PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Trends in the utilization of emergency departments in California, 2005-2015: a retrospective analysis
AUTHORS	Hsia, Renee; Sabbagh, Sarah; Guo, Joanna; Nuckton, Thomas; Niedzwiecki, Matthew

VERSION 1 – REVIEW

REVIEWER	Prof. Dr. Matthias David Charité - University Medicine Berlin, Germany
REVIEW RETURNED	15-Jan-2018

GENERAL COMMENTS	The article considers a very important topic. For years the utilization of emergency departments is globally increasing in the industrial countries. Reasons for this and consequential necessary structural changes should be investigated. Following questions should be answered by the authors and following changes should be done in the manuscript: 1) The study refers only to the health system in the U. S. and the state California which is clearly limiting the validity and generalizability. This is a crucial limitation. 2) Which is the main research hypothesis? 3) Why was the 11-year-interval 2005-2015 chosen? 4) How reliable and exact are the register data (PDD, EDD, OSHPD)? 5) How were “multiple user” of emergency departments (one person utilizes one or more emergency departments repeatedly per year) considered or excluded? 6) Please divide the main diagnoses (page 8/9) at least in women and men, as appropriate furthermore by age groups. 7) The discussion part is clearly too long. Please shorten/cancel at least one page. 8) In “Limitations” absolutely point out the retrospective character of the study. 9) The references are with almost 70 sources very long. 10) Table 2 is dispensable.

REVIEWER	Lauren Birmingham Kent State University, United States

REVIEW RETURNED	26-Jan-2018

GENERAL COMMENTS	Summary: This manuscript presents an overview of emergency department (ED) utilization trends and ED user characteristics in California from 2005-2015. *Methods: How were hospital observation visits categorized? (hospital admission vs. treat & release). Clarify in Methods section. Utilization of observation services has grown overtime--thus the classification of observation visits could impact the trends that were being assessed in this manuscript. *Discussion and Abstract Conclusion: The abstract conclusion states "Our findings reveal considerable unmet healthcare needs and suggest that policies or programs aimed at increasing regular healthcare access among specific patient groups may have the potential to lessen demands on EDs...". I understand the argument made on page 12-- that the relatively low number of ED visits made by Hispanics is likely due to the reasons cited (language barriers, fear of deportation, etc.). However, "unmet healthcare needs" are really the gap between care that is received and care that is *needed*. I'm not sure the authors thoroughly demonstrated that these ED services were truly needed--thus, I would suggest tempering the argument that the findings "reveal considerable unmet healthcare needs". This conclusion is potentially overstated, given the data. We know there is a lot of waste in healthcare, so it may not be correct to assume that all ED visits are needed, and thus, that any population using a relatively lower level of ED visits is experiencing unmet healthcare need. *Abstract Primary and Secondary Outcome Measures: The word "the" is missing from the last sentence. It should precede the word "proportion" in the last sentence.

REVIEWER	Erika H. Newton, MD, MPH Dept. of Emergency Medicine, Stony Brook University, USA
REVIEW RETURNED	31-Jan-2018

GENERAL COMMENTS	General Comments The study is amply justified, well conceived and executed, and should be published. The quality of the writing is strong. The methodology is straightforward and is appropriate to the purpose. The Results are well served by the primary tables and figure, with additional tables available in an Appendix. I have 3 main comments. The authors don’t make clear whether or how their study findings are meant to be extrapolated at the national level. California certainly serves as a cautionary example of how statewide initiatives can fail to go far enough. But as the study reveals (p. 9 line 49 to p. 10 line 3), the state’s recent ED visit trends are not representative of national ones - with California’s visit rate far lower and rising far faster. It also has among the highest proportions of Medicaid-insured. We are told, furthermore, that “state-level examinations of the association between health insurance and ED use...have yielded complex and often conflicting results” (p. 4 lines 51-56) - and are not told just how another state-level study would be different. According

	to the source here cited by the authors (reference #26), these "complex and conflicting results" seen to date stem from the intrinsic complexity of the relationship between ED use and insurance type - a function of factors that go beyond those addressed in this study. The authors provide a thoughtful interpretation of the interplay between insurance type, age, and ED utilization for the 45-64 vs > 65 age groups in particular (p. 10 lines 10-35), and the data here are intriguing. Their applicability to the national experience, however, remains speculative. The findings with regard to payer cannot be overstated (p. 11 lines 46-56): Medicaid patients lead in all categories of ED utilization (highest use, highest use rates, and, overwhelmingly, fastest-growing use rates). It would therefore be helpful if this finding were analyzed in greater depth. In particular, do rising utilization rates by Medicaid patients parallel increasing Medicaid enrolment numbers in California during the study period (particularly in 2009, 2014, 2015)? If so, there is evidence of increased ED utilization by new Medicaid enrollees but which may be temporary, and would be important to factor in. (Lo N, Roby DH, Padilla J et al, Increased service use following Medicaid expansion is mostly temporary: evidence from California's Low Income Health Program. Policy Brief UCLA Cent Health Policy Res. 2014 Oct;(PB2014-7):1-8). The authors devote several paragraphs of their Discussion (p. 10 line 10 to p. 11 line 45) to examining the role of age. They conclude that particular need exists among children (noting the high ED utilization rate for age < 5 and high ED visit growth for age 5-19) and the elderly (with the next highest rate), but also among those 45-65 (lowest but fastest-growing rate). But with most age groups signaling need by one measure or another, age as a factor seems to lose force - particularly when the remaining group, those age 20-44, tops the charts in terms of sheer visit numbers. Greater clarification of the relative significance of each measure would help - or else an acknowledgement that healthcare need was found to exist across the age spectrum, albeit for a range of reasons. In the latter case, the section on age could be streamlined & shortened. Minor Comments -Abstract, p. 2 line 33: Suggest changing to "the annual number of ED visits" -Methods, p. 5 line 33: Suggest changing to "non-public" -Discussion, p. 9 line 56: Suggest changing "unique" to "unusual" -Discussion, p. 12 line 28: Suggest changing to "were to emergency physicians" -Conclusions, p. 14 line 30: Suggest changing to "Our findings suggest that the demand for emergency care continues to rise…" -Table 1, p. 27 line 3: Title seems underspecified. Suggest changing to "Descriptive characteristics of California emergency..."

	-Table 2, p. 28 line 3: Ditto. Suggest changing to "California emergency department…" -Tables 1 & 2, pp. 27, 28: Suggest omitting P-values, as no hypothesis is being tested. -Figure 1, p. 29 line 7, line 26: Suggest changing title to "Proportion of ED visits resulting in admission vs. discharge" and legend text to "Proportion of ED visits resulting in admission vs. discharge, 2005-2015"

VERSION 1 – AUTHOR RESPONSE

Reviewer #1:

The article considers a very important topic. For years the utilization of emergency departments is globally increasing in the industrial countries. Reasons for this and consequential necessary structural changes should be investigated.

Following questions should be answered by the authors and following changes should be done in the manuscript:

1. The study refers only to the health system in the U.S. and the state California which is clearly limiting the validity and generalizability. This is a crucial limitation.

   We agree with this comment. Although we had already pointed out this limitation in our manuscript, we revised our sentence in the Limitations section on page 12 to now read:

   "Second, our data are limited to California residents and may limit the generalizability and applicability of our results on a national or global level, despite California's diverse and high Medicaid-insured population."

2. Which is the main research hypothesis?

   We have added our main research hypothesis in the Introduction section on page 5, which states:

   "We hypothesized that ED visit rates would increase between 2005 and 2015, particularly among minority, Medicaid-insured, and uninsured patients."

3. Why was the 11-year-interval 2005-2015 chosen?

   We chose this 11-year interval as our study period because 2005 is the earliest year for which ED data is available; prior to 2005, OSHPD did not require hospitals to submit ED data, and therefore, 2005 marks the first year of our study. 2015 was the most recent year of OSHPD data we had when we conducted the study.

4. How reliable and exact are the register data (PDD, EDD, OSHPD)?

The OSHPD data have been used in more than 250 publications and have guided health policy decisions in California and nationally. While administrative datasets typically have sparse patient-level data, the California OSHPD data contains a wealth of information at the patient level. All non-federal hospitals in California electronically report patient data directly to OSHPD every six months, where it undergoes a nine-step process to check for errors and ensure coding accuracy.[1,2,3] The details of this reporting and error-checking process are provided by the State of California,[4,5] and the validity of certain variables in these data has been confirmed by several independent studies that found a relatively high-degree of coding accuracy, with the caveat that the risk of unreliability is higher for small sample sizes.[6,7,8]

OSHPD collects facility-level data from over 6,000 healthcare facilities, including hospitals, long-term care facilities, clinics, home health agencies, and hospices. OSHPD also receives demographic and utilization data on almost 16 million patients.[9]

---

[1] State of California - Office of Statewide Health Planning and Development. MIRCal Inpatient Edit Flag Description Guide. 2015; http://www.oshpd.ca.gov/HID/MIRCal/Text_pdfs/ManualsGuides/IPEditFlagDescGuide.pdf. Accessed.

[2] State of California - Office of Statewide Health Planning and Development. MIRCal ED and AS Edit Flag Description Guide. 2014; http://www.oshpd.ca.gov/HID/MIRCal/Text_pdfs/ManualsGuides/EDASEditFlagDescGuide.pdf.

[3] State of California - Office of Statewide Health Planning and Development. Medical Information Reporting for California (MIRCal) - Manuals and Guides. 2015; http://www.oshpd.ca.gov/HID/MIRCal/ManualsGuides.html.

[4] State of California - Office of Statewide Health Planning and Development. MIRCal - Medical Information Reporting for California. 2015; http://www.oshpd.ca.gov/HID/MIRCal/.

[5] State of California - Office of Statewide Health Planning and Development. MIRCal - Data Collection Programs. 2012; http://www.oshpd.ca.gov/HID/MIRCal/DataCollection.html.

[6] Haas J, Luft H, Romano PS, Dean M, Hung Y, Bacchetti P. Community-Acquired Pneumonia, 1996: Model Development and Validation. California Hospital Outcomes Project - California Office of Statewide Health Planning and Development;2000.

[7] Goldman L, Chu P, Prothro C, Osmond D, Bindman A. Accuracy of Condition Present on Admission, Do Not Resuscitate, and E-Codes in California Patient Discharge Data. California Office of Statewide Health Planning and Development - Health Outcomes Center;2011.

[8] Romano PS, Rainwater JA, Michael ES, Yasmeen S, Wiiliam MG, Nina B, Nancy F. OSHPD Postpartum Maternal Outcomes Validation Study. University of California, Davis;2006.

[9] OSHPD. Data and Reports; 2017. https://www.oshpd.ca.gov/HID/

Although OSHPD collects self-reported data from hospitals, any reporting errors are mitigated by routine accuracy checks by the hospitals, which we have explained in more detail in the Limitations section on page 12:

> "First, OSHPD collects retrospective, self-reported data from hospitals, which could introduce potential reporting errors or missing data; however, hospitals submit routine accuracy checks using OSHPD's Medical Information Reporting for California (MIRCal) online system, which reduces such errors."

5. How were "multiple users" of emergency departments (one person utilizes one or more emergency departments repeatedly per year) considered or excluded?

We included multiple users of EDs in our study. In fact, this is one of the strengths of our study, because we were able to evaluate all ED visits in California from 2005 to 2015 and account for users who frequented more than one ED.

6. Please divide the main diagnoses (page 8/9) at least in women and men, as appropriate furthermore by age groups.

We have divided the main diagnoses by sex and age, and included the results as tables at the end of this "Response to Reviewers" document (Response to Reviewers Tables 1 and 2). We did not find any notable or striking findings in these results that would warrant any further significant discussion, and since we shortened our Discussion section based on the reviewers' suggestions, we decided not to include these results in our main paper. However, if the Editor finds it important and noteworthy to include a section about diagnoses stratified by sex and age in the paper, we are happy to do so.

7. The discussion part is clearly too long. Please shorten/cancel at least one page.

Thank you for your comment. We have now shortened our Discussion section, specifically by streamlining our discussion on ED visits and the role of age, and removing the paragraph discussing ED visits by Medicare patients (since we wanted to focus on our main results and highlight the trends among Medicaid and uninsured patients instead). We are happy to make any additional edits if the reviewer and Editor prefer that we shorten the Discussion section even further.

8. In “Limitations” absolutely point out the retrospective character of the study.

We have clarified this limitation in the Limitations section on page 12 as follows:

> “First, OSHPD collects retrospective, self-reported data from hospitals, which could introduce potential reporting errors or missing data; however, hospitals submit routine accuracy checks using OSHPD’s Medical Information Reporting for California (MIRCal) online system, which reduces such errors.”

9. The references are with almost 70 sources very long.

We agree with this suggestion and have now limited our references to 41 sources.

10. Table 2 is dispensable.

Thank you for your comment. We have decided to keep this table on ED visit rates (currently Table 1 in the revised manuscript) as the main table of our paper, since we believe that the results are prominent and relevant given that they are based on population estimates. To address the request for condensing the tables, we have moved the table on descriptive characteristics of ED visits (previously Table 1; currently Supplementary Table 1) to the Appendix so that our results on ED visit *rates* are highlighted as the focus of the paper. However, if the Editor feels strongly about this request, we would be happy to oblige.

Reviewer #2:

Summary: This manuscript presents an overview of emergency department (ED) utilization trends and ED user characteristics in California from 2005-2015.

11. Methods: How were hospital observation visits categorized? (hospital admission vs. treat & release). Clarify in Methods section. Utilization of observation services has grown overtime--thus the classification of observation visits could impact the trends that were being assessed in this manuscript.

All observation stays that initially came through the ED – whether they were admitted to the inpatient setting or were discharged directly from the ED – were captured in our dataset. Our dataset is derived by merging a dataset that contains visits that are directly discharged from the ED with another dataset that contains admitted patients,

from which we select those who entered via the ED. As a result, regardless of whether a hospital keeps its observation stays in the ED or in the inpatient setting, we can capture both (and they will not be double-counted since those datasets are mutually exclusive).

We clarified this point in our Methods section under “Inclusion Criteria and Variable Definition” on page 6 by including the following sentence:

> “All observation stays that initially came through the ED – whether they were admitted to the inpatient setting or discharged directly from the ED – were captured in our dataset.”

12. Discussion and Abstract Conclusion: The abstract conclusion states "Our findings reveal considerable unmet healthcare needs and suggest that policies or programs aimed at increasing regular healthcare access among specific patient groups may have the potential to lessen demands on EDs..." I understand the argument made on page 12-- that the relatively low number of ED visits made by Hispanics is likely due to the reasons cited (language barriers, fear of deportation, etc.). However, "unmet healthcare needs" are really the gap between care that is received and care that is *needed*. I'm not sure the authors thoroughly demonstrated that these ED services were truly needed--thus, I would suggest tempering the argument that the findings "reveal considerable unmet healthcare needs". This conclusion is potentially overstated, given the data. We know there is a lot of waste in healthcare, so it may not be correct to assume that all ED visits are needed, and thus, that any population using a relatively lower level of ED visits is experiencing unmet healthcare needs.

Thank you for this comment. We have deleted the phrase “reveal considerable unmet healthcare needs…” to avoid any overstatement of our results. We have revised the Conclusions section of our Abstract on page 2 to read:

> “Our findings reveal an increasing demand for emergency care and may reflect current limitations in accessing care in other parts of the healthcare system. Policymakers may need to recognize the increasingly vital role that EDs are playing in the provision of care and consider ways to incorporate this changing reality into the delivery of health services.”

We have also deleted the mention of “unmet healthcare needs in our Conclusions section on page 12, and the sentence now reads:

> “Increased ED visit rates by Medicaid-insured and uninsured patients may reflect current limitations in accessing care in other parts of the healthcare system.”

There were other parts of the paper (in the Objectives sentence of the Abstract section and other parts of the Discussion section) that mentioned “unmet needs,” which we have now been deleted to remain consistent throughout the paper.

13. Abstract Primary and Secondary Outcome Measures: The word "the" is missing from the last sentence. It should precede the word "proportion" in the last sentence.

Done.

Reviewer #3:

The study is amply justified, well-conceived and executed, and should be published. The quality of the writing is strong. The methodology is straightforward and is appropriate to the purpose. The Results are well served by the primary tables and figure, with additional tables available in an Appendix.

I have 3 main comments.

14. The authors don’t make clear whether or how their study findings are meant to be extrapolated at the national level. California certainly serves as a cautionary example of how statewide initiatives can fail to go far enough. But as the study reveals (p. 9 line 49 to p. 10 line 3), the state’s recent ED visit trends are not representative of national ones - with California’s visit rate far lower and rising far faster. It also has among the highest proportions of Medicaid-insured. We are told, furthermore, that “state-level examinations of the association between health insurance and ED use...have yielded complex and often conflicting results” (p. 4 lines 51-56) - and are not told just how another state-level study would be different. According to the source here cited by the authors (reference #26), these “complex and conflicting results” seen to date stem from the intrinsic complexity of the relationship between ED use and insurance type - a function of factors that go beyond those addressed in this study. The authors provide a thoughtful interpretation of the interplay between insurance type, age, and ED utilization for the 45-64 vs > 65 age groups in particular (p. 10 lines 10-35), and the data here are intriguing. Their applicability to the national experience, however, remains speculative.

We appreciate the reviewer’s thoughts on this. We have addressed this comment by expanding on our second limitation in the Limitations section on page 12 as follows:

> “Second, our data are limited to California residents and may limit the generalizability and applicability of our results on a national or global level, despite California’s diverse and high Medicaid-insured population.”

Our paper differs from other state-level studies that have examined ED utilization by focusing on a more comprehensive assessment of ED use and patient demographics in California – one of the largest and most diverse states in the country – over an 11-year period, and not just in the context of the Affordable Care Act implementation.

Though we have mentioned this in our first submission, we have clarified this point more clearly in the Introduction section on pages 4-5, which now reads:

> "Although evaluating the impact of the ACA on healthcare utilization and outcomes remains an important task, our study provides a more comprehensive assessment of how patient characteristics and healthcare needs have changed over an 11-year period in California – one of the largest and most diverse states in the country[17] – to help better design the necessary policies and programs to meet patients' healthcare needs. Additionally, California's initiatives to increase enrollment in Medicaid (a government health insurance program for qualified low-income or disabled people) through the ACA and Low Income Health Programs (LIHP) provide a unique opportunity to study how patient characteristics and healthcare needs have changed over time under continual and gradual efforts to increase healthcare access."

15. The findings with regard to payer cannot be overstated (p. 11 lines 46-56): Medicaid patients lead in all categories of ED utilization (highest use, highest use rates, and, overwhelmingly, fastest-growing use rates). It would therefore be helpful if this finding were analyzed in greater depth. In particular, do rising utilization rates by Medicaid patients parallel increasing Medicaid enrolment numbers in California during the study period (particularly in 2009, 2014, 2015)? If so, there is evidence of increased ED utilization by new Medicaid enrollees but which may be temporary, and would be important to factor in. (Lo N, Roby DH, Padilla J et al, Increased service use following Medicaid expansion is mostly temporary: evidence from California's Low Income Health Program. Policy Brief UCLA Cent Health Policy Res. 2014 Oct;(PB2014-7):1-8).

Thank you for this insightful comment. Our results on the rising ED visit rates among patients insured by Medicaid do indeed take into account the increasing Medicaid enrollment numbers in California during the study period, as we calculated ED visit rates by denominating the absolute number of ED visits by patients with Medicaid as their expected payer (numerator) by the Medicaid population in California (denominator).

It is possible that Medicaid enrollees are sicker and therefore could be contributing to the increase in ED visit rates, as current literature has supported this phenomenon,[10] and it is also possible that this increase is temporary, as suggested by the policy brief that the reviewer referenced. However, since our study period ended in 2015 and we did not follow up on patients over time, we cannot definitively comment on whether or not this trend is temporary.

16. The authors devote several paragraphs of their Discussion (p. 10 line 10 to p. 11 line 45) to examining the role of age. They conclude that particular need exists among children (noting the high ED utilization rate for age < 5 and high ED visit growth for age 5-19) and the elderly (with the next highest rate), but also among those 45-65 (lowest but fastest-growing rate). But

[10]Taubman SL Allen HL, Wright BJ, et al. Medicaid increases emergency-department use: evidence from Oregon's health insurance experiment. *Science* 2014;343:263-8.

with most age groups signaling need by one measure or another, age as a factor seems to lose force - particularly when the remaining group, those age 20-44, tops the charts in terms of sheer visit numbers. Greater clarification of the relative significance of each measure would help - or else an acknowledgement that healthcare need was found to exist across the age spectrum, albeit for a range of reasons. In the latter case, the section on age could be streamlined & shortened.

Thank you for this comment. We agree that these several paragraphs on age can be streamlined and shortened, which we have done in the revised manuscript. The discussion on the role of age in the Discussion section on pages 9-10 now reads:

"Our findings are consistent with previous studies,[8,10,15] and suggest that healthcare needs tend to exist across the entire age spectrum, albeit for a range of reasons. Patients aged less than 5 had the highest ED utilization rate as of 2015, outpacing the ED utilization rate for patients 65 and over. This finding, along with the high ED visit rate growth for patients aged 5-19, potentially suggests a need for coordinated acute care for the pediatric population, as well as the need to re-examine the availability and role of EDs equipped to treat children, particularly among underinsured pediatric patients. On the other hand, while patients aged 45-64 had the lowest overall ED visit rate during the study period, this group experienced the greatest ED utilization rate increase. This suggests that patients nearing 65 may have significant health care needs, given prior evidence of sharp increases in healthcare utilization once patients turned 65 years old.[26] Meanwhile, patients aged 65 and over retained high steady ED visit rates.[27] The consistent high ED utilization rates and current trends in providers who refer elderly patients to the ED [28,29] suggests a need for improving geriatric care at a systemic level to treat elderly patients effectively and in a timely manner."

Minor Comments

17. Abstract, p. 2 line 33: Suggest changing to "the annual number of ED visits."

    Done.

18. Methods, p. 5 line 33: Suggest changing to "non-public."

    Done.

19. Discussion, p. 9 line 56: Suggest changing "unique" to "unusual."

    We have now removed this sentence to help streamline and shorten the Discussion section as the reviewers suggested.

20. Discussion, p. 12 line 28: Suggest changing to “were to emergency physicians.”

    Done.

21. Conclusions, p. 14 line 30: Suggest changing to “Our findings suggest that the demand for emergency care continues to rise…”

    Done.

22. Table 1, p. 27 line 3: Title seems underspecified. Suggest changing to “Descriptive characteristics of California emergency...”

    Done. Please note that this table has now been moved to the Appendix and re-labeled as Supplementary Table 1.

23. Table 2, p. 28 line 3: Ditto. Suggest changing to “California emergency department…”

    Done. Please note that this title has now been re-labeled as Table 1.

24. Tables 1 & 2, pp. 27, 28: Suggest omitting P-values, as no hypothesis is being tested.

    Per Reviewer 1’s suggestion, we have now added a hypothesis, and thus have kept the p-values in our tables.

25. Figure 1, p. 29 line 7, line 26: Suggest changing title to “Proportion of ED visits resulting in admission vs. discharge” and legend text to “Proportion of ED visits resulting in admission vs. discharge, 2005-2015.”

    To make the figure title consistent with the table titles, we have now changed the title of Figure 1 to: “Proportion of California emergency department visits resulting in admission vs. discharge, 2005-2015.”

Response to Reviewers Table 1. California emergency department visits by diagnosis and sex, 2005-2015

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Infectious and parasitic diseases											

Male	122002	119177	120270	134732	168657	144092	156143	170433	181835	211337	231914
Female	127512	123533	125515	140182	178190	150758	164797	176535	190704	218653	238992
Unknown	676	13	14	9	9	6	2	7	9	12	19
Neoplasms											
Male	27865	28061	28390	28430	28424	28985	29867	30102	30397	30782	31920
Female	33390	33460	33906	35187	35547	36306	37015	37526	38131	39675	41083
Unknown	42	3	0	2	3	0	0	0	0	0	1
Endocrine disorders											
Male	99971	106697	110919	113339	118191	119899	125223	130161	133632	138795	146086
Female	107806	113367	119448	120075	124490	123670	129337	133772	136105	137902	143755
Unknown	722	15	16	9	7	3	4	5	6	6	5
Diseases of the blood and blood-forming organs											
Male	16696	17760	18719	20796	22421	22601	24320	25891	26425	27789	28566
Female	23510	25315	27414	31195	33247	34100	37363	39762	39770	41960	43379
Unknown	63	2	0	1	1	0	1	1	1	0	0
Mental illness											
Male	217131	216068	226615	242738	256424	275956	292105	321855	337028	366527	392342
Female	189478	190048	199085	212631	222868	234614	242308	265652	271073	295554	305402
Unknown	1842	64	45	28	11	13	14	18	72	71	72
Diseases of the nervous system											
Male	357766	364206	386191	406947	441802	445909	450834	460501	469498	488743	523744
Female	479158	491171	522242	551800	599898	609806	622737	643246	654848	688998	720166

Unknown	3295	79	53	30	43	25	15	26	27	34	41
Diseases of the circulatory system											
Male	407060	410926	422851	436475	450036	468572	486183	509345	511676	529934	566775
Female	445017	447055	459172	473008	491594	500181	520666	550351	536798	556187	585278
Unknown	1936	69	70	33	30	22	15	25	39	44	36
Diseases of the respiratory system											
Male	645730	597397	617013	655203	802511	711509	730453	708205	760735	766295	858350
Female	711924	652714	672061	723317	886246	787921	811971	780714	844656	856674	961588
Unknown	4573	122	96	59	50	31	27	30	24	35	41
Diseases of the digestive system											
Male	344165	376627	383342	381531	401111	400550	423448	441394	454536	476959	508946
Female	401516	442278	449819	451692	478005	481291	507252	534273	547872	571780	606424
Unknown	1866	59	49	27	20	18	12	19	18	18	24
Diseases of the genitourinary system											
Male	185940	193836	200144	207484	217849	222325	232728	245959	254568	274688	292552
Female	373006	388876	403358	424526	451896	466112	491945	516023	530464	578007	608458
Unknown	1703	53	61	11	12	15	9	18	12	17	24
Complications of pregnancy											
Male	68	77	72	43	25	21	12	16	20	24	25
Female	241472	267011	288693	290584	302542	311623	311796	322550	332765	350127	358538
Unknown	1089	27	27	0	2	3	1	0	2	0	10
Diseases of the skin and subcutaneous tissue											
Male	188897	196892	195477	193403	197404	206158	212294	221513	225294	243608	259824

Female	160015	167272	169363	172443	178214	186984	194733	202364	202918	220344	230704
Unknown	1343	29	31	15	11	7	4	7	8	24	12
Diseases of the musculoskeletal system											
Male	225999	230517	231495	240337	255392	267503	278279	302316	311450	342817	375641
Female	290262	294990	298699	307131	329351	348222	363699	392218	402699	441138	474674
Unknown	1698	45	41	17	15	15	12	10	15	26	23
Congenital anomalies											
Male	2723	2760	2998	3136	2999	2982	3125	3084	3229	3400	3637
Female	2075	2095	2156	2245	2167	2228	2228	2340	2386	2638	2721
Unknown	12	1	0	0	0	0	0	0	0	0	0
Conditions originating in the perinatal period											
Male	10338	12325	13303	14308	14419	15198	15880	16259	16333	16984	16533
Female	9158	11095	11812	12197	12519	13398	13763	14326	14366	14787	15060
Unknown	168	1	6	0	4	2	0	5	5	2	7
Injury and poisoning											
Male	1254465	1268834	1284762	1255261	1283900	1287466	1303012	1341961	1337691	1392344	1447368
Female	1013705	1025579	1037210	1033479	1085448	1102699	1122425	1164799	1169646	1227753	1273280
Unknown	8807	348	332	170	106	90	99	100	116	144	135
Ill-defined conditions											
Male	519046	538831	571728	590795	651544	640627	667730	695400	713690	739406	776213
Female	649240	678210	719842	747450	826085	819158	855036	899864	923047	958965	1007572
Unknown	5989	132	116	49	43	34	27	34	54	59	73
Unclassified											
Male	1238	6321	5618	5748	4800	4480	4672	5029	5312	6137	7330

	15	5	5	3	7	5	9	8	6	1	4
Female	142627	72798	65585	65852	54952	50418	53227	56467	58154	66319	77614
Unknown	676	38	19	9	16	9	11	7	10	12	10

Response to Reviewers Table 2. California emergency department visits by diagnosis and age, 2005-2015

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Infectious and parasitic diseases											
<5	68049	65482	61919	68371	80730	62976	60677	69553	60088	79257	75611
5-19	41520	36755	35662	38137	65868	36816	40024	39110	44358	48444	55185
20-44	57242	52096	52171	56333	73482	56953	63871	68546	76154	88124	99468
45-64	36907	37296	40760	47297	55000	55540	63235	69035	77826	89583	99015
65+	46472	51094	55287	64785	71776	82571	93135	100731	114122	124594	141646
Neoplasms											
<5	770	712	783	788	736	711	790	798	824	850	871
5-19	1449	1349	1464	1495	1504	1417	1517	1526	1614	1707	1839
20-44	9449	9698	9779	9943	10296	10456	10850	11153	11412	12095	12684
45-64	21534	21954	22187	22777	23563	24515	25174	25324	25835	26590	26702
65+	28095	27811	28083	28616	27875	28192	28551	28827	28843	29215	30908
Endocrine disorders											
<5	12926	12178	11668	10272	10200	8124	8722	8246	8488	7413	8337
5-19	12227	12673	13162	13064	14298	13089	14116	14234	15267	15317	16132

20-44	49597	52182	55506	56216	58825	59695	61982	64618	66975	69525	71903
45-64	62832	67747	72696	75817	81024	83181	86952	90496	92293	96975	101055
65+	70917	75299	77351	78054	78341	79483	82792	86344	86720	87473	92419
Diseases of the blood and blood-forming organs											
<5	1949	1855	2014	2087	2142	2139	2077	2118	2142	2426	2455
5-19	3367	3207	3380	3742	3970	3832	4363	4246	4255	4556	5097
20-44	11664	12475	13411	14453	15694	15568	17068	17998	18524	19909	20499
45-64	9734	10881	11948	13978	14918	15506	16877	18171	18049	19104	19753
65+	13555	14659	15380	17732	18945	19656	21299	23121	23226	23754	24141
Mental illness											
<5	1027	1026	999	981	1048	1030	1001	1050	1018	1024	1387
5-19	46419	45686	49035	53037	57610	60963	61409	66372	67835	73992	77128
20-44	207031	198997	205175	216502	226192	241650	253508	281059	294241	322962	343350
45-64	118310	124264	133182	145188	153608	163393	172683	187444	191374	204866	214362
65+	35664	36207	37354	39689	40845	43547	45826	51600	53705	59308	61589
Diseases of the nervous system											
<5	151445	144510	152103	153840	165049	156305	148827	141158	143933	133964	148074
5-19	122112	125406	126582	133172	152656	151449	153226	152308	163538	166901	190057
20-44	296142	299487	317718	335147	360684	368819	374551	389531	389001	417146	431836
45-64	175825	187037	207184	224729	244789	254998	265241	278507	281084	301615	308634
65+	94695	99016	104899	111889	118565	124169	131741	142269	146817	158149	165350

Diseases of the circulatory system											
<5	2092	2022	2164	2084	2032	2084	1947	2032	1987	2126	2569
5-19	20861	21547	22524	24393	26800	28105	29289	31149	31395	34237	36822
20-44	176153	174290	179434	184536	194736	200701	205927	220333	216568	231262	246577
45-64	286962	294772	309077	322078	337076	347546	361631	381489	373016	387858	408172
65+	367945	365419	368894	376425	381016	390339	408070	424718	425547	430682	457949
Diseases of the respiratory system											
<5	338381	309706	341480	344561	422644	399660	391734	366561	388580	371315	417517
5-19	237202	213696	214676	225458	356672	267243	281113	263154	297165	307236	353854
20-44	328073	296818	298717	328373	405341	344574	363785	353382	376091	403178	448648
45-64	216552	204999	211726	238414	265803	249987	260361	259334	278076	288836	315140
65+	242019	225014	222571	241773	238347	237997	245458	246518	265503	252439	284820
Diseases of the digestive system											
<5	93520	105128	101409	89352	89699	76005	81482	78368	81610	75207	85397
5-19	84155	88605	91320	92195	101020	95385	101540	104652	112095	113645	122993
20-44	251076	271232	280443	282244	299935	306757	322569	339954	347949	372359	392795
45-64	169645	188527	194697	202422	215239	224128	236570	250688	256120	275324	289588
65+	149151	165472	165341	167037	173243	179584	188551	202024	204652	212222	224621
Diseases of the genitourinary system											
<5	24409	24583	26674	29198	31415	32127	33512	32687	33347	33853	34082
5-19	6500	6523	6944	7389	8061	8171	8352	8403	8682	9330	9623

	0	5	4	1	2	3	3	4	5	1	5
20-44	240586	246553	251210	258469	274671	282395	295773	310125	317307	348313	366004
45-64	115010	123412	128827	137249	145174	149787	159610	170607	176339	193692	206502
65+	115644	122982	127408	133214	137885	142430	152264	164547	171226	183553	198211
Complications of pregnancy											
<5	23	16	32	22	25	7	6	6	4	9	7
5-19	37383	41820	44887	45726	46556	44619	41082	39933	37556	36574	34231
20-44	204414	224370	242810	243909	254998	266068	269620	281500	294050	312210	322923
45-64	794	887	1046	953	984	952	1097	1126	1169	1355	1405
65+	15	22	17	17	6	1	4	1	8	3	7
Diseases of the skin and subcutaneous tissue											
<5	25287	28725	30776	33519	35469	37338	38235	40200	36909	41001	39237
5-19	49500	51665	53514	54577	56245	59071	60324	61537	61212	68024	70028
20-44	156300	157753	152541	147832	149732	155339	159056	164045	166610	178916	190941
45-64	84178	88612	89604	90224	92688	98293	102976	108920	112788	121546	131359
65+	34990	37438	38436	39709	41495	43108	46440	49182	50701	54489	58975
Diseases of the musculoskeletal system											
<5	8056	8388	8929	9385	9919	10162	10744	11227	11060	11709	12446
5-19	38961	39522	42076	44236	47696	49788	52263	57094	58536	64839	71747
20-44	211348	208449	206571	209821	224984	233868	240191	258584	263417	289705	311940
45-64	172797	178930	180512	188962	202170	216490	225939	243685	252634	277367	298651

65+	86797	90263	92147	95081	99989	105432	112853	123954	128517	140361	155554
Congenital anomalies											
<5	1999	2059	2214	2317	2042	2024	2068	2091	2044	2112	2249
5-19	693	681	673	710	687	720	716	713	773	911	988
20-44	1013	1060	1044	1087	1165	1172	1228	1258	1288	1410	1454
45-64	678	661	766	785	796	834	886	852	978	1020	1036
65+	427	395	457	482	476	460	455	510	532	585	631
Conditions originating in the perinatal period											
<5	19345	23231	24922	26272	26647	28208	29259	30230	30333	31451	31270
5-19	66	46	42	50	103	184	177	189	198	168	137
20-44	183	132	144	171	156	174	173	138	145	136	156
45-64	40	10	8	8	21	20	27	23	21	11	25
65+	30	2	5	4	15	12	7	10	7	7	12
Injury and poisoning											
<5	206710	211035	218873	222733	241876	238475	236829	241021	232809	236705	230467
5-19	541751	539409	547077	532894	546485	544276	543525	562001	558588	576634	581458
20-44	822521	815008	807783	775553	782211	782619	790928	814298	808820	848456	893972
45-64	413130	427225	438175	439258	460380	472066	483170	501071	504568	533120	560521
65+	292865	302084	310396	318472	338502	352819	371084	388469	402668	425326	454365
Ill-defined conditions											
<5	186450	187885	212611	222404	256259	237245	238670	245516	253630	245317	260037
5-19	203415	206881	220704	231261	282204	258241	272858	278854	302566	310770	334459
20-44	422582	437196	454107	462459	494932	502815	524035	550323	557375	591060	614048

45-64	214546	230651	245458	256434	273516	285566	301481	321251	321598	341618	353994
65+	147282	154560	158806	165736	170761	175952	185749	199354	201622	209665	221320
Unclassified											
<5	21280	10134	9030	8874	7729	6705	6697	7103	7201	8337	8908
5-19	37200	14584	12143	12439	9420	7501	7441	7884	8006	9729	12372
20-44	95335	45249	38449	38148	30196	27385	29146	31767	32965	39405	48642
45-64	70151	36746	33494	34505	29965	28739	30289	31609	33322	37502	43517
65+	43152	29338	28673	29378	25665	24902	26394	28409	29796	32729	37489

VERSION 2 – REVIEW

REVIEWER	Matthias David Charité Universitätsmedizin Berlin, Campus Virchow-Klinikum, Department of Gynecology, Berlin/Germany
REVIEW RETURNED	14-Mar-2018

GENERAL COMMENTS	All questions were answered sufficiently, the manuscript was consequently revised. I recommend the publication.

REVIEWER	Erika H. Newton, MD, MPH Department of Emergency Medicine, Stony Brook University, U.S.A.
REVIEW RETURNED	18-Mar-2018

GENERAL COMMENTS	The authors satisfactorily address the reviewers' comments for the most part. I propose two additional minor changes: Abstract, lines 5-10 - “Trends and characteristics (of patients)” and “changes in the composition (of visits)...over time” would seem to refer to the same analysis and to be, therefore, redundant. Consider “To examine current trends in the characteristics of patients visiting California emergency departments (EDs) [in order] to better direct the allocation of acute care resources.” (Though visits, not patients, are the true unit of analysis, it’s still patient characteristics being described. The revised manuscript makes clear that the trends in fact apply to visits, not individuals.) Query #11, by Reviewer #2, was not whether observation visits were captured, but how they were categorized. If hospital observation was categorized as hospital admission, this should be stated. Likewise, use of the term “treat-and-release” (page 8, line 31) as a synonym for ED discharge is somewhat misleading if a portion of these

	patients were placed on “ED observation.” If ED observation was categorized as ED discharge, this should be stated.

REVIEWER	Lauren Birmingham Kent State University, Summa Health System
REVIEW RETURNED	26-Mar-2018

GENERAL COMMENTS	This revision improves upon the previous version of this manuscript. The discussion and conclusions have been tempered to not over-generalize to conclusions about unmet healthcare need, which I believe is appropriate. Clarification about observation stays is noted. This is helpful clarification to make, since these are a relatively new phenomenon and are sometimes classified differently in the literature. The conclusion in the Abstract is much improved. The review checklist asks if statistics are described in detail in the manuscript. The data, stratification procedure, and Clinical Classification Software (CCS) use is well-described. The particular statistical test(s) used in this analysis are not described. Including this (as obvious as the method may be to some) would improve the Statistical Analysis section. In the Methods section, the manuscript states, "We clustered 2015 diagnoses into multi-level CCS categories...". Is this all diagnoses or just the primary diagnosis? This would be worth clarifying as this can have a significant impact on the results, and is necessary to understand from a replication standpoint. (Line 23 page 8) Overall this manuscript is improved from its previous form and I recommend the manuscript be accepted with these minor clarifications. Thank you for the opportunity to review this manuscript.

VERSION 2 – AUTHOR RESPONSE

Reviewer #1:

1. All questions were answered sufficiently, the manuscript was consequently revised. I recommend the publication.

   Thank you. We appreciate your help in providing comments that helped us improve our manuscript.

Reviewer #2:

2. This revision improves upon the previous version of this manuscript. The discussion and conclusions have been tempered to not over-generalize to conclusions about unmet healthcare need, which I believe is appropriate. Clarification about observation stays is noted. This is helpful clarification to make, since these are a relatively new phenomenon and are

sometimes classified differently in the literature. The conclusion in the Abstract is much improved.

Thank you for your helpful feedback and suggestions that helped us clarify important points and improve our manuscript.

3. The review checklist asks if statistics are described in detail in the manuscript. The data, stratification procedure, and Clinical Classification Software (CCS) use is well-described. The particular statistical test(s) used in this analysis are not described. Including this (as obvious as the method may be to some) would improve the Statistical Analysis section.

   We have now added information (italicized/underlined text below) on the statistical test we used in the Methods section under 'Statistical Analysis' on page 6. The revised sentence now reads:

   "We analyzed ED visits and visit rates using a linear regression model to test for significant linear temporal trends in California from 2005 to 2015 by age group (<5 years, 5-19 years, 20-44 years, 45-64 years, and 65 years and over); sex (male, female, unknown); race/ethnicity group (non-Hispanic White, non-Hispanic Black, Hispanic, Other); payer/insurance status (private, Medicare, Medicaid, uninsured/self-pay, other, unknown); and metropolitan statistical area (rural or urban)."

4. In the Methods section, the manuscript states, "We clustered 2015 diagnoses into multi-level CCS categories..." Is this all diagnoses or just the primary diagnosis? This would be worth clarifying as this can have a significant impact on the results, and is necessary to understand from a replication standpoint. (Line 23 page 8)

   We analyzed primary diagnoses. We have made this clarification in the Methods section under 'Statistical Analysis' on page 7, and the sentence now reads:

   "We clustered 2015 primary diagnoses into multi-level CCS categories using single-level CCS categorizations provided in the data, which accounted for the transition from ICD-9 to ICD-10 coding in October 2015."

5. Overall this manuscript is improved from its previous form and I recommend the manuscript be accepted with these minor clarifications. Thank you for the opportunity to review this manuscript.

   Thank you for the time and attention you have given to our manuscript.

Reviewer #3:

The authors satisfactorily address the reviewers' comments for the most part. I propose two additional minor changes:

6. Abstract, lines 5-10 - “Trends and characteristics (of patients)” and “changes in the composition (of visits)...over time” would seem to refer to the same analysis and to be, therefore, redundant. Consider “To examine current trends in the characteristics of patients visiting California emergency departments (EDs) [in order] to better direct the allocation of acute care resources.” (Though visits, not patients, are the true unit of analysis, it’s still patient characteristics being described. The revised manuscript makes clear that the trends in fact apply to visits, not individuals.)

   Thank you for this suggestion. We have revised the Objective sentence of the Abstract on page 2, and it now reads:

   > “To examine current trends in the characteristics of patients visiting California emergency departments (EDs) in order to better direct the allocation of acute care resources.”

7. Query #11, by Reviewer #2, was not whether observation visits were captured, but how they were categorized. If hospital observation was categorized as hospital admission, this should be stated. Likewise, use of the term “treat-and-release” (page 8, line 31) as a synonym for ED discharge is somewhat misleading if a portion of these patients were placed on “ED observation.” If ED observation was categorized as ED discharge, this should be stated.

   Since we captured observation stays in both the ED and inpatient settings, they were categorized as either a hospital admission or ED discharge (OSHPD does not distinguish between the two). We have made this clarification and added the italicized/underlined phrase below to the sentence on observation stays in the Methods section under “Inclusion Criteria and Variable Definition” on page 6:

   > “All observation stays that initially came through the ED – whether they were admitted to the inpatient setting or discharged directly from the ED – were captured in our dataset <u>and categorized as either a hospital admission or ED discharge</u>.”

   We have now deleted the term “treat-and-release” in both the Methods (page 6) and Results (page 8) sections to avoid any confusion.