

Impact of the COVID-19 Pandemic on Treatment for Mental Health Needs: A Perspective on Service Use Patterns and Expenditures from Commercial Medical Claims Data

Ta-Hsin Li (✉ thl@us.ibm.com)

IBM Research - Thomas J. Watson Research Center

Leah Kamin

IBM Watson Health

Judy George

IBM Watson Health

Fernando Suarez Saiz

IBM Watson Health

Pablo Meyer

IBM Research - Thomas J. Watson Research Center

Research Article

Keywords:

Posted Date: June 16th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1630631/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Version of Record: A version of this preprint was published at BMC Health Services Research on February 16th, 2023. See the published version at <https://doi.org/10.1186/s12913-023-09080-9>.

Abstract

Objective: To examine changes in use patterns, cost of healthcare services before and after the outbreak of the COVID-19 pandemic, and their impacts on expenditures for patients receiving treatment for depression, anxiety, eating disorders, and substance use.

Methods: This cross-sectional study employed statistical tests to analyze claims in Marketscan® Commercial Database in March 2020-February 2021 and quarterly from March 2020 to August 2021, compared to respective pre-pandemic periods.

Results: Comparing year-over-year changes before and after the pandemic outbreak, proportion of patients receiving anxiety treatment among all individuals obtaining healthcare services grew at a higher rate (13.7% versus 10.0%) which, along with a higher rate of increase in price per episode (5.5% versus 4.3%) resulted in a greater increase in per claimant expenditure (\$0.61 versus \$0.41 per month); proportion of patients receiving treatment for depression grew at a lower rate (3.7% versus 6.9%), but per claimant expenditure grew by same amount due to an increase in price per episode (4.8%). Proportion of patients receiving treatment for anorexia started to increase in the fall of 2020 (21.1% or higher). Patient proportion of alcohol use in age group 18-34 decreased (17.9%) during the pandemic but price per episode increased (26.3%). Patient proportion of opioid use increased in March-May 2020 (11.5%) but decreased or had no significant changes in subsequent periods.

Conclusions: The COVID-19 pandemic resulted in use pattern and expenditure changes for patients receiving mental health services that varied across conditions and time periods. Some use patterns were unexpected.

Key Points

We investigated the changes in use patterns and expenditures of mental health patients before and after the outbreak of the COVID-19 pandemic using claims data in Marketscan®. We found that the changes and their financial impacts vary across conditions and periods of the pandemic. Some changes are unexpected from previously reported prevalence increases among the general population and could underlie unmet treatment needs. Therefore, mental health providers should anticipate the use pattern changes in services with similar COVID-19 pandemic disruptions and payers should anticipate cost increases due, in part, to increased price and/or service use.

1. Introduction

The impact of COVID-19 pandemic and related public health, social and economic measures on mental health conditions have attracted attention from public health researchers and the media [1–19]. Much of the current research describes the epidemiological impacts of COVID-19 on mental health without describing the actual use patterns and their financial implications during the pandemic [1]. This study adds to that literature by identifying changes resulting from the pandemic in use patterns and costs for

patients receiving mental health services and the implications of these changes on expenditures for selected common mental health conditions. These conditions are depression, generalized anxiety disorder, anorexia and bulimia eating disorders, alcohol and opioid use disorders.

The COVID-19 pandemic has generally impacted health service utilization patterns in commercially-insured populations [20]. Notably, there has been significant reductions in preventive healthcare and elective surgeries [20][21]. It is believed these service impacts may be the result of patient fears of infection and reduced or disrupted access to health services [19]. Mental health impacts of the pandemic have been a focus of academic research and media coverage because of the uncertainty and unpredictability of the pandemic leading to increases in known risk factors for mental health conditions. Unlike preventive health and elective surgeries, there is evidence that mental health services use increased during the pandemic as a proportion of total service use [7]-[10].

This cross-sectional analysis uses anonymized patient-level medical claims data from Marketscan® Commercial Database to add insight and clarity to the impact of the COVID-19 pandemic on mental health services. The data are contributed by commercial insurers and cover a population of employees and their dependents who are geographically dispersed across the U.S [22].

By grouping claims into mental health episodes, we detect changes in the proportions of patients receiving mental health services among all individuals with a claim (claimants), the prices per episode, and the episodes per patient, by comparing them in various time periods during the pandemic with the respective periods before the pandemic. Impacts of these changes on the per claimant expenditure are also calculated.

The findings presented here are potentially useful for health insurers to anticipate mental health service changes driven by system-wide disruptions like the COVID-19 pandemic. The findings are also potentially useful for service providers involved with reforming mental health service delivery to address the lasting impacts of the COVID-19 pandemic. Additionally, researchers can use these findings to support hypothesis generating research.

2. Methods And Declaration

The methods described below were originally designed for continuous surveillance and monitoring of changes in all medical conditions and services based on claims data [20].

2.1 Sampling and Grouping

The study design considers 12-month time windows covering or containing a period of interest. For each time window, we analyzed a random sample of 5 million individuals enrolled in a non-capitated healthcare plan for at least one month within the time window; the study included all claims incurred and paid within the time window.

Medical and pharmacy claims within each time window were grouped into medical episodes using Medical Episode Grouper (MEG) based on primary diagnosis codes in the claims together with a consideration of time proximity and clinical relevance [23][24] (see supplementary material).

2.2 Nomenclature and Key Performance Indices

For each target or reference period, we focus on enrollees with at least one claim in this period for any reason; we call them *claimants*. The expenditure on a mental health condition, denoted as *Cost*, is defined as the total allowed amount in the claims for treating patients with this condition, normalized by the number of claimants; it represents the contribution of this condition to the total per claimant expenditure on all conditions.

We consider three factors in use patterns and expenditures that potentially drive the changes of *Cost* in a time period: (1) price per episode, or *Price*, defined as the allowed amount per episode of the condition, (2) episode intensity, or *EPR* (episode-to-patient ratio), defined as the number of episodes per patient, and (3) patient proportion, or *PCR* (patient-to-claimant ratio), defined as the proportion of patients being treated for the condition among all claimants.

For each factor, the *rate of change* is calculated in the target period relative to the reference period. The *financial impact* of this change is defined as the increment of *Cost* when this factor takes on the value in the target period while the remaining factors are held at their values in the reference period (see supplementary material).

The financial impacts of these factors are additive components of the overall financial impact defined simply as the difference between *Cost* in the target period and *Cost* in the reference period. The residual of the overall financial impact after removing these components is attributable to interactions among the contributing factors. All financial impacts will be presented in the unit of US dollars per month as will be for *Cost*.

To detect changes in these factors, we employ a *Z*-test procedure for log ratios in the target period relative to the reference period [25-28] (see supplementary material).

We investigate the effect of the pandemic by comparing the rate of change and the financial impact of change calculated in a pandemic period with a baseline calculated in a pre-pandemic period. The differences between these quantities are called *excess rate of change* and *excess financial impact of change*.

2.3 Target and Reference Periods

This study involves two types of analysis, yearly and quarterly. In the yearly analysis, we considered a 12-month target period 3/2020-2/2021 starting at the outbreak of the pandemic; the pre-pandemic reference

period is 3/2019-2/2020. In the quarterly analysis, we considered six consecutive 3-month target periods during the pandemic starting in 3/2020 until 8/2021. The reference periods are the respective pre-pandemic periods a year prior (or two-year prior if the target period falls in the second year of the pandemic).

2.4 Ethics Approval and Consent to Participate

All experiments were performed in accordance with relevant guidelines and regulations.

3. Results

Table 1 contains the per claimant expenditure (Cost) of each mental health condition in the 12-month period 3/2020-2/2021 together with its contributing factors: price per episode (Price), episode intensity (EPR), and patient proportion (PCR). These quantities are obtained for patients in five age groups as well as for patients in all age groups combined. In this period, the per claimant expenditure on all conditions was \$460.18 per month, of which \$8.12 was spent on depression, \$3.63 on anxiety, \$0.46 on anorexia, \$0.19 on bulimia, \$3.11 on treating patients for alcohol use, and \$0.96 on treating patients for opioid use.

Table 2 shows the rates of change (with 95% confidence intervals) and the financial impacts of change in the contributing factors together with the overall financial impact (Overall) from the yearly analysis. Table 3 summarizes the types of detected changes shown in Table 2 (with moderate or strong statistical significance) and over financial impacts for patients in all age groups combined. Table 4 contains the results of the quarterly analysis, also for patients in all age groups combined.

3.1. Depression and Generalized Anxiety Disorder

In the yearly analysis (Tables 2 & 3), increases in patient proportion of depression and anxiety for all age groups combined are detected in both pandemic and pre-pandemic periods. The patient proportion of anxiety grew at a higher rate in the pandemic period (13.7% versus 10.0%), which, along with a higher rate of increase in price per episode (5.5% versus 4.3%), resulted in a greater increase in per claimant expenditure (\$0.61 versus \$0.41 per month). The patient proportion of depression grew at a lower rate in the pandemic period (3.7% versus 6.9%), but per claimant expenditure grew by the same amount due to an increase in price per episode (4.8%). As a result of these changes in patient proportion, the excess rate and financial impact (Figures 1a and 1b) are negative for depression but positive for anxiety.

When broken down into age groups (Table 2), depression for all age groups had a lower rate of increase in patient proportion in the pandemic period; anxiety had a higher rate of increase in patient proportion for all age groups except age group 0-17 where the rate was lower. For depression, the price per episode increased mainly in age group 35-44, but for anxiety, it increased mainly in age group 18-34.

In the quarterly analysis of patients in all age groups combined (Table 4), all six pandemic periods saw an increase in patient proportion of anxiety; a decrease in patient proportion of depression was detected only in the summer of 2020 (period 2), and the remaining periods had either an increase (periods 1 and 4-6) or no change (period 3). For anxiety, the observed excess rate and financial impact of change in patient proportion (Figures 2a and 2b) were positive in all periods except the summer and fall of 2020 (periods 2 and 3); the nearly 15% excess rate in the spring of 2020 (period 1) was a main contributor to the overall positive excess rate for the following 12-month pandemic period (Figure 1a). In contrast, the observed excess rate and financial impact of change in patient proportion of depression (Figures 2a and 2b) were negative in the summer and fall of 2020 (periods 2 and 3) and in the summer of 2021 (period 6); the nearly -15% excess rate in the summer of 2020 (period 2) was the main contributor to the overall negative excess rate for the 12-month pandemic period (Figure 1a).

The price per episode of depression and anxiety increased in all quarterly pandemic periods except the spring of 2020 (period 1). The increased price per episode of depression in the summer of 2020 (period 2) drove the overall expenditure up despite a decrease in patient proportion. The price per episode of anxiety played a lesser role in the overall financial impact.

3.2. Eating Disorders

In the yearly analysis for anorexia (Table 2), a 20.3% increase in patient proportion was detected in the pandemic period for patients in all age groups combined, but it jumped to 40.2% for patients under age 18; the observed excess rate of change also increased from about 10% to 30% when comparing the same groups (Figure 1c), whereas the observed excess financial impacts were comparable (Figure 1d). Unexpectedly, considering all patients treated for bulimia, another eating disorder, an increased patient proportion detected in the pre-pandemic period was not present in the pandemic period.

The quarterly analysis (Table 4) shows that an increase in patient proportion of anorexia was detected not in the earlier periods of the pandemic but in the fall of 2020 and thereafter (periods 3-6), and the observed excess rate and financial impact (Figures 2c and 2d) became much higher in the winter of 2020 and thereafter (period 4-6). An increase in patient proportion of bulimia was detected early in the spring of 2020 (period 1) associated with the lockdowns, and later in the winter of 2020 and thereafter (periods 4-6); the over -20% excess rate in the summer of 2020 (period 2) determined the overall negative excess rate for the 12-month pandemic period (Figure 1c).

3.3 Alcohol and Opioid Use

For the yearly analysis (Tables 2 & 3), a 4.8% decrease in the patient proportion for treating alcohol use was detected in the pandemic period when all age groups were combined; this decrease was accompanied by a 19.2% increase in price per episode, resulting in a greater increase in the overall expenditure compared to the pre-pandemic period (\$0.36 versus \$0.01). For patients in age group 18-34

(Table 2), there was a more pronounced 17.9% decrease in patient proportion, together with a 26.3% increase in price per episode; the observed excess rate for patient proportion was over -15% (Figure 1e). For the same age group, a decrease in patient proportion for treating opioid use was also detected in the pandemic period, but the observed excess rate and financial impact were positive (Figures 1e and 1f).

For the quarterly analysis (Table 4), a decrease in patient proportion for treating alcohol use was detected in the summer and fall of 2020 (periods 2 and 3) which largely determined the overall negative excess rate of patient proportion in the 12-month pandemic period (Figure 1e). In the summer of 2020 (period 2), a 20.7% increase in price per episode dominated a 9.9% decrease in patient proportion and drove up the per claimant expenditure in this period by \$0.44. For treating opioid use, an increase in patient proportion was detected earlier in the spring of 2020 (period 1); the observed excess rate in this period was over 15% (Figure 2e), but it was offset by a decrease in the summer of 2020 (period 2), resulting in a small positive excess rate in the yearly assessment in the pandemic period (Figure 1e). In the remaining quarterly periods, the observed excess rate and financial impact of change in patient proportion (Figures 2e and 2f) were all negative for treating opioid use.

4. Discussion

The COVID-19 pandemic changed the use patterns and expenditures for patients receiving mental health services. In the 12-month period 3/2020-2/2021, there was a higher rate of increase in the proportion of patients receiving anxiety treatment (except for those under 18 years of age) among all claimants. In this same period, there was a lower rate of increase in the proportion of patients receiving depression treatment. Further studies are needed to explain why these proportions behaved differently during the pandemic among previously reported prevalence increases of these conditions in the general population [4][5], especially whether telemedicine played different roles for these patients.

The lower rate of increase in the proportion of patients aged 18 and younger for anxiety treatment may indicate an unmet need in this age group. Future research should understand the drivers of this unmet need (e.g., access issues with schools being closed, stigma issues, etc.) especially given the increased use of services for anorexia in this age group. The higher rate of increase in the proportion of patients for anxiety treatment in the summer of 2021 (period 6), in contrast with a lower rate of increase in the summer of 2020 (period 2), may be indicative of a more prolonged need for anxiety services.

Prices per episode for depression and anxiety grew at a higher-than-expected rate during the pandemic. Since the analysis suggests the use of services for depression and anxiety may remain high, health insurers may want to focus on ways to control price as a mechanism to address rising costs for depression and anxiety episodes.

Increases of eating disorder prevalence during the pandemic have been reported in the literature [14]. Our analysis shows that patients receiving treatment for anorexia accounted for a higher-than-expected proportion of all claimants only after the fall of 2020 (period 3) rather than immediately after the outbreak of the pandemic (period 1). Patients receiving treatment for bulimia had a similarly delayed

increase. Future research is needed to investigate reasons for this phenomenon, for example, whether it was caused by limited accessibility for traditional treatment of eating disorders in the beginning of the pandemic [9].

According to a Rand study [18], adult consumption of alcohol increased 14% during the pandemic. Our study shows that patients receiving treatment for alcohol use, largely driven by patients in age group 18-34, accounted for a lower-than-expected proportion among all claimants after the outbreak of the pandemic, and the proportion has stayed low since after initial lockdowns. Additional studies are needed to explain this decrease against previously reported increase in alcohol consumption and deaths, but it could also be explained by unmet needs [18][32].

The COVID-19 pandemic proved to be a unique challenge for treating opioid dependence conditions. In the US, the Substance Abuse and Mental Health Services Administration (SAMHSA) went so far as to change treatment guidelines to address possible disruptions in care [19]. Our study shows that in the first three months after the outbreak of the pandemic, the proportion of patients receiving treatment for opioid use among all claimants was higher than expected compared to the same period in the previous year. This may be attributed in part to the ability of these patients to leverage telehealth services [29-31] especially in comparison with patients in need of treatment for alcohol use. However, similar to alcohol use, the time periods following that initial lockdown period show a decrease or no change in the proportion of patients receiving treatment for opioid use relative to the pre-pandemic periods. Further research is needed to understand the implication of these patterns, but such unmet needs might explain the overall reported increase in opioid abuse related deaths [33].

Overall, we think that the unmet needs here described could be a consequence of the healthcare system not being ready to support a society in lockdown and that even an initial increase in telehealth usage [20] [30] could not replace in-person treatment.

5. Limitation

Marketscan® Database only represents a commercially insured population, so any generalization to a different population should be considered with care. Medical episodes built by the MEG methodology are based on primary diagnosis and may undercount claims where mental health conditions were not primary diagnoses or missing from the diagnosis list. A depression episode may be absorbed into a major depressive episode of bipolar disorder if they occurred in close proximity of time, and the latter group was excluded from this analysis. Finally, our analysis excluded claims with missing financial variables.

6. Conclusion

Based on a cross-sectional analysis of health insurance claims in Marketscan® Commercial Database, this study identified changes in use patterns and expenditures for six common mental health conditions.

These changes and their financial impacts vary across conditions and periods of the pandemic. Some use patterns were unexpected from previously reported prevalence increases among the general population, including a lower rate of increase for treatment of depression, a decrease for treatment of alcohol use, no significant change in treatment of opioid use, and a delayed increase for treatment of anorexia. This observational analysis provides insights for health insurers, service providers, and researchers on the impact of the COVID-19 pandemic on mental health services in a commercially-insured population and points to several potential unmet treatment needs.

Declarations

Ethical Approval and consent to participate:

All experiments were performed in accordance with relevant guidelines and regulations

Consent to Publication:

Not applicable

Data Availability statement:

Marketscan® data are commercially available.

Conflict of interest:

No

Funding:

None

Acknowledgment:

Not applicable

Author contribution:

THL prepared tables and figures, and contributed to the writing of the main manuscript text. LK, JG, FS, and PM contributed to the writing of the main manuscript text. All authors reviewed the manuscript.

Additionally,

The paper does not report experiments on humans and/or the use of human tissue samples.

References

1. Moreno C, Wykes T, Galderisi S, Nordentoft M, Crossley N, Jones N, Cannon M, Correll CU, Byrne L, Carr S, Chen EYH, Gorwood P, Johnson S, Kärkkäinen H, Krystal JH, Lee J, Lieberman J, López-Jaramillo C, Männikkö M, Phillips MR, Uchida H, Vieta E, Vita A, Arango C. How mental health care should change as a consequence of the COVID-19 pandemic. *Lancet Psychiatry*. 2020;7(9):813-824, ISSN 2215-0366, [https://doi.org/10.1016/S2215-0366\(20\)30307-2](https://doi.org/10.1016/S2215-0366(20)30307-2)
2. Pierce BS., Perrin PB, Tyler CM, McKee GB, Watson JD. The COVID-19 telepsychology revolution: A national study of pandemic-based changes in U.S. mental health care delivery. *American Psychologist*. 2021;76(1):14–25. <https://doi.org/10.1037/amp0000722>
3. Czeisler MÉ, Lane RI, Petrosky E, et al. Mental health, substance use, and suicidal ideation during the COVID-19 pandemic – United States, June 24-30, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69:1049–1057. <http://dx.doi.org/10.15585/mmwr.mm6932a1>
4. C.S. Mott Children’s Hospital Mott Poll Report. How the pandemic has impacted teen mental health. August 2021. https://mottpoll.org/sites/default/files/documents/031521_MentalHealth.pdf
5. Ettman CK, Abdalla SM, Cohen GH, Sampson L, Vivier PM, Galea S. Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. *JAMA Netw Open*. 2020;3(9):e2019686. doi:10.1001/jamanetworkopen.2020.19686
6. Shah M, Sachdeva M, Johnston H. Eating disorders in the age of COVID-19. *Psychiatry Res*. 2020;290:113122. doi:10.1016/j.psychres.2020.113122
7. Taquet M, Geddes J, Luciano S, Harrison P. Incidence and outcomes of eating disorders during the COVID-19 pandemic. *The British Journal of Psychiatry*. 2021;1-3. doi:10.1192/bjp.2021.105
8. Otto AK, Jary JM, Sturza J, Miller CA, Prohaska N, Bravender T, Van Huysse J. Medical Admissions Among Adolescents with Eating Disorders During the COVID-19 Pandemic. *Pediatrics*. 2021;148(4):e2021052201. doi:10.1542/peds.2021-052201
9. Touyz S, Lacey H, Hay P. Eating disorders in the time of COVID-19. *J Eat Disord*. 2020;8(19). doi:10.1186/s40337-020-00295
10. FAIR Health White Paper. The impact of COVID-19 on pediatric mental health. March 2021. <https://www.fairhealth.org/publications/whitepapers>
11. van Hoeken D, Hoek HW. Review of the burden of eating disorders: mortality, disability, costs, quality of life, and family burden. *Curr Opin Psychiatry*. 2020;33(6):521-527. doi:10.1097/YCO.0000000000000641
12. Solmi F, Downs JL, Nicholls DE. COVID-19 and eating disorders in young people. *Lancet Child Adolesc. Health*. 2021 May;5(5):316-318. doi: 10.1016/S2352-4642(21)00094-8. PMID: 33864741.
13. Rodgers RF, Lombardo C, Cerolini S, et al. The impact of the COVID-19 pandemic on eating disorder risk and symptoms. *Int J Eat Disord*. 2020;53(7):1166–1170.
14. Asch DA, Buresh J, Allison KC, Islam N, Sheils NE, Doshi JA, Werner RM. Trends in US Patients Receiving Care for Eating Disorders and Other Common Behavioral Health Conditions Before and

- During the COVID-19 Pandemic. *JAMA Netw Open*. 2021;4(11):e2134913. doi:10.1001/jamanetworkopen.2021.34913
15. Ochalek TA, Cumpston KL, Wills BK, Gal TS, Moeller FG. Nonfatal opioid overdoses at an urban emergency department during the COVID-19 pandemic. *JAMA*. 2020.doi:10.1001/jama.2020.17477
 16. Graupensperger S, Jaffe A, Flemming CNB, Kilmer JR, Lee CM, Larimer ME. Changes in College Student Alcohol Use During the Covid-19 Pandemic: Are perceived drinking norms still relevant? *Emerging Adulthood*. 2021; 9.5:531-540. doi:10.1177/2167696820986742
 17. Huskamp HA, Busch AB, Uscher-Pines L, Barnett ML, Riedel L, Mehrotra A. Treatment of Opioid Use Disorder Among Commercially Insured Patients in the Context of the COVID-19 Pandemic. *JAMA*. 2020;324(23):2440–2442. doi:10.1001/jama.2020.21512
 18. Pollard MS, Tucker JS, Green HD. Changes in adult alcohol use and consequences during the COVID-19 pandemic in the US. *JAMA Netw Open*. 2020;3(9):e2022942. doi:10.1001/jamanetworkopen.2020.22942
 19. Alexander GC, Stoller KB, Haffajee RL, et al. An epidemic in the midst of a pandemic: Opioid use disorder and COVID-19. *Ann Intern Med*. 2020;173:57-58. doi:10.7326/M20-1141
 20. Medical Claims Monitor: Monitoring the Impact of COVID-19 Across the Healthcare Continuum Based on Claims Data. https://researcher.watson.ibm.com/researcher/view_group.php?id=10570
 21. Whaley CM, Pera MF, Cantor J, Chang J, Velasco J, Hagg HK, Sood N, Bravata DM. Changes in Health Services Use Among Commercially Insured US Populations During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;3(11):e2024984. doi:10.1001/jamanetworkopen.2020.24984
 22. IBM MarketScan Research Databases. <https://www.ibm.com/products/marketscan-research-databases>
 23. IBM Watson Health White Paper. The medical episode grouper: applications and methodology. April 2018. <https://www.ibm.com/downloads/cas/EZALXAMB>
 24. Peterson C, Grosse SD, Dunn A. A practical guide to episode groupers for cost-of-illness analysis in health services research. *SAGE Open Medicine*. 2019;7:1–6. doi:10.1177/2050312119840200
 25. Friedrich J, Adhikari N, Beyene J. The ratio of means method as an alternative to mean differences for analyzing continuous outcome variables in meta-analysis: A simulation study. *BMC Medical Research Methodology*, 2008;8(32). doi:10.1186/1471-2288-8-32
 26. Katz D, Baptista J, Azen SP, Pike MC. Obtaining confidence intervals for the risk ratio in cohort studies, *Biometrics*. 1978;34(3):469–474. <https://doi.org/10.2307/2530610>
 27. Gart JJ, Nam J. Approximate interval estimation of the ratio of binomial parameters: A review and corrections for skewness. *Biometrics*. 1988;44:323–338. <https://doi.org/10.2307/2531848>
 28. Li TH, Yuen-Reed GYC, Jiang H, Tran KN, Kelley B, Halvorson T. Searching and detecting interpretable changes within a hierarchical healthcare data structure in a systematic automated manner. US Patent US20200251205A1. 2020.

29. Mansour O, Tajaniangit M, Heyward J, Mojtabal R, Alexander GC. Telemedicine and office-based care for behavioral and psychiatric conditions during the COVID-19 pandemic in the United States. *Annals of Internal Medicine*. 2021;174(3):428-430. doi:10.7326/M20-6243
30. Eyllon M, Barnes JB, Daukas K, Fair M, Nordberg SS. The impact of the Covid-19-related transition to telehealth on visit adherence in mental health care: An interrupted time series study. *Administration and Policy in Mental Health and Mental Health Services Research*. 2021;doi:10.1007/s10488-021-01175-x
31. Uscher-Pines L, Sousa J, Raja P, Mehrotra A, Barnett M, Huskamp HA. Treatment of opioid use disorder during COVID-19: Experiences of clinicians transitioning to telemedicine. *Journal of Substance Abuse Treatment*. 2020;118:108124. doi:10.1016/j.jsat.2020.108124
32. White AM, Castle IJP, Powell PA, Hingson RW, Koob, GF. Alcohol-related deaths during the COVID-19 pandemic. *JAMA Netw Open*. 2022;doi:10.1001/jama.2022.4308
33. National Institute on Drug Abuse. Overdose death rates. Accessed February 15, 2022. <https://nida.nih.gov/drug-topics/trends-statistics/overdose-death-rates>

Tables

Tables 1 to 4 are available in the Supplementary Files section

Figures

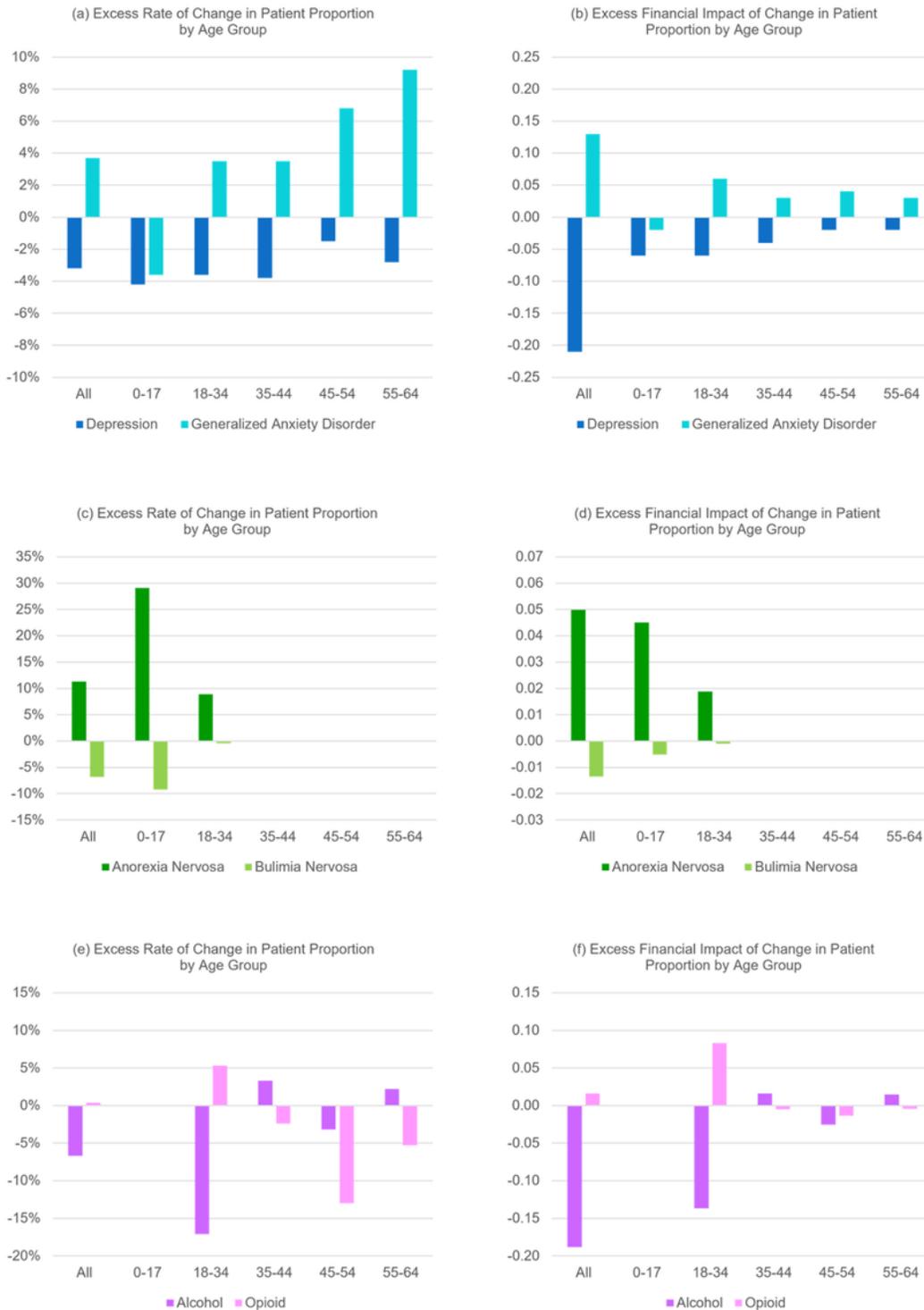


Figure 1

. (a) and (b): excess rate of change and excess financial impact of change in patient proportion (PCR) of depression and generalized anxiety disorder episodes by age group in the pandemic period 3/2020-2/2021 when compared to the baseline in the pre-pandemic period 3/2019-2/2020. (c) and (d): same for anorexia nervosa and bulimia nervosa episodes. (e) and (f): same for alcohol and opioid abuse episodes.

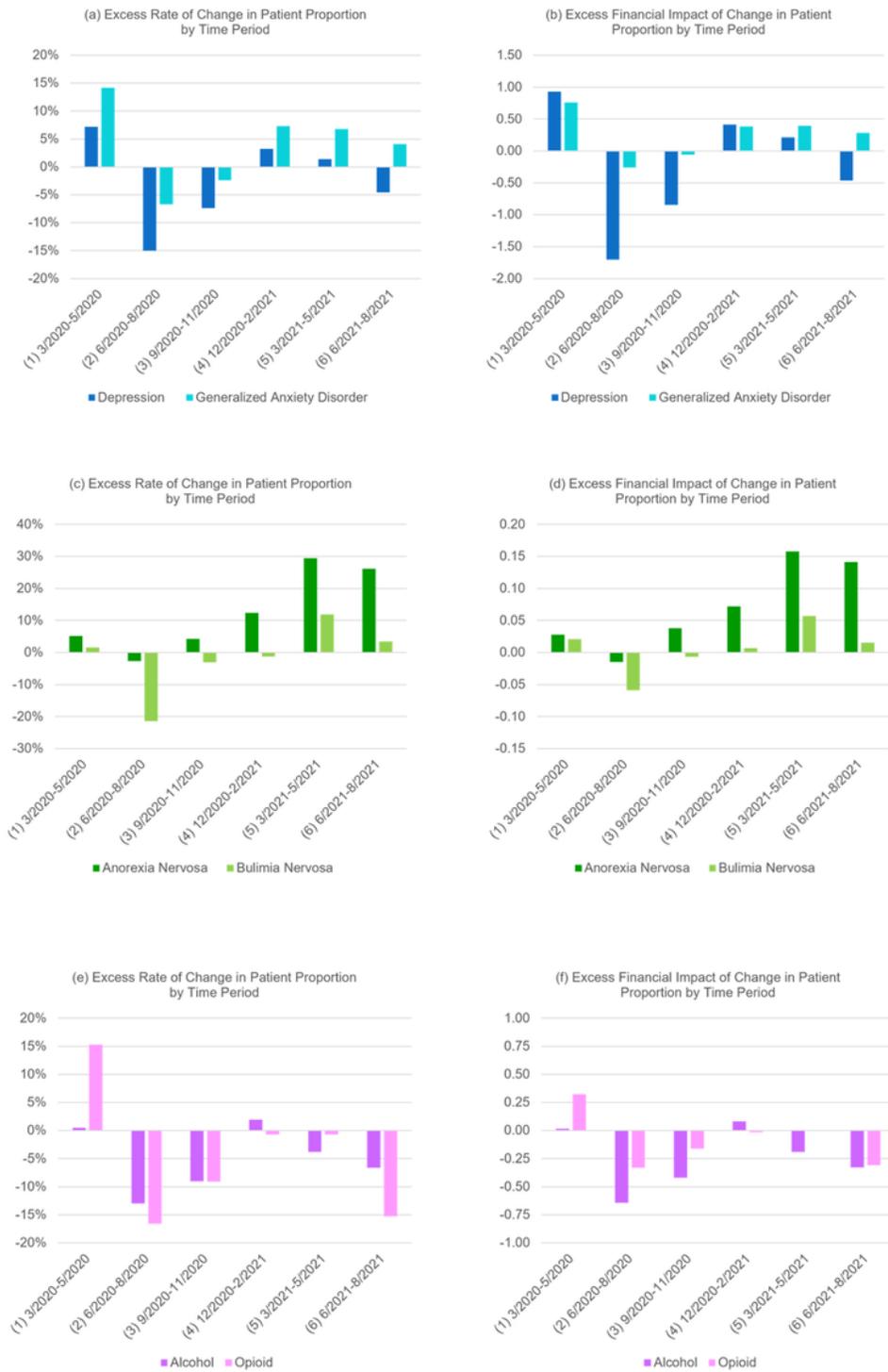


Figure 2

(a) and (b): excess rate of change and excess financial impact of change in patient proportion (PCR) of depression and generalized anxiety disorder episodes in six periods during the pandemic when compared

to the baseline in the respective periods before the pandemic. (c) and (d): same for anorexia nervosa and bulimia nervosa episodes. (e) and (f): same for alcohol and opioid abuse episodes.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [ImpactofCOVID19onMentalHealthsupplementaryv2.pdf](#)
- [Tables.docx](#)