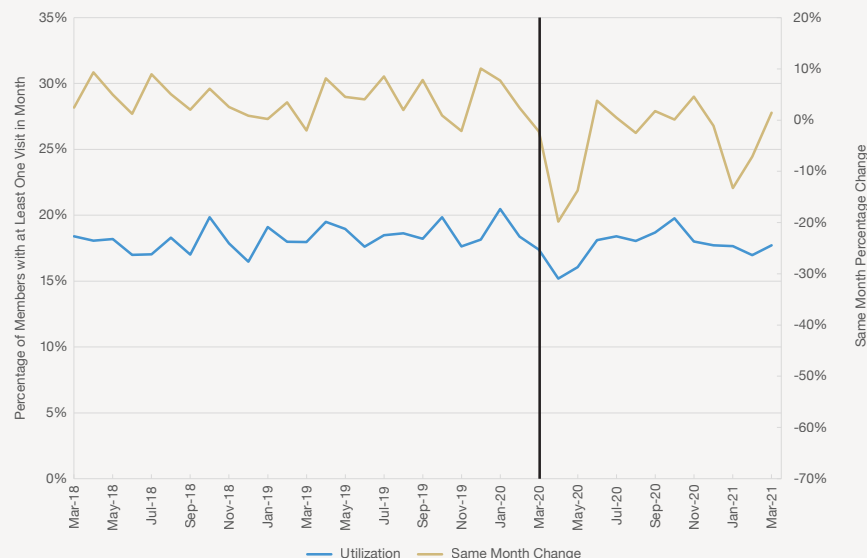


Figure 35: Utilization of Index PC Services and Same Month Percentage Change from Prior Year: Children 0 - 18, March 2018 - March 2021

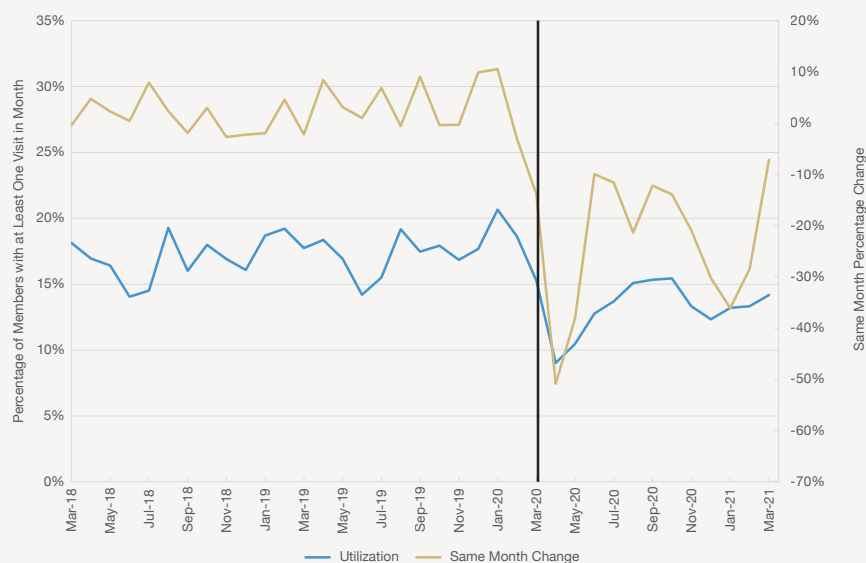


Figure 36: Utilization of Index PC Services and Same Month Percentage Change from Prior Year: Members with Disabilities, March 2018 - March 2021

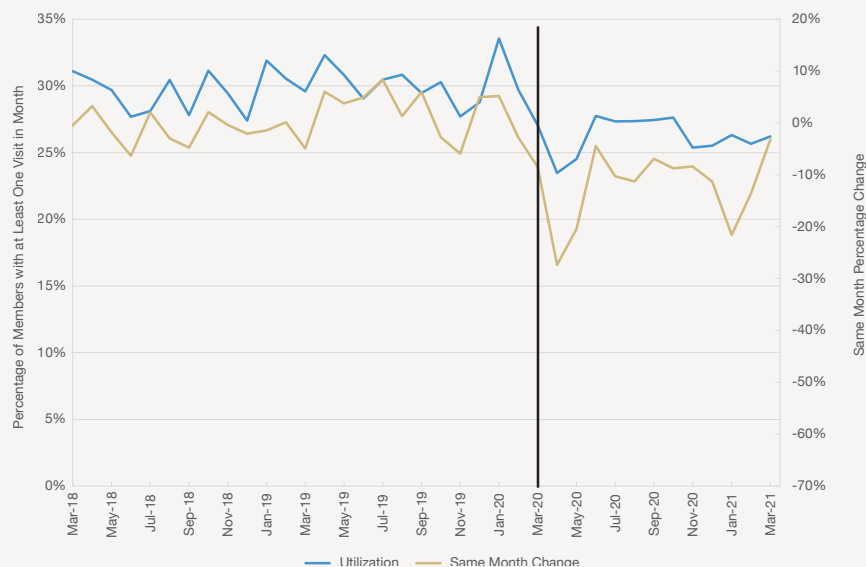


Figure 37: Utilization of Index PC Services and Same Month Percentage Change from Prior Year: All Members by Mode, March 2018 - March 2021

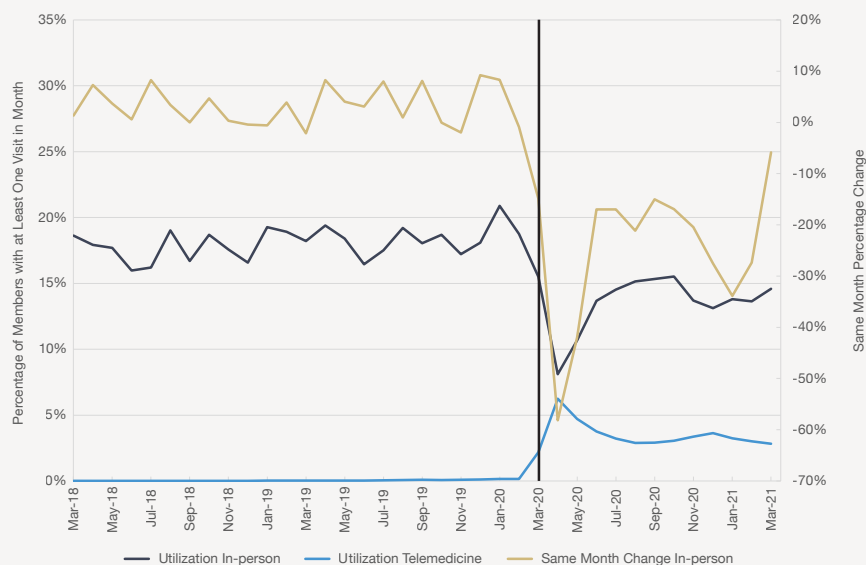


Figure 38: Utilization of Index PC Services and Same Month Percentage Change from Prior Year: Adults 19 - 64 by Mode, March 2018 - March 2021

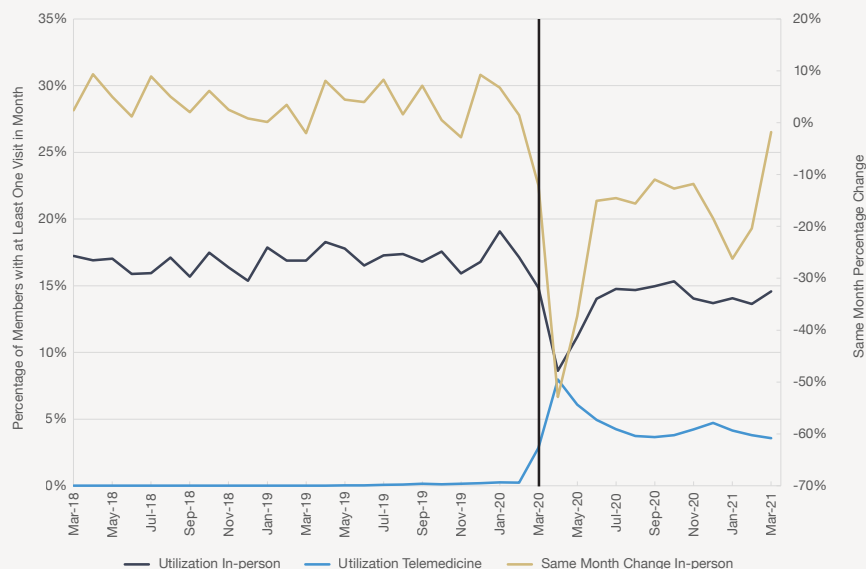


Figure 39: Utilization of Index PC Services and Same Month Percentage Change from Prior Year: Children 0 - 18 by Mode, March 2018 - March 2021

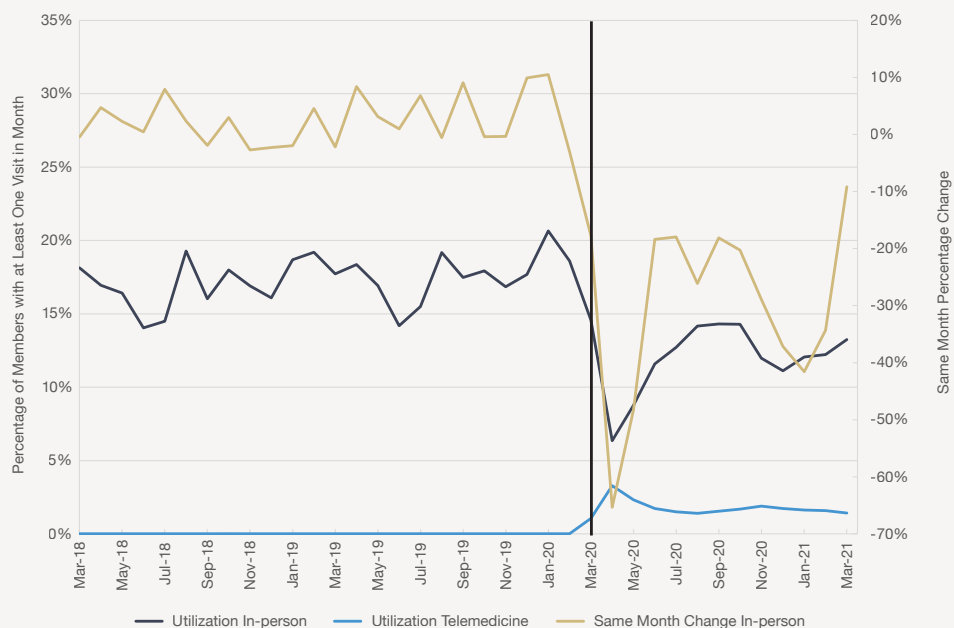
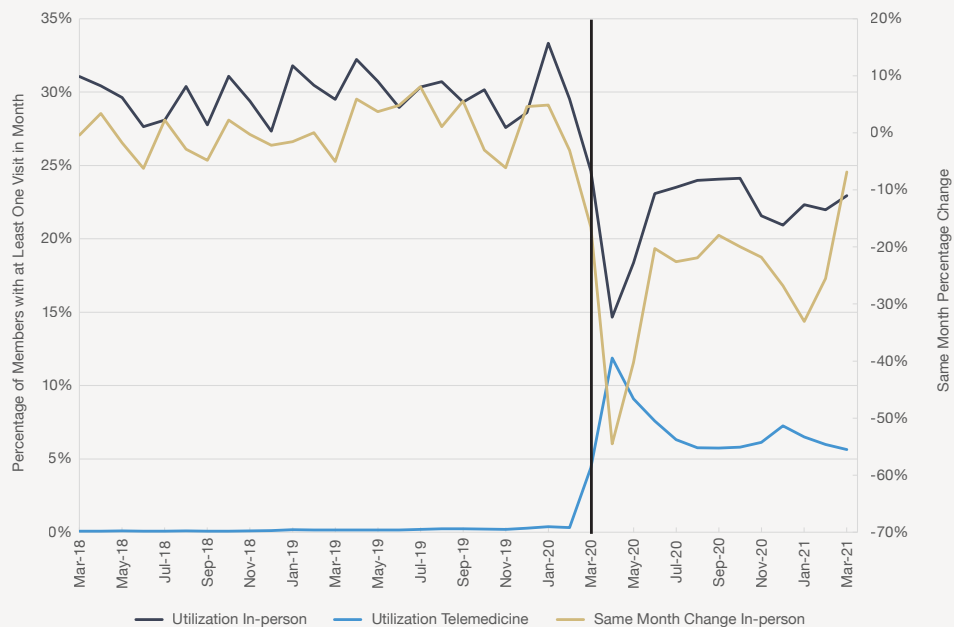


Figure 40: Utilization of Index PC Services and Same Month Percentage Change from Prior Year: Members with Disabilities by Mode, March 2018 - March 2021



While the pre-pandemic trends for ED utilization were relatively stable, the results presented in Figures 33–36 indicate there was a modest increase in utilization of index PC services except for Health First Colorado members with a disability. During the period March 2018 to November 2019, the average same month percentage change was 3% for all members, 4% for adults, 2% for children and essentially zero for members with a disability. However, as was the case for ED utilization, there were substantial same month increases in December 2019 and January 2020 with all members increasing about 9%, adults 5%, children 10% and members with a disability 5%. These temporary increases turned around very quickly as utilization of index PC visits dropped sharply from February through May 2020 at the beginning of the COVID-19 pandemic. As shown in Figures 33–36, the same month percentage changes in April 2020 were -33% for all members, -20% for adults, -51% for children and -27% for members with a disability. Utilization of index PC services turned around quickly and by June 2020 the same month percentage change from the prior year was actually higher for adults (4% increase) and still below June 2019 for all members (-2%), children (-10%) and members with a disability (-5%). However, as the COVID-19 surge in the fall of 2020 emerged utilization of index PC services dropped sharply again and by February 2021 was 7% (adults) to 28% (children) below their levels in February 2019. The greater reductions in utilization of index PC services for children was likely due to the same factors discussed above regarding their greater reduction in ED utilization (online schools reducing exposure to infectious diseases and parental concerns about exposure to COVID-19 in health care facilities).

Figures 37–40 present the utilization rates for index PC services by in-person and telemedicine modalities, along with the same month percentage change for in-person visits. The same month percentage change for telemedicine visits was not calculated because of the very low utilization of this modality prior to March 2020.

The findings presented in these figures show that the decline in index PC utilization would have been even steeper without the use of telemedicine visits. The utilization rate for telemedicine visits peaked in the same month (April 2020) as the nadir of in-person utilization. Comparing the same month percentage change for in-person utilization in these figures to the rates in the corresponding Figures 33–36 for April 2020 illustrates the impact of telemedicine on utilization rates. For example, the same month percentage change in April 2020 for all Health First Colorado members was -58% for in-person index PC visits in Figure 37 compared to -33% for all index PC visits in Figure 33. The same comparisons for adults were -53% compared to -20%, for children were -65% compared to -51%, and for members with disabilities were -55% compared to -27%. These figures also illustrate the relationship between utilization of telemedicine index PC services and the surges in COVID-19 cases.

Figures 37–40 also reveal substantial differences in the utilization of telemedicine for index PC services across the three sub-groups of Health First Colorado members. Adult members 19–64 utilized telemedicine index PC services at a rate of almost 8% in April 2020 compared to children that utilized these services at just over 3% in the same month. Members with disabilities utilized telemedicine index PC services at the highest rates at almost 12% in April 2020. During the first post-pandemic year (April 2020 through March 2021), adults, on average, utilized telemedicine for index PC services at a rate of almost 3 percentage points higher than children. Similarly, during the first post-pandemic year members with disabilities utilized telemedicine for these services at a rate 2 percentage points higher than adults age 19–64. The differential use of telemedicine services by children for PC services may be attributed to the lack of coverage for well child checks until November 2020. Notably, the Department’s recent evaluation reported that children (especially those under age nine) had higher usage of telemedicine overall – this was largely for therapeutic services with speech therapy comprising most visits.¹ Additional analyses of the role telemedicine plays in

children's access to PC services should be conducted as data that include well child checkups as telemedicine reimbursable services become available.

Another significant question that will only be answered as the COVID-19 public health emergency ends is whether the lower rates of utilization of ED and PC services continue. To the extent the experiences of Health First Colorado members during the pandemic has clarified conditions that can be treated as effectively in PC or urgent care setting instead of EDs, lower utilization of ED services could have a notable budgetary impact for the Department. Alternatively, lower utilization of PC services could result in additional health complications in subsequent years that could increase expenditures for all categories of health care requiring increases in the Department's budget. It will be important to analyze trends in utilization of health care services and the consequences of these trends on members' health and total cost of care as the pandemic ends.

Primary Diagnoses of Emergency Department and Primary Care Visits

To contribute to the evidence base needed to develop and refine telemedicine policies involving the long-term changes in utilization of ED and PC services, this section examines patterns in the primary diagnoses of ED services and index PC services from January 2018 through December 2020. FFS Health First Colorado claims for these services were used to identify the most prevalent diagnoses using the Clinical Classification Software (CCS) for the International Classification of Diseases, 10th Revision, Clinical Modification/Procedure Coding System (ICD-10-CM/PCS) developed and maintained by the Agency for Healthcare Research and Quality in the U.S. Department of Health and Human Services. This version of the CCS categorizes diagnoses into 224 mutually exclusive categories; we used these 224 categories to identify the most prevalent diagnoses. Because there can be substantial monthly variation, we identified the 10 most prevalent diagnoses in each calendar quarter and reported any diagnoses that appear in two or more calendar year quarters during the three-year period. The analysis examines the incidence of CCS categories for ED and index PC visits and addresses the following research questions:

- 1 To what extent did the most prevalent conditions/diagnoses of ED visits change over time?
- 2 To what extent did the most prevalent conditions/diagnoses of index PC visits change over time? Do the patterns in the most prevalent conditions/diagnoses for index PC visits differ by visit modality?

The analysis addresses these two questions for all Health First Colorado members as well as the three sub-groups: adults aged 19-64 years, children aged 18 years and younger, and members with a disability. These figures (Figure 41 – 65) use a heat map format with darker shades indicating a higher rate and lighter shades indicating lower rates.

PRIMARY DIAGNOSES OF EMERGENCY DEPARTMENT VISITS

Figures 41-44 present the most prevalent CCS categories for Emergency Department visits by calendar year quarter.

Figure 41: Top CCS Categories for Emergency Department Visits: All Members, January 2018 - December 2020

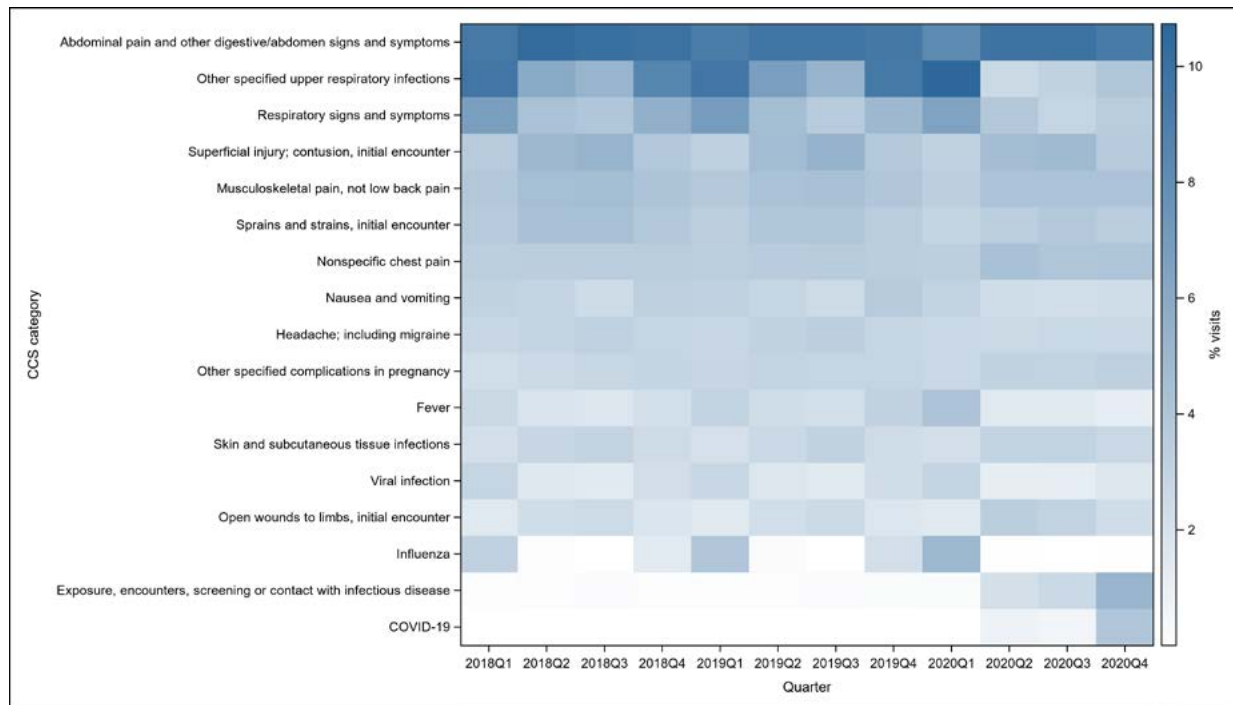


Figure 42: Top CCS Categories for Emergency Department Visits: Adults 19-64, January 2018-December 2020

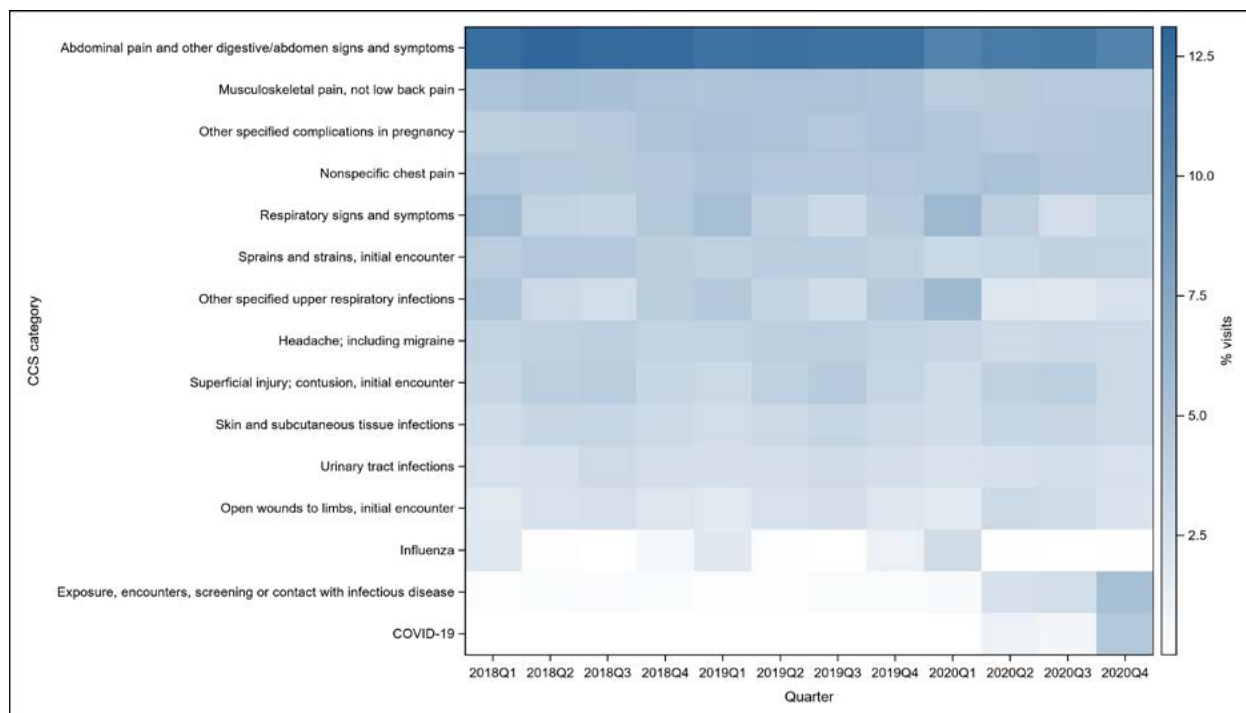


Figure 43: Top CCS Categories for Emergency Department Visits: Children 0-18, January 2018-December 2020

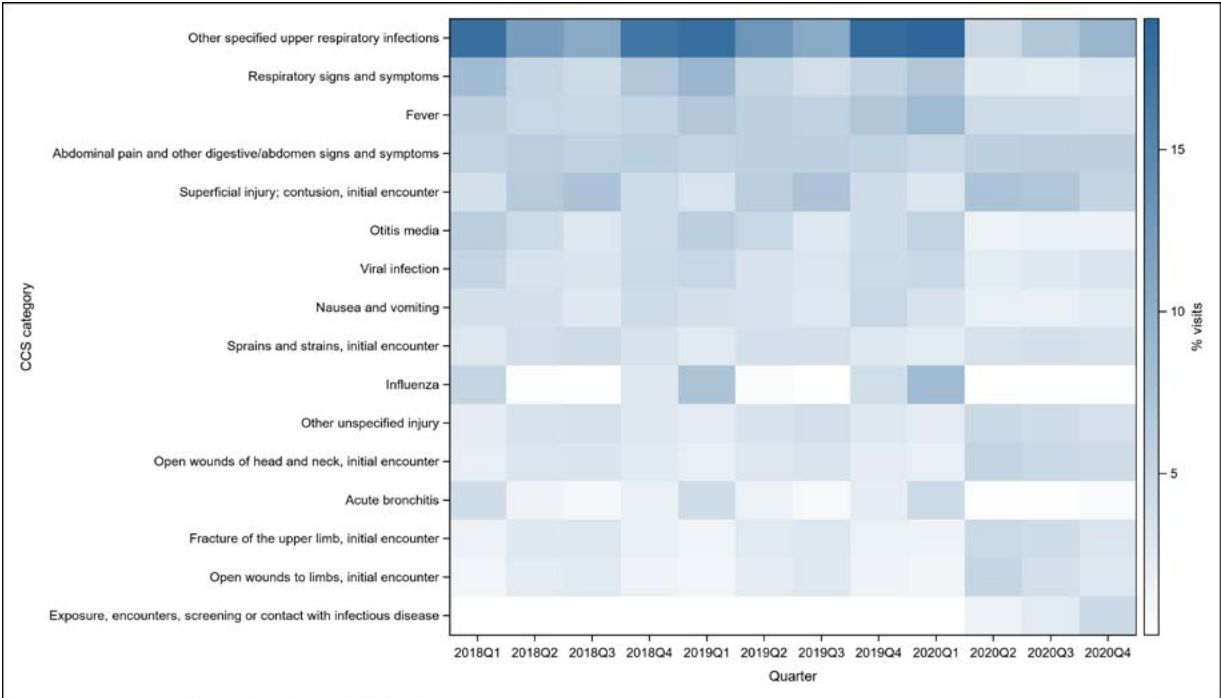
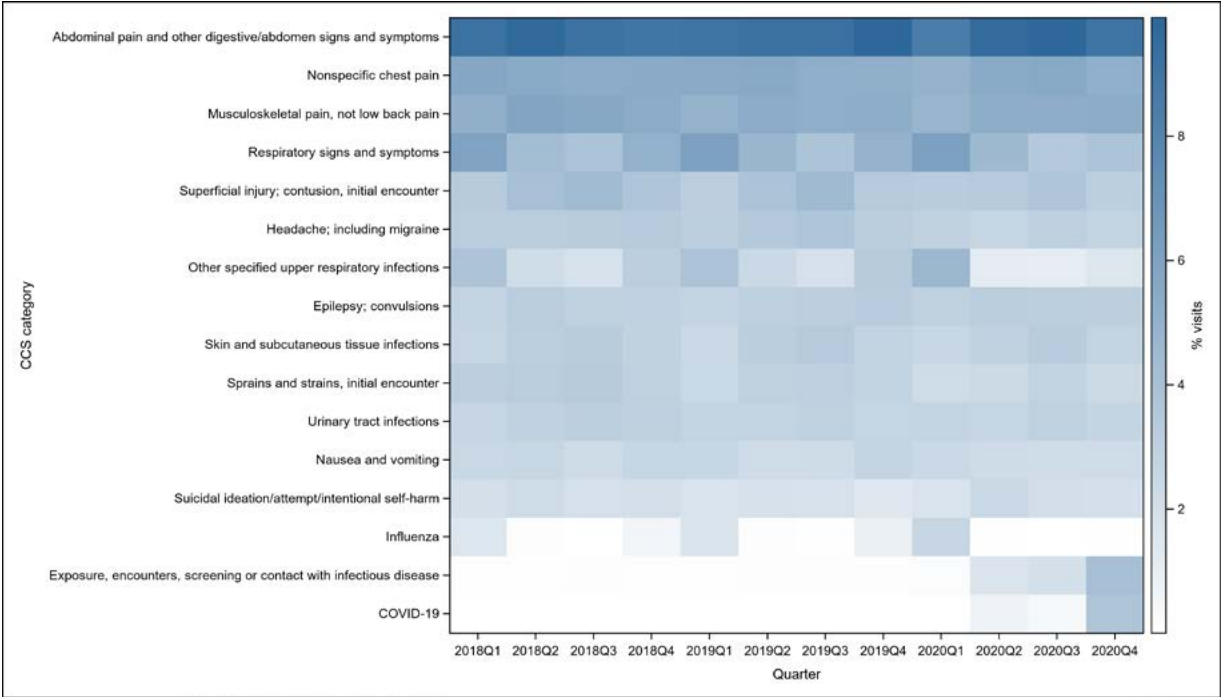


Figure 44: Top CCS Categories for Emergency Department Visits: Members with Disabilities, January 2018-December 2020



Overall, for all groups of Health First Colorado members, there was a higher percentage of visits for exposure/encounter with infectious diseases and the emergence of visits for COVID-19 starting in March 2020 (2020Q2) and increasing substantially in the last quarter of 2020 (Q4), which corresponds to the surge in COVID-19 cases in November and December 2020. Abdominal pain remained a relatively frequent diagnosis for both adults and members with disabilities. The rates of influenza and other respiratory infections were much lower for both adults and children, as well as members with disabilities; acute bronchitis, otitis media, and other respiratory symptoms also represent smaller percentages of visits for children after March 2020. Corresponding to the reduction in visits for influenza and other infections among children, after March 2020 there was an increase in the percentage of ED visits related to injuries. It is important to note that these represent percentages of the total visits. Because the total number of ED visits has declined it is possible that what appears to be an increase may not be an actual increase in actual incidence per 1,000 members.

PRIMARY DIAGNOSES OF INDEX PRIMARY CARE VISITS

Figures 45–48 present the most prevalent CCS categories for index PC visits using the same heat map format and with the cohorts presented in the same order.

Figure 45: Top CCS Categories for All Index PC: All Members, January 2018 - December 2020

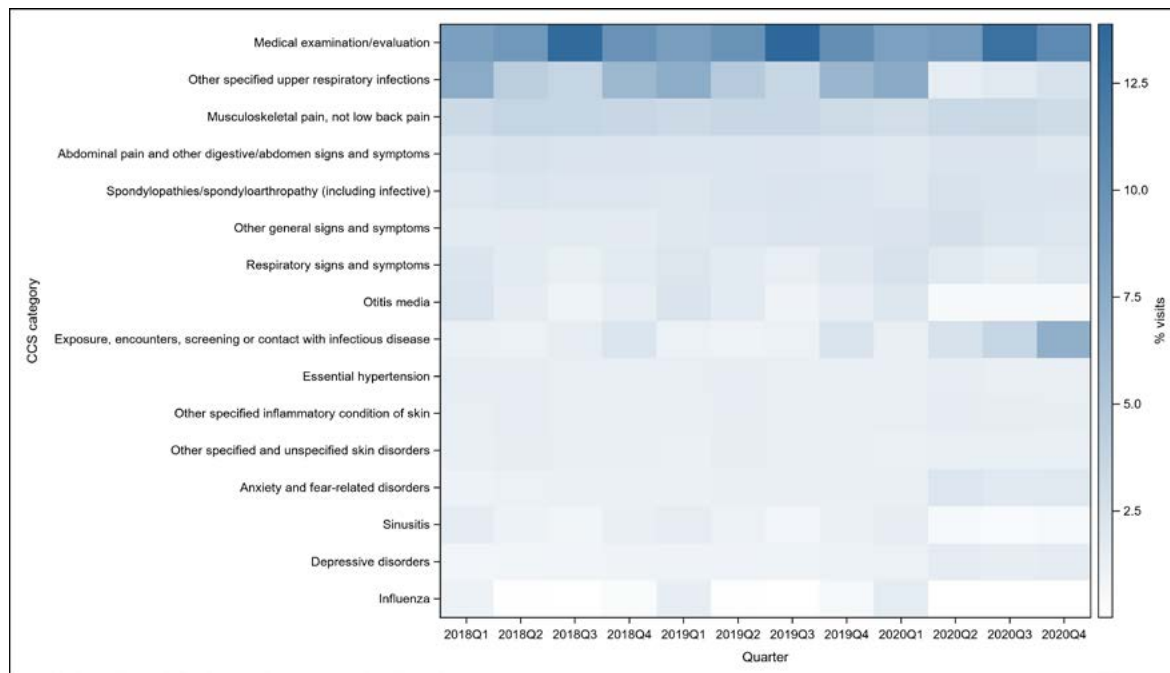


Figure 46: Top CCS Categories for All Index PC: Adults 19-64, January 2018 - December 2020

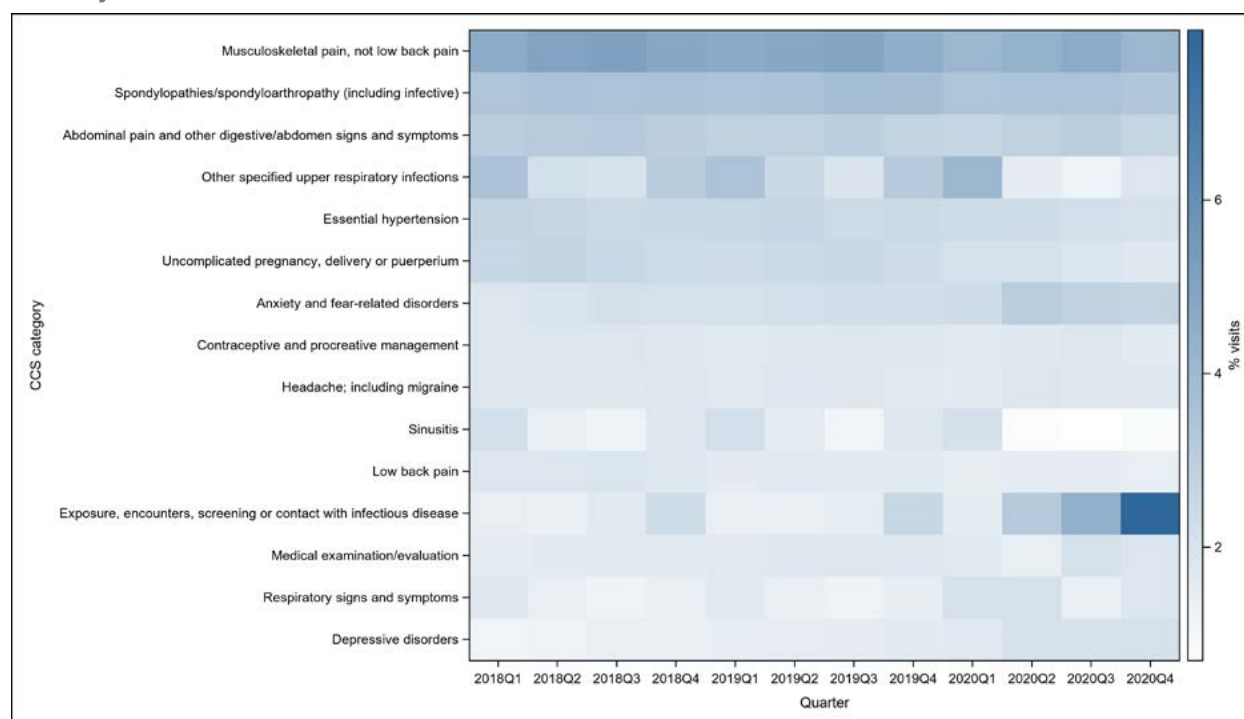


Figure 47: Top CCS Categories for All Index PC: Children 0 - 18, January 2018 - December 2020

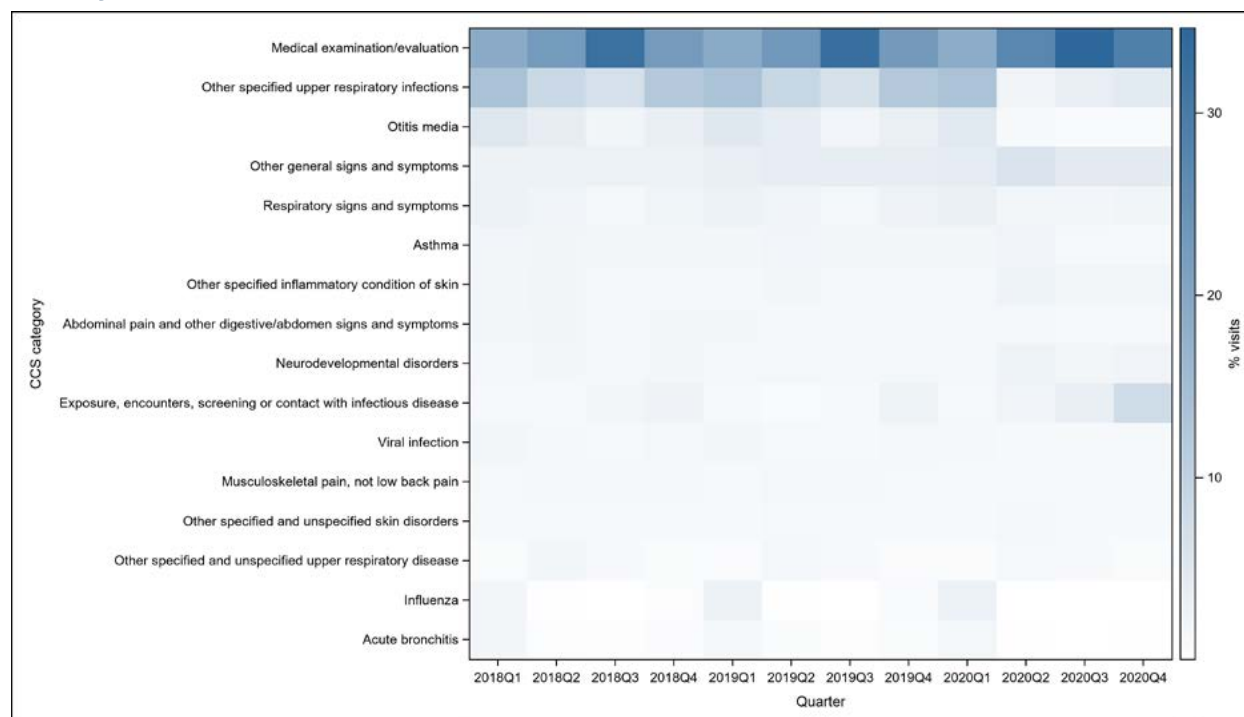
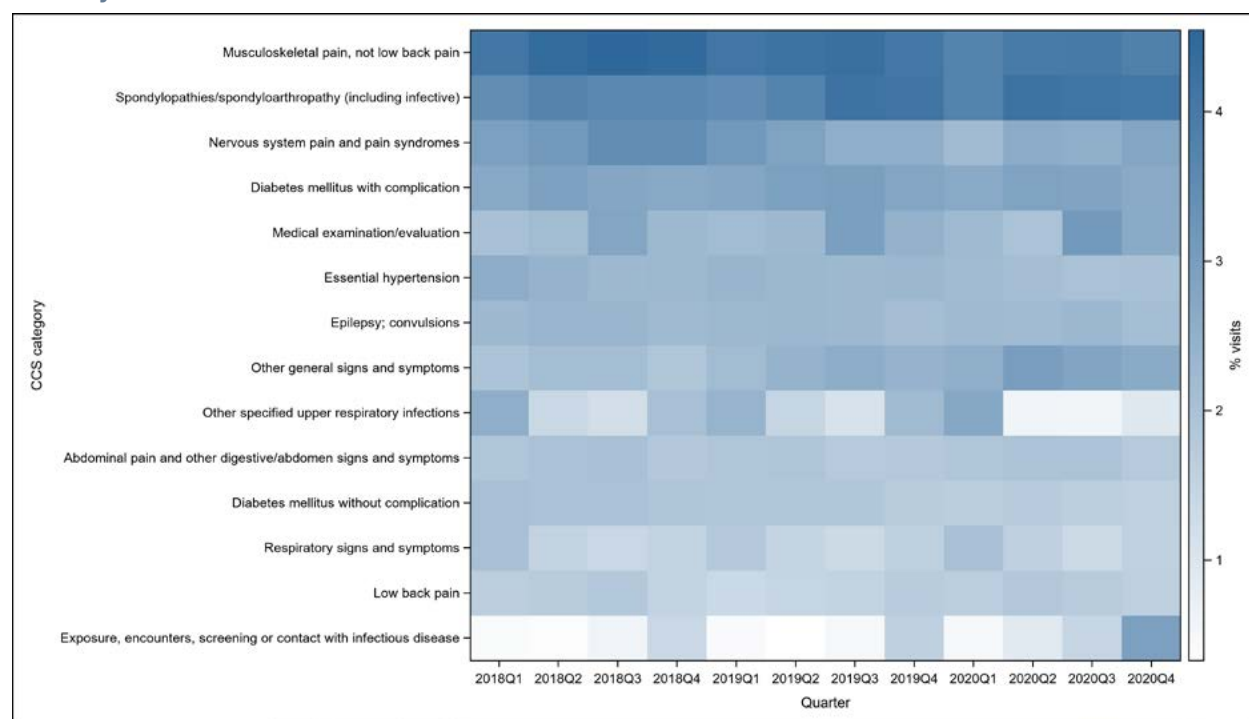


Figure 48: Top CCS Categories for All Index PC: Members with Disabilities, January 2018 - December 2020



The top CCS categories for index PC visits presented in these figures are consistent with the findings for ED visits. As with ED visits, the percentage of index PC visits for exposure/encounter with infectious diseases increased. Similarly, there were proportionally fewer visits for infections although the specific infections differ by sub-group (e.g., sinusitis, influenza, upper respiratory infections, otitis media). As shown in Figure 46, for adults there was also an increase in the prevalence of anxiety and depressive related disorders and to a lesser extent headache beginning in the second quarter of 2020 through the following two quarters of 2020. The findings in Figures 47 and 48 do not display any other distinct patterns or changes for children and members with a disability.

Figures 49–56 present the most prevalent CCS categories for in-person index PC visits (49–52) and telemedicine index PC visits (53–56). The results for the telemedicine modality before the second quarter of 2020 (2020Q2) should be interpreted in the context that there were relatively very few telemedicine visits during the pre-pandemic period.

Figure 49: Top CCS Categories for In-person Index PC: All Members, January 2018 - December 2020

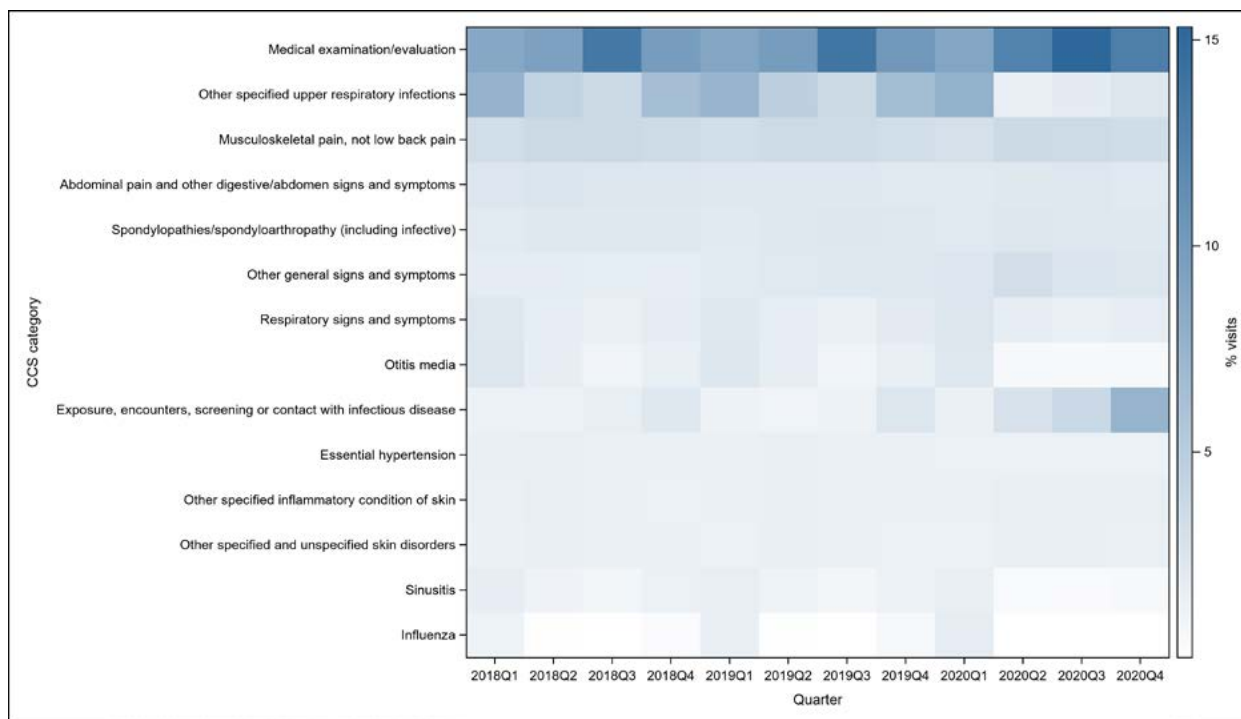


Figure 50: Top CCS Categories for In-person Index PC: Adults 19-64, January 2018 - December 2020

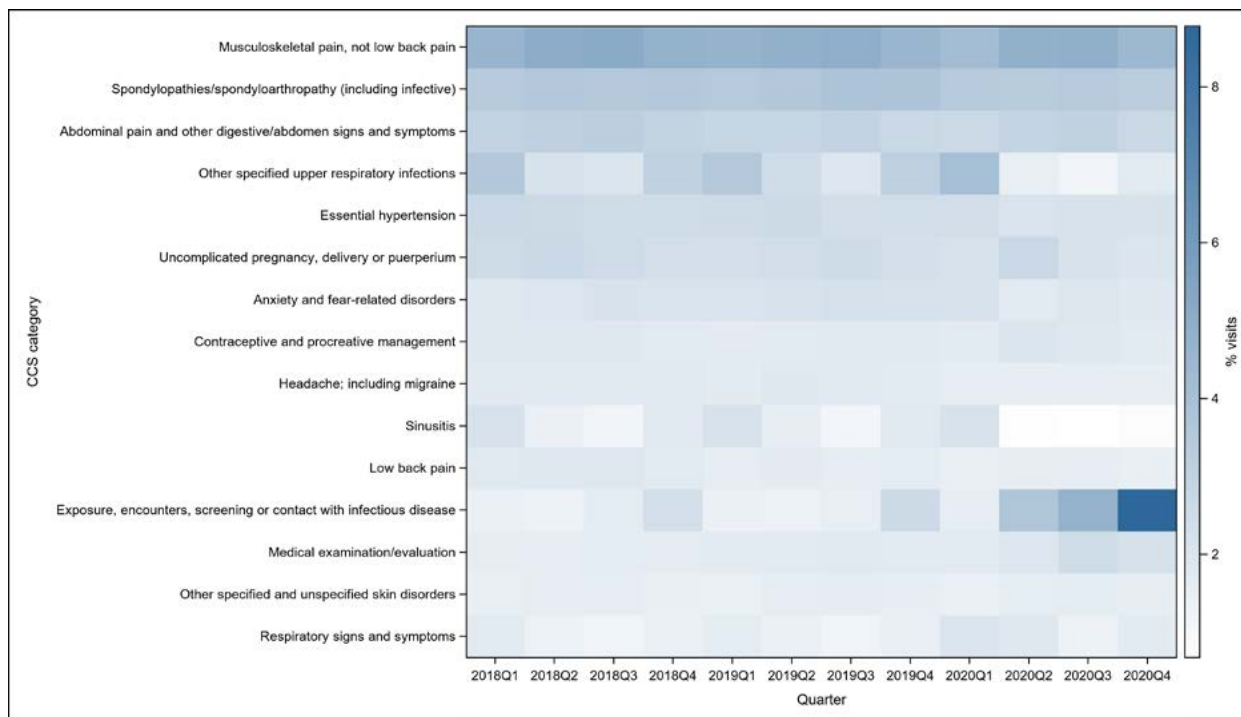


Figure 51: Top CCS Categories for In-person Index PC: Children 0 - 18, January 2018 - December 2020

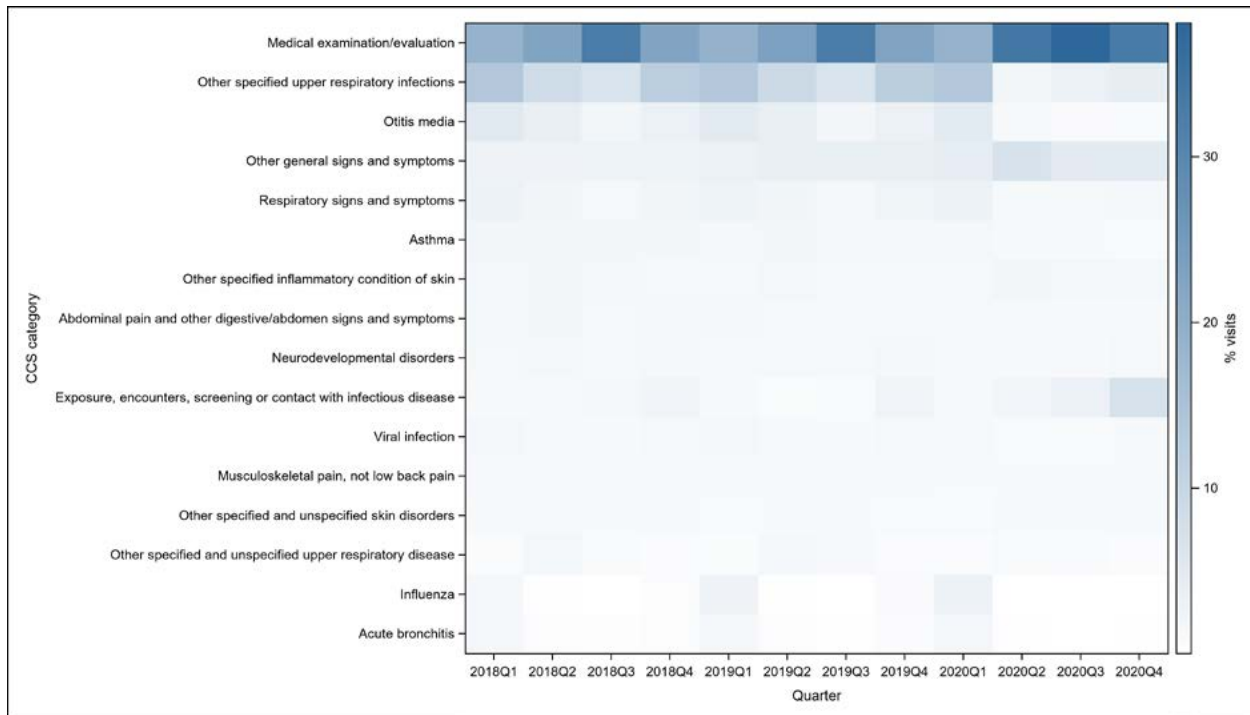


Figure 52: Top CCS Categories for In-person Index PC: Members with Disabilities, January 2018 - December 2020

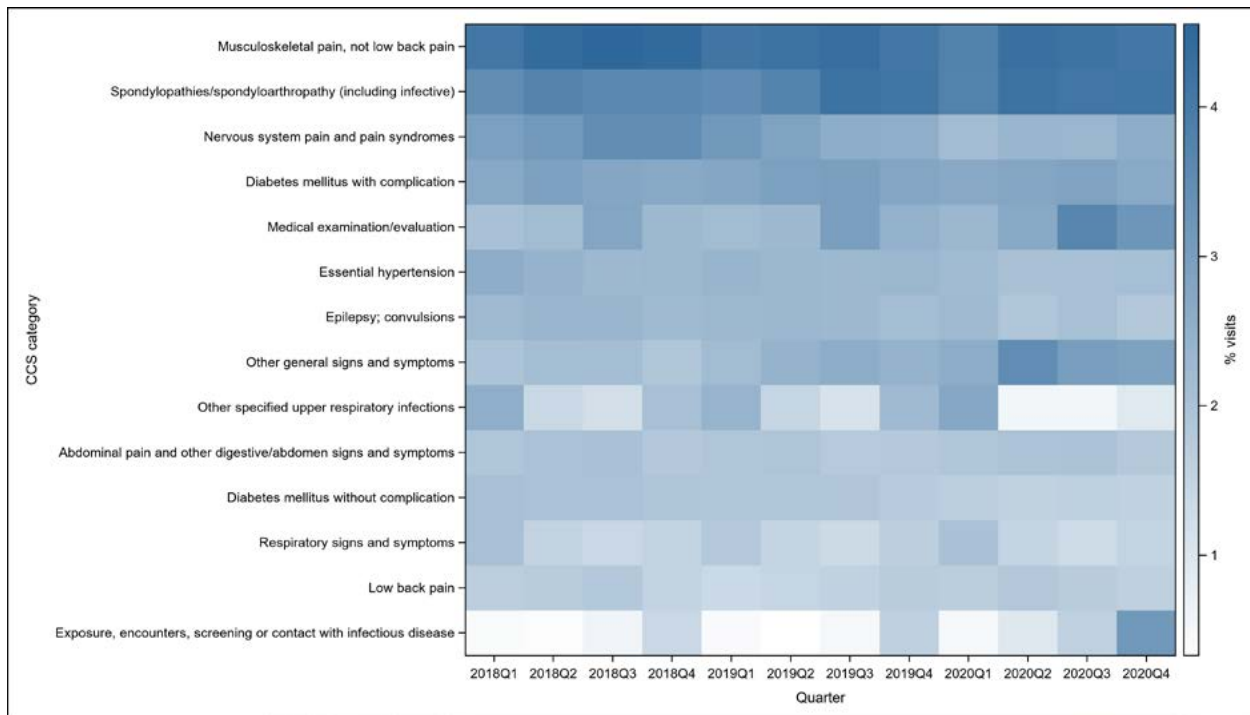


Figure 53: Top CCS Categories for Telemedicine Index PC: All Members, January 2018 - December 2020

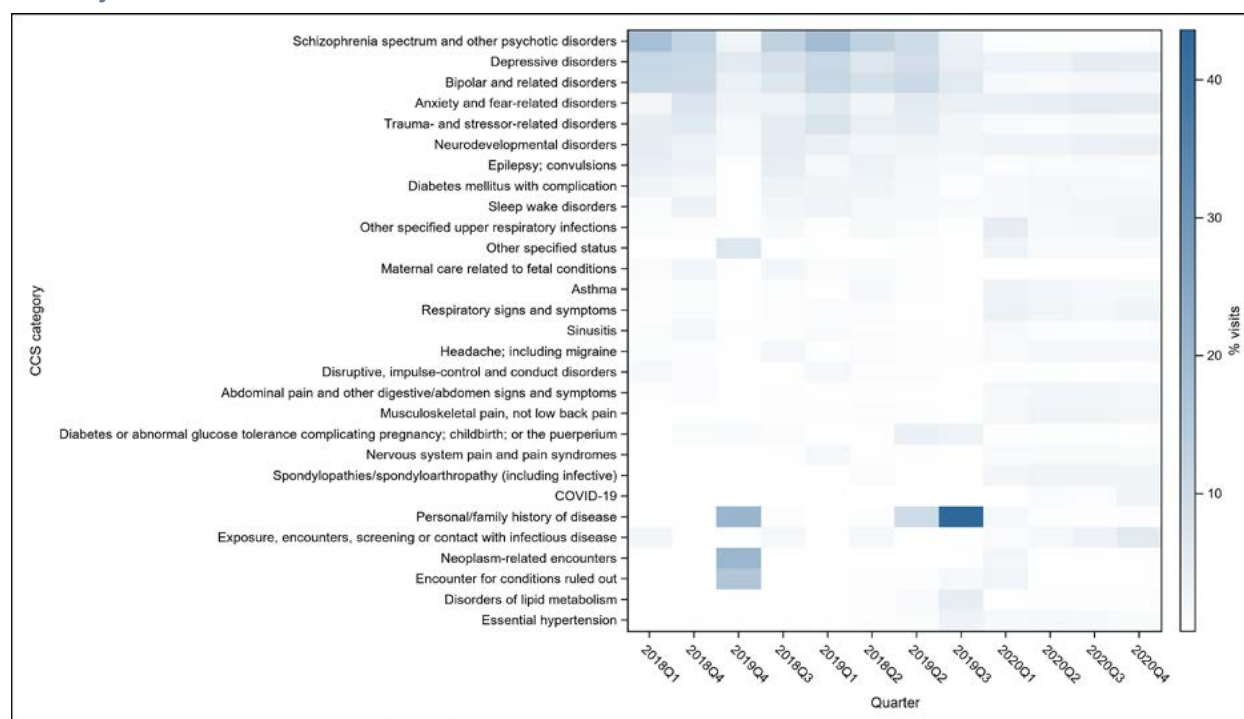
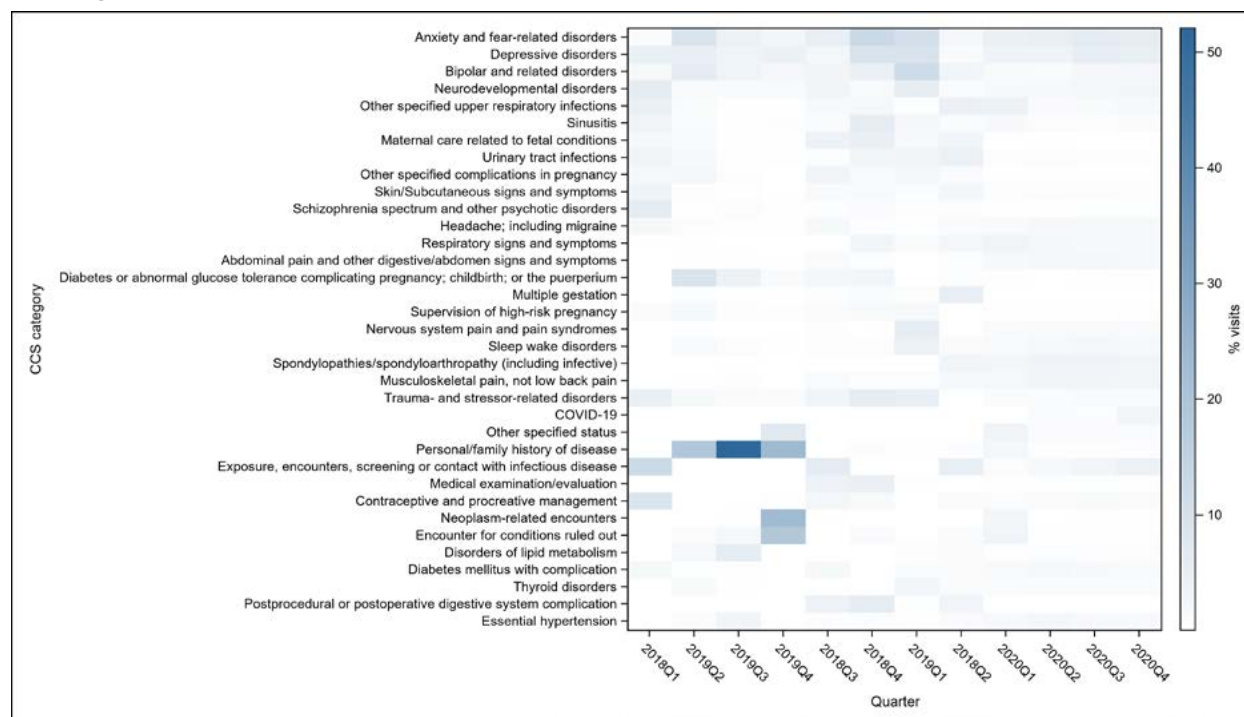


Figure 54: Top CCS Categories for Telemedicine Index PC: Adults 19-64, January 2018 - December 2020



Heatmap illustrating the percentage of visits for various CCS categories across quarters from 2019Q4 to 2020Q4. The y-axis lists the CCS categories, and the x-axis shows the quarters. The color scale on the right indicates the percentage of visits, ranging from 0% (lightest blue) to 15% (darkest blue).

CCS categories (Y-axis):

- Epilepsy; convulsions
- Diabetes mellitus with complication
- Neurodevelopmental disorders
- Sleep wake disorders
- Asthma
- Other general signs and symptoms
- Other specified status
- Respiratory signs and symptoms
- Abdominal pain and other digestive/abdomen signs and symptoms
- Fever
- Other specified and unspecified skin disorders
- Other specified inflammatory condition of skin
- Other specified and unspecified upper respiratory disease
- Other specified upper respiratory infections
- Influenza
- Other specified complications in pregnancy
- Maternal care related to fetal conditions
- Headache; including migraine
- Trauma- and stressor-related disorders
- Anxiety and fear-related disorders
- Depressive disorders
- Other specified and unspecified congenital anomalies
- Cardiac and circulatory congenital anomalies
- COVID-19
- Viral infection
- Personal/family history of disease
- Exposure, encounters, screening or contact with infectious disease
- Medical examination/evaluation
- Contraceptive and procreative management
- Neoplasm-related encounters
- Encounter for conditions ruled out
- Cystic fibrosis
- Obesity
- Other specified and unspecified gastrointestinal disorders

Quarters (X-axis): 2019Q4, 2018Q3, 2019Q2, 2019Q1, 2019Q3, 2018Q1, 2018Q2, 2018Q4, 2020Q3, 2020Q1, 2020Q2, 2020Q4

Color scale (% visits): 0, 5, 10, 15

A heatmap visualization showing the percentage of visits across various CCS categories over time, from 2018Q1 to 2020Q4. The y-axis lists 26 CCS categories, and the x-axis shows quarters. A color scale on the right indicates the percentage of visits, ranging from approximately 5% (lightest blue) to 30% (darkest blue). The highest percentages are observed for 'Schizophrenia spectrum and other psychotic disorders' and 'Bipolar and related disorders' in the early 2019 period.

CCS category	2018Q1	2018Q3	2018Q4	2019Q1	2018Q2	2019Q4	2019Q2	2019Q3	2020Q1	2020Q2	2020Q3	2020Q4
Schizophrenia spectrum and other psychotic disorders	28	27	26	29	27	26	25	27	20	20	20	20
Bipolar and related disorders	25	24	23	26	24	23	22	24	18	18	18	18
Depressive disorders	22	21	20	23	21	20	19	21	15	15	15	15
Trauma- and stressor-related disorders	18	17	16	19	17	16	15	17	12	12	12	12
Anxiety and fear-related disorders	15	14	13	16	14	13	12	14	10	10	10	10
Neurodevelopmental disorders	12	11	10	13	11	10	9	11	8	8	8	8
Epilepsy; convulsions	10	9	8	11	9	8	7	9	6	6	6	6
Disruptive, impulse-control and conduct disorders	8	7	6	9	7	6	5	7	4	4	4	4
Sleep wake disorders	7	6	5	8	6	5	4	6	3	3	3	3
Respiratory signs and symptoms	6	5	4	7	5	4	3	5	2	2	2	2
Nervous system signs and symptoms	5	4	3	6	4	3	2	4	1	1	1	1
Nervous system pain and pain syndromes	4	3	2	5	3	2	1	3	0	0	0	0
Headache; including migraine	3	2	1	4	2	1	0	2	0	0	0	0
Multiple sclerosis	2	1	0	3	1	0	0	1	0	0	0	0
Spondylopathies/spondyloarthropathy (including infective)	1	0	0	2	0	0	0	1	0	0	0	0
Musculoskeletal pain, not low back pain	1	0	0	2	0	0	0	1	0	0	0	0
Miscellaneous mental and behavioral disorders/conditions	1	0	0	2	0	0	0	1	0	0	0	0
Personality disorders	1	0	0	2	0	0	0	1	0	0	0	0
Other specified and unspecified mood disorders	1	0	0	2	0	0	0	1	0	0	0	0
Urinary tract infections	1	0	0	2	0	0	0	1	0	0	0	0
Other specified status	1	0	0	2	0	0	0	1	0	0	0	0
Personal/family history of disease	1	0	0	2	0	0	0	1	0	0	0	0
Neoplasm-related encounters	1	0	0	2	0	0	0	1	0	0	0	0
Encounter for conditions ruled out	1	0	0	2	0	0	0	1	0	0	0	0
Disorders of lipid metabolism	1	0	0	2	0	0	0	1	0	0	0	0
Diabetes mellitus with complication	1	0	0	2	0	0	0	1	0	0	0	0
Essential hypertension	1	0	0	2	0	0	0	1	0	0	0	0

The top diagnoses for the in-person index PC visits track with those for all index PC visits as most of these visits were in-person, particularly in the pre-pandemic period. For telemedicine index PC visits (Figures 53–56), there were twice as many CCS categories from the pre-pandemic and post-period as there were for in-person index PC visits. However, as noted above, some caution should be applied in comparing diagnoses pre- and post-pandemic for this modality because there were so few telemedicine visits prior to the pandemic.

The results in Figures 53–56 show that in the pre-pandemic period, psychological diagnoses and chronic diseases were among the most prevalent conditions addressed in telemedicine index PC visits. While categories of psychological and neurological diagnoses continued to be addressed by telemedicine visits in the post-period, additional CCS categories among the most frequent diagnoses included many of the most prevalent categories for in-person index visits. For example, among adults, other common diagnoses in telemedicine visits included exposure to infectious disease, spondylopathies (back pain), headaches, respiratory signs and symptoms, and abdominal pain. In children, other common diagnoses included neurodevelopmental disorders, upper respiratory infections, and respiratory signs and symptoms. In members with disabilities, other common diagnoses included spondylopathies, pain syndromes, sleep wake disorders, neurodevelopmental disorders, and epilepsy. The increase in prevalence of upper respiratory infections paralleled the proportional decrease in in-person visits for these conditions. There was also a proportional decrease in in-person visits for depression in adults corresponding to the proportional increase in telemedicine visits for depression. These patterns suggest that telemedicine index PC visits were being used more frequently in place of in-person visits for these CCS categories while continuing to be used to address pre-pandemic diagnoses.

The findings of our analysis are consistent with the literature. An analysis by the Colorado Health Institute using data from the Colorado Health Observation Regional Data Service (CHORDS; representing 14 health care provider organizations on the Front Range) similarly reported high use of telemedicine for mental health conditions; in their examined period of March 15 to July 4, 2020, more than 50% of visits for anxiety and depression were conducted via telemedicine. There was a proportionally larger decrease in in-person visits for anxiety and depression compared to the overall decrease in combined in-person and telemedicine visits, suggesting telemedicine replaced many in-person visits for these diagnoses.¹³ Similar high percentages of telemedicine visits for mental health conditions have also been reported for Medicare Advantage and commercially insured patients nationally.¹⁴ Large decreases in in-person visits for upper respiratory infections, bronchitis and sinusitis have also been observed in national Medicare Advantage and commercial insurance claims data, though notably a substantial percentage of these visits from the pre-pandemic years were conducted via telemedicine (37.9 - 43.9% of visits for these conditions).¹⁴ This could reflect lower transmission rates of non-COVID-19 respiratory infections because of social distancing and masking as well as health care organization policies preferentially scheduling possible respiratory conditions as telemedicine visits to decrease in-person exposures.

Effectiveness of Telemedicine Relative to In-Person Primary Care Visits

While there is some evidence from prior studies as well as the insights of providers and patients on which conditions are most appropriate for telemedicine visits, there is an insufficient evidence base to inform ongoing telemedicine policies. Systematic reviews of telemedicine delivery modes relative to in-person visits found the greatest benefit for provider-patient interactions dealing with the management of chronic conditions (including diabetes and cardiovascular disease) and treatment of behavioral health conditions.¹² Primary care providers suggest telemedicine is particularly well-suited for review of results, medication initiation for chronic conditions, behavioral health, and, if patients are able to measure their blood pressure and blood sugar, chronic management of hypertension and diabetes.^{7,8} One analysis suggested that 69% of primary care services required the physical presence of a health care provider, with particular in-person need for wellness visits.¹⁵ A diverse group of patients interviewed in Colorado shared that telemedicine seems to be a good substitute for medication management, prescription refills, follow-up appointments, check-ins with their provider, disease maintenance, and mental health services.⁶ A common theme of the existing literature is that more evidence is needed regarding the effectiveness and cost of telemedicine relative to in-person health care visits.

To begin to fill this evidence gap, we assessed the effectiveness of a telemedicine index PC visit by comparing the likelihood a telemedicine visit is followed by another PC or ED visit to the likelihood of these patient outcomes following an in-person visit for up to 60 days after an index PC visit. If telemedicine visits were not as effective in addressing the reasons for the PC appointment, the likelihood of a subsequent PC or ED visit would increase relative to the likelihood of these outcomes following an in-person visit.

We used two statistical methods for this analysis. These methods are commonly referred to as time-to-first-event analysis, survival analysis, or failure time analysis for competing events because once one of these events occurs the other one is no longer possible as the first event. The first method is a cumulative incidence analysis for competing events that estimates the probability that an ED visit or a PC visit has occurred on or prior to each day after an index PC visit. In this analysis, we examined the cumulative incidence for each of the competing events up to 60 days after an index PC visit. The second analysis used a multivariable Cox proportional hazards model that accounts for patient characteristics and other potentially confounding factors that may determine the likelihood of either an ED or PC visit occurring following an index PC visit. This analysis accounted for patient age at the index visit, race/ethnicity, health status/medical complexity, and residence in an urban, suburban or rural location. The Cox proportional hazards model estimation accounted for repeated measures for an individual using a robust variance calculation.

Both analyses distinguish the modality of the index PC visit (in-person or telemedicine) and separate analyses were conducted for all Health First Colorado members, adults aged 19–64 years, children aged 18 years and younger, and members with a disability. Each analysis examined three periods: (1) pre-pandemic period from March 1, 2018 to February 29, 2020; (2) post COVID-19 public health emergency period 1 from March 15, 2020 to June 30, 2020; and (3) post COVID-19 public health emergency period 2 from July 1, 2020 to November 30, 2020. We differentiated the post-period into two because the early months had multiple confounding factors such as stay-at-home orders, rapid increases in use of telemedicine with its associated learning curve, cancellations of non-emergency surgeries, and only emerging knowledge about transmission of the virus.

CUMULATIVE INCIDENCE ANALYSIS MODEL

Tables 2–5 present the results from the cumulative incidence analysis. Results were not reported for telemedicine index PC visits in the pre-pandemic period because there were very few of these visits prior to March 15, 2020.

Table 2: Cumulative Probability of an ED or PC Visit for Selected Days After an Index PC Visit: All Member

Pre-Period (3/1/2018 - 2/29/2020)				Post-Period 1 (3/15/2020 – 6/30/2020)				Post-Period 2 (7/1/2020 – 11/30/2020)					
In-person		Telemedicine		In-person		Telemedicine		In-person		Telemedicine			
Number of Index Visits		5,804,164		10,045		508,775		208,211		1,071,392		196,030	
Days After Index Visit	ED	PC	ED	PC	ED	PC	ED	PC	ED	PC	ED	PC	
	1	0.58%	2.47%			0.46%	2.93%	0.50%	3.68%	0.43%	2.63%	0.52%	3.89%
	2	1.06%	4.44%			0.84%	5.25%	0.86%	6.17%	0.79%	4.66%	0.94%	6.23%
	3	1.45%	6.25%			1.15%	7.33%	1.15%	8.41%	1.09%	6.49%	1.27%	8.38%
	4	1.81%	8.00%			1.43%	9.27%	1.42%	10.47%	1.36%	8.27%	1.57%	10.33%
	5	2.14%	9.76%			1.69%	11.20%	1.67%	12.58%	1.61%	10.12%	1.86%	12.36%
	10	3.44%	20.02%			2.69%	22.30%	2.62%	24.04%	2.63%	20.72%	2.91%	23.76%
	15	4.45%	28.53%			3.41%	30.88%	3.31%	32.94%	3.38%	29.38%	3.67%	33.58%
	30	6.46%	44.71%			4.84%	46.72%	4.71%	50.18%	4.81%	45.35%	5.09%	52.32%
	60	8.59%	59.58%			6.42%	60.52%	6.25%	64.38%	6.30%	59.51%	6.46%	66.89%

Table 3: Cumulative Probability of an ED or PC Visit for Selected Days After an Index PC Visit: Adults 19 – 64

Pre-Period (3/1/2018 - 2/29/2020)				Post-Period 1 (3/15/2020 – 6/30/2020)				Post-Period 2 (7/1/2020 – 11/30/2020)					
In-person			Telemedicine		In-person		Telemedicine		In-person		Telemedicine		
Number of Index Visits	2,771,721			6,337		266,871		134,211		553,315		126,166	
Days After Index Visit	ED	PC	ED	PC	ED	PC	ED	PC	ED	PC	ED	PC	
1	0.59%	2.56%			0.53%	2.89%	0.52%	3.71%	0.49%	2.80%	0.53%	3.88%	
2	1.09%	4.59%			0.98%	5.37%	0.90%	6.22%	0.92%	5.05%	0.96%	6.25%	
3	1.52%	6.45%			1.35%	7.58%	1.22%	8.51%	1.27%	7.05%	1.30%	8.39%	
4	1.92%	8.28%			1.69%	9.65%	1.52%	10.63%	1.60%	9.01%	1.63%	10.34%	
5	2.28%	10.20%			2.01%	11.80%	1.78%	12.80%	1.90%	11.13%	1.92%	12.41%	
10	3.73%	21.76%			3.20%	24.32%	2.80%	24.92%	3.08%	23.34%	3.02%	24.41%	
15	4.81%	31.44%			4.04%	34.03%	3.54%	34.37%	3.95%	33.42%	3.80%	34.85%	
30	6.89%	49.26%			5.67%	51.47%	4.99%	52.37%	5.55%	51.31%	5.31%	54.23%	
60	8.93%	63.86%			7.35%	65.19%	6.58%	66.48%	7.14%	65.48%	6.77%	68.59%	

Table 4: Cumulative Probability of an ED or PC Visit for Selected Days After an Index PC Visit: Children 0 – 18

Pre-Period (3/1/2018 - 2/29/2020)				Post-Period 1 (3/15/2020 – 6/30/2020)				Post-Period 2 (7/1/2020 – 11/30/2020)					
In-person			Telemedicine		In-person		Telemedicine		In-person		Telemedicine		
Number of Index Visits	2,218,679			845		168,691		41,905		380,404		41,931	
	Days After Index Visit												
	ED	PC	ED	PC	ED	PC	ED	PC	ED	PC	ED	PC	
1	0.55%	1.87%			0.32%	2.46%	0.38%	3.31%	0.29%	1.91%	0.45%	3.68%	
2	0.96%	3.53%			0.57%	4.27%	0.59%	5.53%	0.52%	3.37%	0.79%	5.81%	
3	1.28%	5.12%			0.75%	5.99%	0.80%	7.53%	0.70%	4.80%	1.03%	7.83%	
4	1.55%	6.57%			0.90%	7.53%	0.94%	9.15%	0.85%	6.12%	1.23%	9.57%	
5	1.80%	7.92%			1.02%	8.89%	1.09%	10.79%	0.98%	7.35%	1.41%	11.24%	
10	2.79%	15.55%			1.60%	16.61%	1.60%	19.27%	1.59%	14.59%	2.03%	19.97%	
15	3.61%	21.98%			2.01%	22.59%	2.00%	25.93%	2.08%	20.51%	2.51%	27.76%	
30	5.47%	34.91%			2.99%	34.21%	3.04%	38.72%	3.13%	32.51%	3.51%	43.25%	
60	7.81%	50.14%			4.47%	48.10%	4.41%	53.05%	4.50%	46.70%	4.67%	58.13%	

Table 5: Cumulative Probability of an ED or PC Visit for Selected Days After an Index PC Visit: Members with Disabilities

Pre-Period (3/1/2018 - 2/29/2020)				Post-Period 1 (3/15/2020 – 6/30/2020)				Post-Period 2 (7/1/2020 – 11/30/2020)						
In-person			Telemedicine		In-person		Telemedicine		In-person		Telemedicine			
Number of Index Visits			813,764		2,863		73,213		32,095		137,673		27,933	
Days After Index Visit	ED	PC	ED	PC	ED	PC	ED	PC	ED	PC	ED	PC		
1	0.64%	3.79%			0.54%	4.15%	0.56%	4.03%	0.55%	3.98%	0.58%	4.27%		
2	1.20%	6.42%			0.97%	7.08%	1.02%	6.77%	1.02%	6.70%	1.06%	6.78%		
3	1.67%	8.69%			1.35%	9.51%	1.33%	9.15%	1.45%	8.93%	1.45%	9.18%		
4	2.12%	10.94%			1.73%	11.89%	1.64%	11.55%	1.85%	11.20%	1.86%	11.42%		
5	2.56%	13.30%			2.08%	14.36%	1.98%	13.96%	2.19%	13.70%	2.27%	13.83%		
10	4.23%	26.27%			3.36%	28.07%	3.15%	26.60%	3.65%	27.16%	3.74%	26.48%		
15	5.46%	36.45%			4.31%	38.45%	4.05%	36.08%	4.70%	37.64%	4.79%	36.54%		
30	7.68%	55.96%			6.05%	58.18%	5.71%	55.96%	6.49%	56.93%	6.47%	57.32%		
60	9.53%	70.72%			7.51%	72.05%	7.31%	70.35%	7.87%	70.99%	7.75%	72.39%		

Tables 2–4 reveal several common patterns; Table 5 presents divergent results for Health First Colorado members with disabilities. For all members, adults aged 19 – 64 years, and children aged 18 years and younger in both the first and second post-periods the likelihood of a subsequent PC visit following a telemedicine visit was higher than following an in-person visit. Generally, the differences between the cumulative incidence of a subsequent PC visit increased over time. Finally, the difference in the cumulative incidence also increased in the second post-period compared to the first post-period.

Comparing the cumulative incidence in Tables 3 and 4 indicates that children were less likely to have a subsequent PC visit compared to adults throughout the 60-days following an index visit; however, the difference between telemedicine and in-person probabilities were greater for children than adults. In the second post-period the probabilities that an adult (Table 3) had a subsequent PC visit on day 1 following a telemedicine and in-person index visit were 3.88% and 2.80%, respectively, with a 1.08 percentage point difference. In comparison, for children (Table 4) the corresponding probabilities were 3.68% and 1.91% with a 1.77 percentage point difference. Moreover, this difference between adults and children increased over time. At 30 days after an index visit in the second post-period, the probabilities for adults with a telemedicine and in-person index visit were 54.23% and 51.31%, respectively, compared to 43.25% and 32.51% for children, with the corresponding differences of 2.92 and 10.74 percentage points. While less pronounced in the first post-period than in the second post-period, this same pattern holds.

The patterns in Tables 2–4 are more mixed in examining the cumulative incidence of an ED visit following an index PC visit with different modalities. In comparing the probabilities of a subsequent ED visit between telemedicine and in-person modalities in the post-periods, it is important to recognize that the likelihood of a subsequent ED visit was substantially less than the likelihood of a subsequent PC visit. As a result, the difference between cumulative incidences of a subsequent ED visit for telemedicine and in-person was less than 1 percentage point in all three tables in both post-periods over all 60 days following an index PC visit. In most instances, a subsequent ED visit was more likely following a telemedicine index PC visit, but there were some instances where the likelihood of a subsequent ED visit was lower following a telemedicine index PC visit compared to an in-person index PC visit. For example, adults (Table 3) during the second post-period over the first 10 days the probabilities of a subsequent ED visit were higher following a telemedicine index PC visit but after 10 days the probabilities were higher following an in-person index PC visit. In addition, as shown in Figures 29–32, utilization of ED services was still substantially lower in the second post-pandemic period compared to the pre-pandemic period suggesting that these mixed results may not persist as the pandemic continues to subside.

Members with disabilities also had mixed results as shown in Table 5 and the differences between modalities were generally smaller compared to Tables 2–4. In addition, the differences in the cumulative incidence probabilities over time for the in-person modality were also smaller for this sub-group. In comparing the probabilities for telemedicine and in-person modalities in the two post-periods, this table indicates that the likelihood of a subsequent PC visit following a telemedicine index PC visit was lower compared to the likelihood following an in-person index PC visit in the first post-period. However, by the second post-period, this relative difference shows that telemedicine index PC visits had a higher likelihood of a subsequent PC visit over the first 10 days, was lower from day 10 to day 15 and then higher again for days 30 and 60. Overall, the findings in Table 5 suggest that the likelihood of either a subsequent ED or PC visit was less sensitive to the modality of the index PC visit for members with disabilities.

These results are consistent with prior analyses. Studies conducted prior to the pandemic using Blue Cross Blue Shield of Michigan claims data over a seven-year period, found that telemedicine visits corresponded to a higher rate of subsequent related visits than in-person visits for all categories except mental illnesses.¹⁶ A study limited to direct-to-consumer telemedicine (usually with a provider the patient does know) and focused on one condition — acute respiratory infections — found that the telemedicine visits were more likely to lead to downstream related office visits (10.3% versus 5.9%), and more urgent care visits. Conversely in-person visits had slightly higher rates of ED visits in the seven-day window (rates were low in both groups, 0.6% vs 0.5%).¹⁷ Other researchers also with a focus on direct-to-consumer care and with acute respiratory infections in a matched cohort study found a higher frequency of follow up visits for patients at 2 and 21 days post-visit for the telemedicine cohort.¹⁸ Finally, in a multi-site impact study focusing on seniors, researchers found that “visit resolution” rates were higher for in-person visits but still concluded telemedicine is an effective modality a high percentage of the time in addressing urgent (but not emergent) needs.¹⁹ As with many other studies, caution should be exercised in extrapolating to the post-COVID world given the limited scope and focus as well as use of commercially-insured population claims data in these prior studies.

MULTIVARIATE COX PROPORTIONAL HAZARDS MODEL RISK MODEL

The results presented in Tables 2–5 were not adjusted for any differences in the characteristics of members with an index PC visit. To substantiate the findings in these tables and to distinguish between the effects of payment policies and differences in member characteristics, we applied a Cox proportional hazards model to the same data underlying Tables 2–5. As noted above, this analysis accounted for the following member characteristics: age at the index PC visit, race/ethnicity, health status/medical complexity, residence in an urban, suburban or rural location, and primary diagnosis at the index PC visit. The primary diagnosis from each index visit was classified into clinically relevant groupings using the CCS. CCS diagnoses groups with fewer than 30 visits for either mode of index visit, missing, or that were only found for one index type were combined together and relabeled as ‘Other’. Of the more than 530 categories in the CCS, 491 categories were associated with at least one in-person index PC visit and 471 categories were associated with at least one telemedicine index PC visit. In-person visits included 20 categories not seen in telemedicine visits and no categories were unique to telemedicine visits.

The Cox proportional hazards model estimates the proportional difference in the likelihood an ED visit or another PC visit will occur on each day following an index PC visit during the next 60 days. The results in Table 6 present the estimated proportional difference in the likelihood a member will have an ED visit or a PC visit following a telemedicine index PC visit compared to an in-person index PC visit in the same post-pandemic period. An estimate of 1.000 would indicate that the likelihood of having an ED or PC visit following an index PC visit is the same for in-person and telemedicine visits. An estimate greater than 1.000 indicates that members with a telemedicine index PC visit were more likely to have an ED or PC visit compared to members with an in-person index PC visit. An estimate less than 1.000 indicates that members with a telemedicine index PC visit were less likely to have an ED or PC visit compared to members with an in-person index PC visit.

Table 6: Covariate Adjusted Proportional Difference in Likelihood of an ED Visit or Subsequent PC Visit in a Day for the First 60 Days Following an Index PC Visit for Telemedicine Index Visit Relative to In-person

Population	Post-Period 1 (3/15/2020 – 6/30/2020)		Post-Period 2 (7/1/2020 – 11/30/2020)	
	ED	PC	ED	PC
All Members	0.948 (0.928 – 0.968)	1.011 (1.003 – 1.018)	1.022 (0.999 – 1.045)	1.101 (1.092 – 1.109)
Adults 19 - 64	0.911 (0.888 – 0.935)	1.016 (1.006 – 1.025)	0.975 (0.948 – 1.002)	1.078 (1.068 – 1.088)
Children 0 - 18	0.958 (0.910 – 1.009)	1.032 (1.015 – 1.050)	1.033 (0.978 – 1.091)	1.184 (1.164 – 1.205)
Members with Disabilities	0.950 (0.903 – 1.000)	0.970 (0.952 – 0.987)	1.018 (0.963 – 1.077)	1.051 (1.032 – 1.071)

**95% confidence interval for the covariate adjusted proportional difference in parentheses*

The results presented in Table 6 are consistent with the results in Tables 2–5 suggesting that after controlling for the member characteristics included in the Cox proportional hazard model there were remaining differences in the likelihood of a subsequent PC visit related to the modality of an index PC visit. Given the big disruption to health care caused by the COVID-19 public health emergency, the first post-period has multiple confounders and for purposes of interpreting the findings we focused on the results from the second post-period.

Focusing on the second post-period, the results in Table 6 indicate that members with a telemedicine index PC visits were more likely to have a subsequent PC visit compared to similar members with an in-person index PC visit (the point estimates are greater than 1.000). The 95% confidence intervals indicate that these higher likelihoods were statistically significant at the 5% level of significance. In contrast, the confidence intervals for a subsequent ED visit include 1.000 suggesting that there was no significant difference in the likelihood of a subsequent ED visit for members with a telemedicine index PC visit relative to those with an in-person index PC visit.

Overall, in the second post-period, the results presented in Tables 2–6 suggest that telemedicine index PC visits had a higher likelihood of resulting in a subsequent PC visit compared to in-person index PC visits beginning the first day after the index PC visit and continuing for the next 60 days. This pattern holds for all Health First Colorado members as well as for each of the three sub-groups. While the evidence is mixed, the findings in these tables indicate the likelihood of a subsequent ED visit does not differ between telemedicine and in-person index PC visits. It is important to recognize that even in the second post-period there were continued COVID restrictions in place and these findings may not generalize to a post-pandemic period as both providers and patients adjust their use of telemedicine to optimize its use relative to in-person visits. With these limitations in mind, the results presented in Tables 2–6 suggest there could be consequential budget implications resulting from the shift to telemedicine under the payment policies instituted as part of the COVID-19 response. These implications are explored next.

Fiscal Implications

The findings presented above from our analysis of the Denver Health appointment data and Health First Colorado claims data have a number of fiscal implications for the Department’s budget if recent telemedicine experiences from July 2020 through March 2021 continue. To explore two of these implications we created two simple budget simulation models to conduct a number of “what-if” scenarios. One model explores the fiscal implications of the mixture of scheduled in-person and telemedicine appointments for PC and BH given the differential no-show rates for these two modalities. The second simulation model explores the fiscal implications of the mixture of in-person and telemedicine index PC visits given the differential likelihood of a subsequent PC visit for these two modalities.

NO-SHOW SIMULATION MODEL

The first budget simulation model incorporates the findings from our analysis of the Denver Health appointment data with a number of assumptions involving: the number of appointment slots available in primary and BH care settings; the percentage of available slots scheduled; and, payments for FQHC PC encounters, non-FQHC FFS PC visits, and BH services. The simulation model provides the opportunity to explore the budgetary implications of different values for the no-show rates for scheduled in-person and telemedicine PC appointments, the percentage of PC appointments scheduled for a telemedicine modality, and the percentage of PC appointment slots in FQHCs. This model also provides the opportunity to explore the implications for BH services of different values for the no-show rates for scheduled in-person and telemedicine BH appointments, and the percentage of BH appointments scheduled for a telemedicine modality.

To illustrate the budgetary implications using the first simulation model we assumed the number of PC appointment slots was 522,000 and the number of BH appointment slots was 487,000 statewide. These values were selected based on an extrapolation from an estimated average number of PC visits and BH visits in the pre-pandemic state fiscal year 2019, which we approximated as 300,000 completed PC visits and 280,000 completed BH encounters in an average month, using the average percentage of Denver Health appointment slots with a completed appointment (57.5%). We also used the average percentage of available slots scheduled in the Denver Health data of 30% to approximate the number of scheduled appointments in PC and BH settings, which for these simulations were 365,400 in PC and 340,900 in BH. Finally, we set the payment rates as follows: the median payment for PC services in FQHCs at \$221 per encounter, the non-FQHC FFS at \$104 per visit, and the BH at \$80 per service under the capitated BH program. These payment rates were selected using a median payment for each service from state fiscal year 2019 and increased by 3% per year to estimate a 2021 value.

Tables 7 and 8 present the budget simulation results from the first model with a base case scenario and three what-if scenarios for PC services and two scenarios for BH services. Each scenario varies one component of the base case. The model calculates the additional costs of the scenario relative to what we expected monthly expenditures to be if 100% of the appointments were in-person with no-show rates from the post-pandemic period for the modality of the scheduled appointment. Specifically, in Table 7 the base case calculated the additional cost if 15% of the PC appointments were via telemedicine with the two post-period no-show rates shown in the table relative to 100% of the PC appointments being in-person with the 20.3% no-show rate. Similarly, in Table 8 the base case calculated the additional cost if 50% of BH appointments were telemedicine with the two post-period no-show rates shown in the table relative to 100% of the BH appointments being in-person with a 17.3% no-show rate.

Table 7. The Effect of No-show Rate Changes on the Cost of PC Visits per Month

Models and Parameters	Estimated cost of additional PC visits/month (dollars)
Model 1a. Base Case Model Assumptions % of PC visits by telemedicine = 15% % of PC visits in FQHC = 24% No-show rate for in-person visits (post-period) = 20.3% No-show rate for telemedicine visits (post-period) = 11.4%	\$644,286
Models 1b. Base Case Model with increase no-show rate for telemedicine No-show rate for telemedicine visits (post-period) = 15.0%	\$383,692
Models 1c. Base Case Model with decrease % of PC telemedicine visits % of PC visits by telemedicine = 5%	\$214,762
Models 1d. Base Case Model with decrease % of PC visits at FQHC % of PC visits in FQHC = 18%	\$610,043

As shown in Table 7, the estimated additional cost of completing 15% of PC appointments via telemedicine with 24% of these appointments completed in an FQHC with no-show rates of 20.3% and 11.4% for in-person and telemedicine appointments, respectively, is \$644,286 per month. This amount would be the additional expenditures for PC services the Department would incur maintaining the current payment policies compared to the case where all appointments were scheduled as in-person PC visits. The second scenario presented in Table 7 calculates the estimated additional expenditures if the no-show rate for telemedicine PC visits were 15.0% instead of 11.4%. This increase in the no-show rate for telemedicine visits, which is essentially half-way between the base case and the no-show rate for in-person visits, decreased the additional cost estimate to \$388,692. The third scenario sets the telemedicine no-show rate back to 11.4% but reduces the percentage of PC appointments via telemedicine from 15% to 5%, and this change would result in an estimated additional cost of \$214,762. Finally, the fourth scenario only changes the percentage of PC appointments in FQHCs from 24% to 18%, and this change would result in an estimated additional cost of \$610,043. Overall, these four scenarios suggest that any additional cost from maintaining the current telemedicine payment policies are primarily driven by the differences in no-show rates for telemedicine PC appointment relative to in-person no-show rates and the percentage of PC visits completed via telemedicine.

Table 8. The Effect of No-show Rate Changes on the Cost of BH Visits per Month

Models and Parameters	Estimated cost of additional BH visits per month (dollars)
Model BH-1a. Base Case Model Assumptions % of BH visits by telemedicine = 50% No-show rate for in-person visits (post-period) = 17.3% No-show rate for telemedicine visits (post-period) = 14.3%	\$409,120
Model BH-1b. Base Case Model with increase no-show rate for telemedicine No-show rate for telemedicine visits (post-period) = 15.0%	\$313,680
Model BH-1c. Base Case Model with decrease % of BH telemedicine visits % of BH visits by telemedicine = 25%	\$204,560

As shown in Table 8, the estimated additional cost of completing 50% of BH appointments via telemedicine with no-show rates of 17.3% and 14.3% for in-person and telemedicine appointments, respectively, is \$409,120 higher than it would be if all appointments were scheduled as in-person visits. Note, the BH appointment no-show rates were calculated using the Denver Health data and includes BH visits paid for by the Regional Accountable Entities, Denver Health Medicaid Choice, and the Department directly (FFS); however, the estimated payment amount is based on the median payment made by the Regional Accountable Entities. This amount would be the additional expenditures for BH services the Department would incur maintaining the current payment policies compared to the case where all BH appointments were scheduled as in-person visits. The second scenario presented in Table 8 calculates the estimated additional expenditures if the no-show rate for telemedicine BH visits were 15.0% instead of 14.3%. This increase in the no-show rate for telemedicine visits, which is the same no-show rate used in the second scenario in Table 7, decreased the additional cost estimate to \$316,680. The third scenario sets the telemedicine no-show rate back to 14.3% but reduces the percentage of BH appointments via telemedicine from 50% to 25%; this change would result in an estimated additional cost of \$204,560. These three scenarios suggest that any additional cost from maintaining the current telemedicine payment policies for BH are driven by both the differences in no-show rates and the percentage of BH visits completed via telemedicine.

FOLLOW-UP PRIMARY CARE VISIT LIKELIHOOD SIMULATION MODEL

Tables 9–11 illustrate the potential fiscal implications of differences in the likelihood of an index PC visit being followed by a subsequent PC visit based on the modality of the index PC visit. To illustrate the budgetary implications using the second simulation model we assumed the number of index PC visits was 270,000 statewide, which is 90% of the 300,000 completed primary care visits used in the no-show models. The payment rates for subsequent PC services were the same as used in the no-show models, that is, \$221 per encounter for FQHCs and \$104 for non-FQHC FFS visits. The percentage of index PC visits in a FQHC was set at 24%. The likelihood of a subsequent PC visit was set at the cumulative incidence percentage at 30 days shown in Tables 2–4 for all Health First Colorado members, adults and children in the second post-period. The simulation model results for all members is in Table 9, for adults in Table 10 and for children in Table 11. The scenarios examined in each of these tables varied the percentage of index PC visits using a telemedicine modality. In all three tables, the base case for estimating the additional cost is 100% in-person index PC visits.

Table 9. The Effect of Telemedicine on Costs of Subsequent PC Visits per Month: All Members

Models and Parameters	Estimated cost of additional PC visits/month (dollars)
Model 3a. Base Case Model Assumptions % of Index Visit by Telemedicine = 15% % of PC following index 30 days (in-person) = 45.35% % of PC following index 30 days (telemedicine) = 52.32%	\$372,862
Model 3b. Base Case with: % of Index Visit by Telemedicine = 20%	\$479,149
Model 3c. Base Case with: % of Index Visit by Telemedicine = 10%	\$248,575
Model 3d. Base Case with: % of Index Visit by Telemedicine = 5%	\$124,287

Table 10: The Effect of Telemedicine on Costs of Subsequent PC Visits per Month: Adults 19-64

Models and Parameters	Estimated cost of additional PC visits/month (dollars)
Model 4a. Base Case Model Assumptions % of Index Visit by Telemedicine = 15% % of PC following index 30 days (in-person) = 51.31% % of PC following index 30 days (telemedicine) = 54.23%	\$78,059
Model 4b. Base Case with % of Index Visit by Telemedicine = 20%	\$104,079
Model 4c. Base Case with: % of Index Visit by Telemedicine = 10%	\$52,040
Model 4d. Base Case with: % of Index Visit by Telemedicine = 5%	\$26,019

Table 11: The Effect of Telemedicine on Costs of Subsequent PC Visits per Month: Children 0-18

Models and Parameters	Estimated cost of additional PC visits/month (dollars)
Model 4a. Base Case Model Assumptions % of Index Visit by Telemedicine = 15% % of PC following index 30 days (in-person) = 32.51% % of PC following index 30 days (telemedicine) = 43.25%	\$287,142
Model 4b. Base Case with: % of Index Visit by Telemedicine = 20%	\$382,900
Model 4c. Base Case with: % of Index Visit by Telemedicine = 10%	\$191,384
Model 4d. Base Case with: % of Index Visit by Telemedicine = 5%	\$95,626

The results in Tables 9–11 indicate that moving from 100% in-person index PC visits to a mix of in-person and telemedicine increases the estimated monthly expenditures for PC services for all members, adults and children. As shown in these tables the smaller the percentage of index PC visit that are telemedicine, the closer the estimated additional costs are to zero. These simulations also highlight that index PC visits by children are the biggest driver of monthly expenditures from moving to a mix of in-person and telemedicine index PC visits.

While these analyses suggest that telemedicine will increase cost, these simulation models make several assumptions that may not hold as the health care system adjusts to a post-COVID reality that looks more similar to the pre-COVID world. For example, the primary driver of additional monthly cost is the percentage mix of telemedicine relative to in-person modalities visits and the percentage of visits via telemedicine may return to their pre-pandemic levels, mitigating these cost increases. The declines in telemedicine during the COVID non-surge periods (the second post-period in Tables 2–6) are suggestive of this possibility. Additionally, the impact of a reduction in no-shows may not affect the overall number of completed visits if members that did not show for their initial appointment rescheduled and completed an appointment at a later date. Finally, as patients, providers, payers, researchers and policymakers gain experience with telemedicine it is likely there will be increased understanding of what types of visits are most appropriate for telemedicine and which ones require in-person encounters with providers, resulting in fewer subsequent PC visits compared to the experiences in the second post-pandemic period.

Discussion

In the wake of COVID-19, the use of telemedicine has exploded. In the early months, during the strict stay-at-home order and heightened anxiety about visiting health care facilities, telemedicine enabled people to continue to receive care in the safety of their homes.

The policy changes expanding the range of services eligible to be reimbursed via telemedicine and the providers able to provide the services were necessary in the public health emergency. It was done, however, without the benefit of extensive research on its efficacy, the services most suited for the modality, its effects on access to care, whether it ameliorates or exacerbates already existing inequalities, and its impact on costs. Telemedicine research prior to March 2020 most often reviewed direct-to-consumer products (usually made available to commercially-insured individuals), had small sample sizes, and/or focused on a narrow set of diagnoses. During the course of this past year, researchers, stakeholders, and policy makers have been working to assess the future of telemedicine. Even so, the work frequently focuses on the early months of the pandemic due to claims run-out and other data delays. The findings from our analysis add to this research and serve to help the Department make policy decisions about the future of telemedicine for Health First Colorado members and their health care providers.

Clinic Efficiency

A key question of payers, providers, and policy makers is whether ambulatory care settings operate more efficiently and schedule more appointments with greater use of telemedicine. While Denver Health did increase the number of unique PC appointment slots during the pandemic (a trend that started prior to March 2020), it does not appear that Denver Health scheduled more appointments for individual providers as unscheduled appointment slots drove the increase. Where telemedicine differed substantially from in-person appointments was in the no-show rate of scheduled appointments. Specifically, after the initial months of the pandemic (March to June 2020) telemedicine no-shows were lower than they were for in-person visits. The impact of the lower no-show rates for telemedicine scheduled appointments on the capacity of providers to see more patients is not fully known as clinics may adjust, or already are adjusting, their scheduling practices to accommodate a lower no-show rate for telemedicine appointments. In addition, as COVID-imposed restrictions (i.e., masking and social distancing) end, it is likely that the percentage of visits that are provided via telemedicine will continue to decline, particularly with greater knowledge about which visits are suited for telemedicine and which require in-person care. This pattern of decreasing telemedicine appointments was evident during the past year as the percentage of visits provided with this modality declined during the non-surge periods.

The review of Denver Health data indicates that differences in no-show rates among patient groups for in-person appointments were lessened for audio only telemedicine visits. This was the case for non-Hispanic Black patients and more complex patients (Tier 4) where telemedicine no-show rates did not diverge as much for these groups as they did for in-person appointments. These findings indicate an opportunity for audio only telemedicine visits to be utilized as a tool to address disparities in accessing care. Additionally, this aligns with the prevailing thinking that these groups are more likely to face challenges with access to audio/video modes, suggesting that retaining the audio only option is important to improve equitable access to services. A blog post from the recent California Health Care Foundation sponsored RAND report also supports this with the authors asserting that, “Many payers including the Centers for Medicare and Medicaid Services are likely to stop reimbursing for most audio only visits in coming months because of cost and quality concerns. This is a mistake. We are at risk of devaluing and prematurely casting off a key telemedicine modality, a move that could mean the difference between a needed doctor visit and no visit at all.” The author also argues that payment for audio only should continue for at least a few years to “avoid exacerbating disparities in access to care.”⁵

Emergency Department and Primary Care Utilization and Diagnoses

As has been reported elsewhere, including the Department’s own recently released evaluation, there was a large drop in utilization of ED services after March 15, 2020. This followed what had been an increase in ED utilization (except for members with disabilities whose utilization remained consistent) in the pre-pandemic period. In the period from July to October 2020, utilization increased and returned to near pre-pandemic levels for adults and members with disabilities until the COVID-19 surge in November and December 2020. However, ED utilization by children remained much lower than in the pre-pandemic years. This may be a result of hesitancy to bring children into health care facilities or because other conditions such as seasonal flu had much lower rates in 2020 and early 2021 because children were not in school or in other group settings. The analysis of primary diagnoses for ED visits suggests this is likely the case as there was a decline in the percent of ED visits for upper respiratory infections, otitis media, influenza, and acute bronchitis in the post-pandemic period while injuries represented a larger percentage of visit diagnoses.

Utilization of PC services showed similar patterns with a large drop in utilization particularly for children. These declines would have been even larger if not for the concurrent increases in telemedicine PC modalities that offset the decreases in utilization of in-person PC visits to some extent. After rebounding somewhat, during the COVID-19 surge in November and December 2020, there was another dip in utilization. During the periods between COVID-19 surges, utilization of in-person PC services increased and there was a corresponding decrease in the utilization of telemedicine PC services for all Health First Colorado members and sub-groups. These patterns suggest that as the public health emergency ends it is likely PC will return to most visits using an in-person modality. When looking at diagnoses of PC visits, there were increases as a percentage of index PC visits related to exposure to infectious diseases, anxiety, and depression for all populations. Adults also had higher rates of back pain, headaches, and abdominal pain; sleep wake disorders increased among members with disabilities. The range of diagnoses treated via a telemedicine modality expanded substantially in the post-period compared to the pre-period, reflecting limited use of telemedicine prior to the pandemic. Overall, these findings suggest telemedicine index PC visits were being used more frequently in place of in-person visits and not as a substitute for non-urgent ED visits.

Effectiveness of Primary Care Telemedicine and Fiscal Implications

While there is some evidence from prior studies addressing the efficacy of telemedicine visits, the studies were often limited in scope and conducted prior to the telehealth utilization explosion in the spring of 2020. Our analysis, which found that telemedicine index PC visits have a higher likelihood of resulting in a subsequent PC visit, adds to this research. This suggests that some portion of telemedicine index PC visits result in a follow-up visit and that telemedicine, therefore, may not be as effective as in-person visits for all PC services; and further analysis is needed to identify the most appropriate PC services for a telemedicine modality. If this level of additive visits were to persist after the pandemic ends there would be a subsequent increase in cost to the Department's budget.

Greater utilization of telemedicine has a number of potential fiscal implications. In exploring these implications, we used two simple budget simulation models to consider the impact of lower no-show rates for telemedicine and the greater likelihood of a follow-up PC visits following an index PC visit as compared to in-person. Both lower no-show rates for telemedicine appointments and the increased likelihood of subsequent PC visits individually increased cost. Costs could increase even more if both of these factors remain after the end of the public health emergency. As expected, the primary driver of increased cost was the percentage of index PC visits conducted via telemedicine. Notably, these budget simulations are based on several assumptions that may not hold as the health care system adjusts to a post-COVID reality that could look more similar to the pre-COVID world. As mentioned above, the declines in utilization of telemedicine modalities during the non-surge periods suggest that telemedicine use could return to pre-pandemic levels or, at a minimum, higher than those levels but still lower than the current rates. Additionally, health systems and individual providers may adjust their scheduling protocols to account for lower no-show rates and the overall number of completed visits could be unchanged. Finally, as the evidence base builds there will be increased understanding of what types of visits are most appropriate for telemedicine and in-person encounters, resulting in similar rates of subsequent PC and ED visits across the modalities.

Conclusion and Next Steps

Telemedicine was a valuable tool to ensure access to health care services during a period in which people were hesitant to visit health care facilities and, at times, to leave their homes at all and the availability of audio only does seem to have helped members of color and individuals with medical complexities access services (based on lowering no-show rates).

While this study contributes to the evidence base for telemedicine policies, substantial gaps remain as policy makers refine and consider telemedicine policies to optimize health care delivery after the public health emergency. Recently both the Government Accountability Office (GAO) and the Medicare Payment Advisory Commission (MedPAC) recommended further research and review of telemedicine. Until additional evidence is developed, they recommended Medicare should continue to pay for specified telehealth services provided to all beneficiaries regardless of their location, cover certain telehealth services in addition to services covered before the public health emergency, and cover certain telehealth services when they are provided through an audio only interaction if there is potential for clinical benefit.²⁰⁻²²

There are several areas of research and evaluation we would propose for continued review, especially after the pandemic has waned and our lives and the ways in which we access health care services have stabilized. In particular, additional research and review in the following areas will support policy makers in making telemedicine policy decisions:

- More in-depth study of workflows and operations in clinics that use different combinations of in-person and telemedicine appointments. This is needed to understand the relationship of telemedicine and clinic operational efficiency and assess whether these changes reduce inefficiency or whether the process of managing two different modalities adds complexity. These studies would benefit from the application of systems engineering and time-driven activity-based costing methods across a variety of health care delivery settings.
- Continued review of telemedicine usage and diagnoses to help highlight which conditions are best suited for telemedicine appointments. Building this evidence base will identify the circumstances where a telemedicine modality is appropriate and when a patient's needs are best met by an in-person visit. For example, BH is potentially well-suited to telemedicine, and there is a consensus that telemedicine can be more effective in managing chronic conditions, whereas well-child visits and other annual visits are more effective in-person. There may be, however, other conditions that are amenable to this modality.
- Enhanced understanding of patient and provider preference and maximizing telemedicine to address inequities in health care access including an assessment of and support for barriers to expand audio/video services.

- Continued examination of whether there were differences in follow-up visits after telemedicine index visits by diagnosis type. Prior research suggests telemedicine index visits were associated with lower rates of follow-up visits for mental health conditions but higher rates of follow-up visits for other diagnoses.¹⁶ As telemedicine expands, there is opportunity for more robust studies.
- Assessment of telemedicine effectiveness in different primary care settings. Delivery of telemedicine primarily falls into two distinct categories: (1) direct-to-consumer telemedicine delivered by a provider that does not have an ongoing relationship with a patient, and (2) telemedicine visits conducted by providers where a patient has an established primary care medical home. Other studies have found that direct-to-consumer telemedicine visits are more likely to lead to related downstream visits,¹⁷ represent additional visits rather than replacement of other visits,²³ and lead to slightly lower rates of antibiotic prescribing for adults but more inappropriate antibiotic prescribing for children.^{18,24} A better understanding of the cost and quality of care provided by each of the delivery strategies is essential to determine the most cost-effective role of telemedicine in post-pandemic health care delivery.
- Similarly, a better understanding of the extent to which there are differences in access, cost, and quality-of-care between audio/video and audio only telemedicine modalities is needed to identify the most cost-effective mode that also improves equity in access to care.
- Longer-term assessments of associations between modality (in-person compared to telemedicine) and utilization of more expensive services such as ED or inpatient hospitalizations using at least a full year of data after the end of the public health emergency are also needed. These assessments are needed to evaluate the overall cost effectiveness and value of telemedicine modalities.
- Longer-term monitoring is needed of the extent to which telemedicine modalities expand or contract after the public health emergency ends for PC or BH services, and whether there is a return to predominantly in-person care for these services. The results from monitoring these trends would provide the information the Department and policymakers need to understand if telemedicine will perpetuate or drive further exacerbations in access to care and overall health status that could increase costs in the long-term.

While the analyses in this report focused primarily on ED, PC, and to a lesser extent specialty care services; similar analyses that focuses on other providers and service types would further contribute to the evidence base available to the Department and other stakeholders in developing and refining telemedicine policies.

Appendix I: Denver Health Data and Methods

Study Population

Denver Health Ambulatory Care Services provided the FHPC with a data file that included all outpatient appointment times across the Denver Health system from March 15, 2018 through March 14, 2021, for all providers, which will be referred to as an appointment slot. Denver Health provided data for all potentially available outpatient appointment as well as all appointments scheduled for each appointment slot. In preliminary analysis we found some appointment slots for providers were showing up as available when the provider turned off scheduling, and Denver Health confirmed this was possible. We made the analytic decision to exclude appointment slots for a provider in a day when the provider had no scheduled appointments to avoid a potential inflation of available slots. This resulted in approximately 3.3 million appointment slots during the study period. Each appointment slot included a unique slot identifier, a slot start time, the associated provider identifier and clinic/department name. Information for scheduled appointments included provider identifier, clinic/department name, visit mode (in-person, telephone, audio/video), visit status (completed, no-show, canceled), primary payer name, and limited de-identified patient demographics. Patient information included a unique arbitrary patient identifier, age at visit, sex, race, ethnicity, and health risk tier.

Appointment Slots and Scheduled Appointments

To identify a unique appointment slot, we used a combination of unique provider identifier, department name, and time to account for the potential of a provider having more than one appointment scheduled for the same time (i.e., double booking). Scheduled appointments were identified as a unique combination of unique provider identifier, department name, time, and unique arbitrary patient identifier. It is possible that a unique appointment slot has one or more scheduled appointments. Unscheduled appointment slots were identified as a unique appointment slot that had no scheduled appointments.

Denver Health's scheduling software provides a designation of completed, canceled, and no-show for each scheduled appointment that we used to determine its status. Any scheduled appointment with a designation other than completed, cancelled, and no-show was excluded from the analysis. Additionally, we used Denver Health's categorization of appointment mode as in-person, audio/visual, or telephone to classify each scheduled appointment as an in-person or telemedicine. There was a relatively small number of audio/visual appointments during the study period and, as such, we combined telephone and audio/visual appointments into the telemedicine category.

Appointment slots and scheduled appointments were categorized into four department types: (1) primary care (PC); (2) PC with integrated behavioral health services (IBH); (3) specialty BH services; and, (4) specialty care.

As noted above, a portion of unique appointment slots had multiple scheduled appointments and we used a hierarchical assignment rule for our analysis of appointment slots. Specifically, if a unique appointment slot had at least one scheduled appointment identified as completed, this slot was categorized as a completed slot. If the slot did not have any scheduled appointments with a completed designation and the slot had at least one scheduled appointment identified as a no-show, the slot was categorized as a no-show slot. If a slot had no completed or no-show scheduled appointments and at least one canceled scheduled appointment, it was categorized as a canceled slot. Finally, if a slot had no scheduled appointments it was categorized as an unscheduled slot. This hierarchy allowed us to assess whether the scheduled slot was used or unused.

Completion rates were calculated monthly as the percentage of appointment slots and scheduled appointments with a completed status. No show rates were calculated monthly as the percentage of appointment slots and scheduled appointments with a no-show status. Rates of unscheduled appointment slots were calculated monthly as the percentage of slots with an unscheduled status.

Finally, as noted above, we received data that corresponded to the beginning of the public health emergency starting March 15, 2020 and, to provide three full years of data, we requested data from March 15, 2018 through March 14, 2021. During the course of the analysis, we adopted a month-level focus and we adjusted the appointment slots and scheduled appointments for these two months by extrapolating the average number of daily appointments in the month to a full-month measure.

Differences in Completion and No-Show Rates

To assess demographic differences in completion and no-show rates for telemedicine and in-person visits among Health First Colorado members, we analyzed the patient demographic information provided for each unique scheduled appointment. Denver Health provided patient demographics for all payers; Appendix I Table 1 characterizes patient demographics for each payer. The analysis reports results only for scheduled appointments where Health First Colorado was identified as the primary payer; that is where the payer name was Medicaid or Denver Health Medicaid Choice. Patient demographic characteristics included sex, age in years, primary payer, race, ethnicity, and Denver Health patient risk tier. Information on race, ethnicity, and sex are typically collected through patient self-report at registration with Denver Health. Based on the self-reported information, we categorized sex as male or female and grouped race and ethnicity data into the following categories: Hispanic, non-Hispanic Black, non-Hispanic white, and non-Hispanic other/multiple races. For the analysis we defined three age groups: 0-17, 18-64, and 65 and older. The analysis also examined differences among groups with different health risk tiers. Denver Health uses the 3M™ Clinical Risk Groups (CRGs) classification methodology to assign each patient one of four risk tiers using a “clinically acceptable and actionable risk-tiering approach by pairing the use of published predictive models with frontline clinical judgment.”²⁵ Individuals are placed in risk tiers initially based on CRG status as follows:

CRG Status	CRG Status Description	Peds Tier	Adult Tier
1	Healthy	1	1
2	History of significant acute disease	2	1
3	Single minor chronic disease	2	2
4	Minor chronic disease in multiple organ sys	2	2
5	Single dominant or moderate chronic disease	Tier 2 or 3	2
6	Significant chronic disease in multiple organ sys	3	3
7	Dominant chronic disease in 3+ organ sys	3	3
8	Dominant and metastatic malignancies	4	4
9	Catastrophic condition	4	4

Additionally, adults who do not have a CRG score of 8 or 9 (Tier 4) are placed in that Tier if they: have three or more inpatient visits during the past 12 months; have 10 or more ED visits during the past 12 months; are defined as high risk (function of inpatient visits, ED visits and high CRG status); or are classified by the Regional Accountable Entity as a high cost high utilizer. Children may be promoted to a higher tier if they: have a diagnosed mental health condition; are defined as having special health care needs (meet certain criteria for diagnosis, treatment and/or utilization); have pre-specified number of inpatient or ED visits; are classified by the Regional Accountable Entity as high cost high utilizer; or have a foster care Health First Colorado eligibility type.

Appendix I Table 1. Denver Health Demographics for Scheduled Appointment Slots by Health Care Payer, March 2018-March 2021

Total N=2,571,047			Health First Colorado N=1,515,666		Commercial N=370,213		Medicare N=320,015		Other N=365,153	
Department/ Specialty	N	%	N	%	N	%	N	%	N	%
BHS-Primary Care	191121	7.4%	128268	8.5%	33916	9.2%	10568	3.3%	18369	5.0%
BHS-Specialty	190108	7.4%	116651	7.7%	36047	9.7%	21284	6.7%	16126	4.4%
Primary Care	1750361	68.1%	1058306	69.8%	245147	66.2%	181630	56.8%	265278	72.6%
Specialty	439457	17.1%	212441	14.0%	55103	14.9%	106533	33.3%	65380	17.9%
Sex										
Female	1581525	61.5%	927680	61.2%	228690	61.8%	184097	57.5%	241058	66.0%
Male	988321	38.4%	587217	38.7%	141154	38.1%	135889	42.5%	124061	34.0%
Age Category, years										
Less than 18	748466	29.1%	589289	38.9%	81709	22.1%	---	---	77456	21.2%
18 to 64	1587188	61.7%	916183	60.4%	280884	75.9%	125348	39.2%	264773	72.5%
65 and Older	235393	9.2%	10194	0.7%	7620	2.1%	194655	60.8%	22924	6.3%
Ethnicity										
Hispanic	1345571	52.3%	800405	52.8%	129314	34.9%	135764	42.4%	280088	76.7%
Non-Hispanic	1191346	46.3%	698563	46.1%	232166	62.7%	181977	56.9%	78640	21.5%
Unreported	34130	1.3%	16698	1.1%	8733	2.4%	2274	0.7%	6425	1.8%
Race										
American Indian/ Alaska Native	23635	0.9%	16481	1.1%	2689	0.7%	3451	1.1%	1005	0.3%
Asian	80930	3.1%	51846	3.4%	10978	3.0%	8481	2.7%	9625	2.6%
Black/African American	398961	15.5%	274924	18.1%	36730	9.9%	62182	19.4%	25125	6.9%
Multiple/Other	263511	10.2%	146242	9.6%	35160	9.5%	19523	6.1%	62586	17.1%
White	1804010	70.2%	1026173	67.7%	284647	76.9%	226378	70.7%	266812	73.1%

Total N=2,571,047			Health First Colorado N=1,515,666		Commercial N=370,213		Medicare N=320,015		Other N=365,153	
Risk Tier										
1	1036965	40.3%	659110	43.5%	171614	46.4%	28641	8.9%	177600	48.6%
2	950259	37.0%	551152	36.4%	139374	37.6%	130080	40.6%	129653	35.5%
3	368736	14.3%	198077	13.1%	40983	11.1%	99018	30.9%	30658	8.4%
4	149319	5.8%	72557	4.8%	7567	2.0%	59669	18.6%	9526	2.6%

There were a small number of scheduled appointments with a telemedicine mode prior to March 2020, and completion and no-show rates were not reliably measured. As such, these rates are only reported for the March 2020 to March 2021 period.

Appendix II: Health First Colorado Claims Data and Methods

Population of Interest

Individuals with at least one month of enrollment in Health First Colorado (the state's Medicaid program) from March 2017 through April 2021 were eligible for inclusion in the study population. The study population of interest is a person-month based on an individual's enrollment status in each month beginning in March 2017 through April 2021. Monthly enrollment status was determined using the budget groups defined by the Department of Health Care Policy and Financing (Department aggregated together into five groups of members (Study Groups) as follows:

Study Group	Budget Group(s)
Members with Disabilities not in Foster Care	Disabled Adults 60 to 64 (OAP-B) Disabled Buy-In - ADULT Disabled Individuals 18 to 59 (AND/AB) Disabled Buy-In - CHILD Disabled Individuals to 17 (AND/AB)
Adults 65 and older	Adults 65 and older (OAP-A)
Pregnant Adults	MAGI Pregnant Adults SB 11-250 Eligible Pregnant Adults
Children in Foster Care	Foster Care
Adults 18 – 64 not pregnant and without a disability	Breast & Cervical Cancer Program MAGI 69 - 133% FPL MAGI Adults MAGI TO 68% FPL
Children not in foster care and without a disability	MAGI Eligible Children SB 11-008 Eligible Children

Months that individuals were enrolled in Health First Colorado and with aid codes or other eligibilities that are not classified within one of these budget groups were excluded from the population of interest.

Additionally, months where members were enrolled in a capitated managed care plan with a plan type in one of the following codes were excluded:

Code	Description
ACCAK	ACC Access Kaiser
CARSK	Colorado Access Full RSK
CHP+D	Child Health Plan Plus - Dental
CHP+M	Child Health Plan Plus
PACE	Program For All-Inclusive Care For The Elderly
PIHP	Denver Health Medicaid Choice
RMHP	Rocky Mountain Health Plans Prime
SMCN	State Managed Care Network – CHP +

Visit Classification Algorithms

EMERGENCY DEPARTMENT VISITS:

Claims were identified as emergency department visits using the following criteria:

- 1 A claim type code of outpatient (including Medicare cross-over claims) and one of the following revenue codes: '0450', '0451', '0452', '0456', '0459', '0981'
OR
- 2 A professional claim (including Medicare cross-over claims) and a procedure code in the range of 99281 to 99285
OR
- 3 A professional claim (including Medicare cross-over claims) with a place of service of 23 and a procedure code of 69990 or between 10021 and 69979.

PRIMARY CARE VISITS:

Claims were identified as index PC visits using outpatient and professional claims (including Medicare cross-over claims), that did not occur during an inpatient stay, using the following criteria:

- 1 An attending provider of type 32, 45, or 61
OR
- 2 A claim with billing provider type code 16, 51
OR
- 3 A claim with rendering provider type code: 16, 26, 05, 25, 39, 41, 32, 45, or 51
AND
- 4 One of the following Current Procedural Terminology procedure codes:
 - In the range of 69210 to 69250
 - '36415', '36416', '59400', '59425', '59426', '59510', '59610', '59618', '77052', '77055', '77057', '77080', '82951', '82952', '87086', '90378', '90384', '90385', '90386', '90460', '90461', '90471', '90472', '90473', '90474', '90632', '90633', '90636', '90645', '90647', '90648', '90649', '90650', '90654', '90655', '90656', '90657', '90658', '90660', '90661',

'90669', '90670', '90672', '90680', '90681', '90686', '90688', '90696', '90698',
 '90700', '90702', '90703', '90704', '90705', '90707', '90708', '90710', '90713',
 '90714', '90715', '90716', '90718', '90721', '90723', '90732', '90733', '90734',
 '90736', '90740', '90743', '90744', '90746', '90747', '92551', '92552', '92553',
 '92558', '92585', '92586', '92587', '92588', '96110', '99173', '99174', 'D0120',
 'D0140', 'D0145', 'D0150', 'D0190', 'D1110', 'D1120', 'D1206', 'D1208', 'G0101',
 'G0102', 'G0124', 'G0143', 'G0144', 'G0145', 'G0147', 'G0148', 'G0202', 'G0432',
 'P3000', 'P3001', 'Q0091', 'Q0111', 'S0195', 'S3620', 'T1023', '69210', '90651',
 '90706', '96127', '98967', '98968', '98969', '99441', '99442', '99443', '99444',
 '99446', '99447', '99448', '99449', '99487', '99489', '99495', '99496', '99490',
 'G0181', '80055', '80061', '81007', '82270', '82274', '82465', '82728', '82947',
 '82948', '82950', '83020', '83036', '84030', '84153', '84478', '85013', '85014',
 '85018', '85660', '86580', '86592', '86593', '86631', '86632', '86689', '86701',
 '86702', '86703', '86782', '86803', '86804', '86901', '87081', '87088', '87110',
 '87164', '87166', '87205', '87270', '87285', '87320', '87340', '87341', '87350',
 '87380', '87390', '87391', '87490', '87491', '87520', '87521', '87522', '87590',
 '87591', '87592', '87801', '87810', '87850', '90847', '90853', '90887', '96372',
 '97802', '97803', '97804', '99050', '99201', '99202', '99203', '99204', '99205',
 '99211', '99212', '99213', '99214', '99215', '99304', '99305', '99306', '99307',
 '99308', '99309', '99310', '99315', '99316', '99318', '99324', '99325', '99326',
 '99327', '99328', '99334', '99335', '99336', '99337', '99341', '99342', '99343',
 '99344', '99345', '99347', '99348', '99349', '99350', '99355', '99363', '99364',
 '99367', '99368', '99381', '99382', '99383', '99384', '99385', '99386', '99387',
 '99391', '99392', '99393', '99394', '99395', '99396', '99397', '99401', '99402',
 '99403', '99404', '99406', '99407', '99408', '99409', '99411', '99412', '99420',
 '99429', 'G0442', 'G0443', 'G0444', 'G0445', 'G0446', 'G0447', 'G9006', 'G9012',
 'H0001', 'H0002', 'H0004', 'H0025', 'H0031', 'H0034', 'H0039', 'H0049', 'H1010',
 'H1011', 'T1017', '96150', '96151', '96152', '96153', '96154', '96155', '99398',
 '99497', 'H0023', 'S0257', '98966', '99374', '99375', '99377', '99378', '99379',
 '99380', 'G0182'

INDEX PRIMARY CARE VISITS:

Claims were identified as index primary care visits using outpatient and professional claims (including Medicare cross-over claims), that did not occur during an inpatient stay, using the following criteria:

- 1 Identified as a PC visit
AND
- 2 One of the following Current Procedural Terminology procedure codes:

'76801', '76802', '76805', '76811', '76812', '76813', '76814', '76815', '76816', '76817',
 '90791', '90792', '90832', '90833', '90834', '90836', '90837', '90838', '90839', '90840',
 '90846', '90847', '90849', '90853', '90863', '92507', '92508', '92521', '92522', '92523',
 '92524', '92526', '92606', '92607', '92608', '92609', '92610', '92630', '92633', '96101',
 '96102', '96110', '96111', '96112', '96113', '96116', '96118', '96119', '96121', '96125',
 '96130', '96131', '96132', '96133', '96136', '96137', '96138', '96139', '96146', '97110',
 '97112', '97129', '97130', '97140', '97150', '97151', '97153', '97154', '97155', '97158',

'97161', '97162', '97163', '97164', '97165', '97166', '97167', '97168', '97530', '97533', '97535', '97537', '97542', '97755', '97760', '97761', '97763', '97802', '97803', '97804', '98966', '98967', '98968', '99201', '99202', '99203', '99204', '99205', '99211', '99212', '99213', '99214', '99215', '99382', '99383', '99384', '99392', '99393', '99394', '99401', '99402', '99403', '99404', '99406', '99407', '99408', '99409', '99441', '99442', '99443', 'G0108', 'G0109', 'G8431', 'G8510', 'G9006', 'H0001', 'H0002', 'H0004', 'H0006', 'H0025', 'H0031', 'H0032', 'H0049', 'H1005', 'H2000', 'H2011', 'H2015', 'H2016', 'S9445', 'S9485', 'T1017', 'V5011'

Visits were identified as telemedicine if they satisfied: a claim type code of professional claim (including Medicare cross-over claims) and a place of service of 02 (telemedicine) or a claim type code of outpatient (including Medicare cross-over claims) and a procedure modifier of GT. Visits that were not identified as telemedicine were considered to be in-person. In the very rare instances where the same individual had multiple index primary care claims occur on the same day with both in-person and telemedicine modes we excluded both claims from the analysis (0.1%). These index primary care visits were excluded because we needed to identify an index visit as either a telemedicine or in-person visit on a calendar day for the time to event analysis.

Covariate and Outcome Definitions for Time to Event Analysis

An index PC visit is defined as a PC visit that was eligible for reimbursement as a telemedicine visit prior to November 12, 2020 as identified by the Department (hcpf.colorado.gov/provider-telemedicine) and detailed below. An index PC visit includes both in-person and telemedicine visits. ED and all PC visits were defined as specified above. Index PC visits that occurred between March 1, 2018 and January 31, 2020, and after March 14, 2020, were included in the analysis. The number of days from an index PC visit to an ED or PC visit is defined over a 60-day period following an index PC visit. The time to event is the number of days following the index PC visit to the first ED or PC visit, whichever occurred first. If neither an ED nor PC visit occurred within 60 days, the time to event was set to 60 days and identified as a censored observation in the analysis. The 60-day window was modified to the end of the last day of the month of observed enrollment if an individual's enrollment in Health First Colorado ended sooner than 60 days. Additionally, index visits occurring in January 2020 were censored at February 29, 2020. If both an ED and PC visit were observed on the same day, the subject was considered to have had an ED visit.

Medical Complexity

Claims for the year prior to each index event were used to measure an individual's medical complexity. For individuals younger than 18 years of age at the time of the index primary care visit, medical complexity was assessed using the Pediatric Medical Complexity (PMCA) algorithm (Simon TD, Cawthon ML, Stanford S, et al. Pediatric medical complexity algorithm: a new method to stratify children by medical complexity. *Pediatrics*. 2014;133(6):e1647-e1654. doi:10.1542/peds.2013-3875). For index primary care visits where the individual was 18 years or older, we assessed the individual's medical complexity using the Charlson Comorbidity Index algorithm (Glasheen WP, Cordier T, Gumpina R, Haugh G, Davis J, Renda A. Charlson Comorbidity Index: ICD-9 Update and ICD-10 Translation. *Am Health Drug Benefits*. 2019 Jun-Jul;12(4):188-197. PMID: 31428236; PMCID: PMC6684052.). We created a three-level measure of medical complexity from each of these algorithms. Individuals assessed using the PMCA were assigned to level 1 if the PMCA algorithm identified the individual as having no chronic conditions, level 2 if the algorithm indicated the individual had a non-complex chronic condition and level 3 if the individual had a complex chronic condition. Individuals assessed using the Charlson Comorbidity Index were assigned to level 1 if they had no identified comorbidities, level 2 if they had one identified comorbidity and level 3 if they had more than one identified comorbidity.

Geographic Features

For each index primary care visit we created a measure to account for any potential geographic differences in the likelihood of experiencing a subsequent emergency department or primary care visit. Specifically, we created a three-level measure using the county of enrollment at the time of the index visit using Rural Urban Continuum Codes (<https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation/>). Counties were classified as Metro (codes 1-3), Adjacent to Metro (codes 4, 6, 8), and Rural (codes 5, 7, 9).

2013 Rural-Urban Continuum Codes	
Code	Description
Metro counties:	
1	Counties in metro areas of 1 million population or more
2	Counties in metro areas of 250,000 to 1 million population
3	Counties in metro areas of fewer than 250,000 population
Nonmetro counties:	
4	Urban population of 20,000 or more, adjacent to a metro area
5	Urban population of 20,000 or more, not adjacent to a metro area
6	Urban population of 2,500 to 19,999, adjacent to a metro area
7	Urban population of 2,500 to 19,999, not adjacent to a metro area
8	Completely rural or less than 2,500 urban population, adjacent to a metro area
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area

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