

## PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (<http://bmjopen.bmj.com/site/about/resources/checklist.pdf>) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	Identifying mental health and substance use disorders using emergency department and hospital records: a population-based retrospective cohort study of diagnostic concordance and disease attribution
<b>AUTHORS</b>	Wang, Linwei; Homayra, Fahmida; Pearce, Lindsay; Panagiotoglou, Dimitra; McKendry, Rachael; Barrios, Rolando; Mitton, Craig; Nosyk, Bohdan

### VERSION 1 – REVIEW

<b>REVIEWER</b>	Sidra Goldman-Mellor University of California, Merced U.S.A.
<b>REVIEW RETURNED</b>	02-Apr-2019

<b>GENERAL COMMENTS</b>	<p>The authors' evaluation of concordance between ED- and hospital-based mental health and substance use disorder diagnoses provide a nice addition to the field. I thought the study was well-done, appropriately described, and nicely written. I had just a few comments that I hope will improve its utility:</p> <ol style="list-style-type: none"><li>1. Given the authors' citation of the Davis et al. 2016 BMJ Psychiatry systematic review, can they elaborate in the Introduction on what their paper adds that is new? This was not clear. One possibility is that they used a highly socioeconomically disadvantaged patient population, with high prevalence of MHSUD. The authors should provide more comment on this in the Discussion section, as it is possible that the patient population led to different results than might otherwise have been observed.</li><li>2. In the Introduction and/or Methods sections, the authors should provide some kind of justification for their selection of patient- and visit-level characteristics to examine as predictors of diagnostic concordance.</li><li>3. Minor point: In the first paragraph of the Results, can the authors clarify the meaning of "It is notable that ED data increased attribution of mental health and substance use disorders within the study cohort by 25.5%." Increased relative to what? I think they mean (based on the Tables) relative to just using hospital visits, but this should be made explicit.</li><li>4. Minor point: Please make sure to define acronyms (e.g., ICD) at first occurrence in the manuscript.</li><li>5. Minor point: 95% CI lower- and upper-bound estimates should be separated by commas, not hyphens, for optimal clarity.</li></ol>
-------------------------	---

<b>REVIEWER</b>	Astrid Guttman ICES, Canada
<b>REVIEW RETURNED</b>	23-Apr-2019

<b>GENERAL COMMENTS</b>	<p>Peer review BMJ Open “Identifying mental health and substance use disorders using emergency department and hospital records: diagnostic concordance and disease attribution”</p> <p>Overall, this is an important area since administrative data, especially those from emergency department visits are being used for mental health services research and surveillance purposes. The manuscript is clearly written. While the authors appropriately used the STARD reporting guideline, a bit more reference to some of the recommendations of RECORD would be helpful. In particular, more detail about linkage accuracy (see below) and context and validity of the health administrative data is warranted.</p> <p>Major comments:</p> <p>1) While the analytic cohort was described as those with an ED visit that resulted in hospital admission. However in Table 3A there is a variable around discharge status from the ED which includes those discharged home or left against medical advice. This calls into question the validity of the entire cohort of dyads. If the discharge disposition is not accurate (ie there is still an associated admission record for the same patient on the same day) then this should be stated but more detail about the linkage method or the accuracy of the personal healthcare identifier should be described to reassure the reader that the presence of ED records for discharged patients with a supposed associated admission is not a linkage error. Even if this is an issue with the disposition variable, it doesn't make any sense to have that variable in the model.</p> <p>2) More details about the clinical context of the EDs under study would be helpful. Do they have psychiatrists or other mental health crisis teams that provide service in the ED? Are there differences in access to these specialized services across the hospitals that might explain the variation in concordance (as well as potentially the weekend effect)? This would help the reader to decide how generalizable the findings are to administrative data from other jurisdictions.</p> <p>3) It would be helpful to know why self harm admissions were not considered – these are a common reason for need for hospitalization for a mental health disorder and may in part explain the discordance as the actual underlying mental health diagnosis would often be made during the admission whereas the ED visit would be focused on medical stabilization and no MH diagnosis coded.</p> <p>Minor comment: The interpretation of the higher discordance of weekend and after hours ED visits in relation to quality of care is a bit too strong. Given that there is only one diagnosis field in the ED records and patients who are admitted are by definition being referred for more intensive care including diagnosis and treatment. Assessing whether these really are “missed” diagnoses or whether any patient harm ensues would require a different design.</p>
-------------------------	---

## VERSION 1 – AUTHOR RESPONSE

Reviewer(s)' Comments to Author:

Reviewer: 1

Reviewer Name: Sidra Goldman-Mellor

Institution and Country: University of California, Merced U.S.A.

Please state any competing interests or state 'None declared': None declared

Please leave your comments for the authors below.

The authors' evaluation of concordance between ED- and hospital-based mental health and substance use disorder diagnoses provide a nice addition to the field. I thought the study was well-done, appropriately described, and nicely written. I had just a few comments that I hope will improve its utility:

1. Given the authors' citation of the Davis et al. 2016 BMJ Psychiatry systematic review, can they elaborate in the Introduction on what their paper adds that is new? This was not clear. One possibility is that they used a highly socioeconomically disadvantaged patient population, with high prevalence of MHSUD. The authors should provide more comment on this in the Discussion section, as it is possible that the patient population led to different results than might otherwise have been observed.

We have included the following sentence in the last paragraph of Introduction to elaborate the added value of our paper to the Davis's systematic review:

“One systematic review identified 39 studies which examined the accuracy of mental health diagnoses in administrative data, yet none of these studies assessed the diagnostic accuracy in ED.(14) ”

We have also included the following sentence in the second last paragraph of the Discussion following the reviewer's suggestion:

“Finally, caution should be exercised while generalizing our findings to other settings, noting that our study population represents a highly socioeconomically disadvantaged patient population with high prevalence of MHSUD”

2. In the Introduction and/or Methods sections, the authors should provide some kind of justification for their selection of patient- and visit-level characteristics to examine as predictors of diagnostic concordance.

We have updated the 4<sup>th</sup> paragraph of the Methods to justify our selection of covariates:

“We defined a priori a list of patient- and ED visit-related factors which might be associated with the diagnostic discordance as informed by the literature (17) and given data availability, including gender (male, female), age (<25, 25-34, 35-44, 45-54, 55-64, ≥65), homeless status (yes, no), event urgency using the Canadian Triage Acuity Scale (CTAS)<sup>16</sup>, length of ED visit (<6 hours, ≥6 hours; defined as the difference between date/time of triage or registration in ED and date/time the patient left the nursing unit), and time (day: 9:00am-8:59pm, 9:00pm-8:59am) and day (weekday, weekend, holiday) of ED visit. Additionally, we considered the fiscal year of ED visit (2007-2011, 2012-2014, 2015-2017) and a hospital indicator variable to examine the potential differences in diagnostic discordance over time, and across hospitals, respectively. Finally, we considered whether the patient ever resided in the DTES (yes, no) given the features of high disease prevalence and high vulnerability of the DTES neighborhood.<sup>8</sup>”

3. Minor point: In the first paragraph of the Results, can the authors clarify the meaning of "It is notable that ED data increased attribution of mental health and substance use disorders within the study cohort by 25.5%." Increased relative to what? I think they mean (based on the Tables) relative to just using hospital visits, but this should be made explicit.

We have now clarified this sentence in the first paragraph of the Results following the reviewer's suggestion:

"It is notable that ED data increased attribution of mental health and substance use disorders within the study cohort by 25.5% compared with using hospital records only."

4. Minor point: Please make sure to define acronyms (e.g., ICD) at first occurrence in the manuscript.

We have now defined ICD at its first occurrence as follow:

"Our objectives were to determine the concordance, and individual- and hospital-level factors associated with concordance between *the International Statistical Classification of Diseases and Related Health Problems (ICD), Ninth and Tenth Revisions, Canada (ICD-9-CA and ICD-10-CA)* diagnosis codes assigned in the ED and at discharge from hospital for any mental health and substance use related conditions observed in VCH between 2007 and 2017."

5. Minor point: 95% CI lower- and upper-bound estimates should be separated by commas, not hyphens, for optimal clarity.

We have updated the format for 95% CI following the reviewer's suggestion in text and Tables.

Reviewer: 2

Reviewer Name: Astrid Guttman

Institution and Country: ICES, Canada

Please state any competing interests or state 'None declared': None Declared

Please leave your comments for the authors below

Peer review BMJ Open "Identifying mental health and substance use disorders using emergency department and hospital records: diagnostic concordance and disease attribution"

Overall, this is an important area since administrative data, especially those from emergency department visits are being used for mental health services research and surveillance purposes. The manuscript is clearly written.

While the authors appropriately used the STARD reporting guideline, a bit more reference to some of the recommendations of RECORD would be helpful. In particular, more detail about linkage accuracy (see below) and context and validity of the health administrative data is warranted.

We have included more details about the data linkage for ED visits which resulted in hospital admission in the first paragraph of the Methods following the reviewer's suggestion and in response to the RECORD checklist 12.3 (State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided):

“Linkage of ED visits to the resulting hospital admission was ascertained based on the following data fields and criteria: (if an ED visit had the same ‘ContinuumID’ as the hospital admission OR if the hospital admission occurred within one day of the ED visit) AND (the ED visit had a flag indicating admission to an hospital OR the hospital admission indicated an entry code of ‘E’ (emergency department)). The ‘ContinuumID’ was a unique ID used within a VCH facility to track patient movement across different health systems at each visit, and therefore might not capture the ED visit that resulted in admission at another hospital. Therefore, we supplemented this by capturing hospital admission within the same day of ED visit. These linkages were further ascertained using available data fields in ED (‘AdmittedFlag’) and in DAD (‘Entrycode’) to confirm ED visits which resulted in hospital admission.”

Major comments:

While the analytic cohort was described as those with an ED visit that resulted in hospital admission. However in Table 3A there is a variable around discharge status from the ED which includes those discharged home or left against medical advice. This calls into question the validity of the entire cohort of dyads. If the discharge disposition is not accurate (ie there is still an associated admission record for the same patient on the same day) then this should be stated but more detail about the linkage method or the accuracy of the personal healthcare identifier should be described to reassure the reader that the presence of ED records for discharged patients with a supposed associated admission is not a linkage error. Even if this is an issue with the disposition variable, it doesn’t make any sense to have that variable in the model.

We have included more details about the data linkage for ED visits which resulted in hospital admission in the first paragraph of the Methods following the reviewer’s suggestion:

“Linkage of ED visits to the resulting hospital admission was ascertained based on the following data fields and criteria: (if an ED visit had the same ‘ContinuumID’ as the hospital admission OR if the hospital admission occurred within one day of the ED visit) AND (the ED visit had a flag indicating admission to an hospital OR the hospital admission indicated an entry code of ‘E’ (emergency department)). The ‘ContinuumID’ was a unique ID used within a VCH facility to track patient movement across different health systems at each visit, and therefore might not capture the ED visit that resulted in admission at another hospital. Therefore, we supplemented this by capturing hospital admission within the same day of ED visit. These linkages were further ascertained using available data fields in ED (‘AdmittedFlag’) and in DAD (‘Entrycode’) to confirm ED visits which resulted in hospital admission.”

We have also followed the reviewer’s suggestion to remove the ‘discharge disposition’ variable from our multivariable regression models given the accuracy issue regarding this variable. Our findings on factors associated with diagnostic discordance remained similar after removing this variable. We have updated Table 3, Table 3A and the corresponding text to reflect this change.

2) More details about the clinical context of the EDs under study would be helpful. Do they have psychiatrists or other mental health crisis teams that provide service in the ED? Are there differences in access to these specialized services across the hospitals that might explain the variation in concordance (as well as potentially the weekend effect)? This would help the reader to decide how generalizable the findings are to administrative data from other jurisdictions.

The availability of information on the clinical context of the 11 VCH EDs included in this analysis is limited and inconsistent. We have noted this as a potential limitation in the discussion section, and provided available information on EDs in the appendix.

“The study team had limited access to information on the clinical context of emergency departments, such as the availability of psychiatrists and other specialized services, which may help to explain variation in concordance across settings and may limit generalizability to health administrative data used for these purposes in other jurisdictions. ”

We have also included more detail on EDs in the first paragraph of the Methods:

“The DAD contains data on inpatient acute care, day care, and rehabilitation care at 11 hospitals under the purview of VCH, and the ED contains data on emergency department visits at 11 hospitals and acute care clinics under the purview of VCH. Available detail on each ED is included in Appendix 1. ”

Table 1: Service hours and mental health services available in 11 hospitals/acute care clinics under the purview of VCH

Emergency department*	No. of ED visits in the past year (No. visits resulting in hospital admission in the past year)	Hours	Psychiatrists or Mental health crisis teams on site?
St Paul’s Hospital	210488 (29967)	24 hours	Yes. The emergency department contains an Acute Behavioral Stabilization Unit which provides specialized care for patients with complex mental health and substance use needs. The unit is managed by Emergency with the staffing support being an interdisciplinary team of emergency physicians, emergency nurses, psychiatrists, registered psychiatric nurses (or equivalent), psychiatric assessment nurses and workers, as well as input from consultative services such as the specialized Addictions Consultation Team.
Vancouver General Hospital	91836 (17832)	24 hours	Yes. Psychiatric Emergency Assessment & Triage (PEAT) service is a co-managed space in the VGH Emergency Department for assessing and triaging ED clients who present with MHSU conditions.
Mount St. Joseph Hospital	22008 (2822)	08:00-20:00	Yes. Geriatric psychiatry service: provides acute care and consultation, initial assessment, and follow-up care for ambulatory patients over the age of 65 who are experiencing complex psychiatric disorders.
Lions Gate Hospital	15594 (2167)	24 hours	Yes. There is a Psychiatric Emergency Program which provides access to prompt psychiatric assessments through the emergency department

			at Lions Gate Hospital. Mental Health nurses staffed in the emergency department provide mental health assessment in consultation with the on call psychiatrist.
Richmond Hospital	11689 (2093)	24 hours	Yes. The Psychiatry Assessment and Emergency Unit provide short-term assessment, stabilization and treatment services for individuals experiencing a psychiatric/mental health crisis. Provides a 4-bed brief stay (72 hours or less) unit for assessment, stabilization and treatment of individuals experiencing a psychiatric/mental health crisis. The interdisciplinary team is able to access both hospital and community resources, on an as needed basis.
Powell River General Hospital	1856 (142)	24 hours	Yes. In-Patient Psychiatry: a 7-bed unit on the 4th Floor of the Powell River General Hospital provides acute care for people suffering from an acute psychiatric illness that are unable to be cared for at home or in supportive community programs.
University of British Columbia (UBC) Health Sciences Centre	3996 (151)	8:00-20:00	No.
Squamish General Hospital	555 (49)	24 hours	No. Squamish General Hospital does not have a psychiatric ward or mental health beds. People in acute mental health distress will be transported from the Squamish emergency department to Lions Gate Hospital. If the issue is not acute, emergency room doctors can help the patient access a treatment team that includes two psychiatrists in Squamish.
Whistler D & T Centre	287 (9)	8:00-20:00	Yes. The Whistler Health Centre which provides emergency care also provides Mental Health and Substance Use services at the same location. Outpatient individual and group counseling for people with mental health and/or addiction problems. It also has an Adult Mental Health and Substance Use Program, which serves clients over the age of 19 who are diagnosed with a major mental illness and experiencing significant problems that interfere with their functioning in the community.
Pemberton D & T Centre	161 (9)	8:30-20:30	The Pemberton Health Centre which provides emergency care also provides Mental Health and Substance Use services at the same location. Outpatient individual and group counselling are available for people with mental health and/or addiction problems.

Sechelt Hospital	1052 (150)	24 hours	The Psychiatry Assessment and Emergency Unit provides short-term assessment, stabilization, and treatment services for individuals experiencing a psychiatric/mental health crisis. A mental health emergency services nurse is on site Monday to Friday.
------------------	------------	----------	---

\*Data for Mount St. Joseph Hospital, Powell River General Hospital and St. Paul Hospital are available from April 1 2009, onward. Data for Sechelt Hospital are from October 17, 2012 onward. Data for Whistler D & T Centre, and Pemberton D & T Centre are from April 1 2015 onward.

3) It would be helpful to know why self-harm admissions were not considered – these are a common reason for need for hospitalization for a mental health disorder and may in part explain the discordance as the actual underlying mental health diagnosis would often be made during the admission whereas the ED visit would be focused on medical stabilization and no MH diagnosis coded.

As described in the Method section, “we defined mental health conditions and SUD using ICD-9-CA from 290-319, or their ICD-10-CA equivalents from F00-F99, consistent with the Canadian surveillance system<sup>4,6</sup>” for mental health disorders, which did not include self-harm diagnoses codes.

We agree with the reviewer that self-harm admissions might explain some of the diagnostic discordance between ED visits and hospital admissions. Although we did not directly consider self-harm diagnoses codes in determining mental health and substance use disorders (MHSUD)-related hospital admissions, we believe that our sensitivity analyses which considered all discharge diagnoses codes (up to 25) in hospital would capture the majority of self-harm related hospital admissions and classify them as MHSUD-related, as any hospital admission for self-harm is likely to also have a diagnosis code between 290-319 (or F00-F99) in addition to the self-harm diagnoses codes. To be specific, among the ED visits that resulted in hospitalization only 0.24% had a hospital diagnosis code indication of intentional self-harm and our classification of MHSUD captured 90% of those cases.

Finally, we have included the following sentence in the limitation section of the Discussion to explicit this potential limitation:

“Fourth, we did not consider diagnoses codes related to intentional self-harm, which was a common reason for hospitalization due to a mental health disorder. However, among the ED visits that resulted in hospitalization only 0.24% had a hospital diagnosis code indication of intentional self-harm. Furthermore, our sensitivity analyses which used all (up to 25) diagnoses codes in hospital captured 90% of the self-harm related hospital admissions as those admissions are likely to have a diagnosis code between 290-319 (or F00-F99) in addition to the self-harm diagnoses codes.”

Minor comment:

The interpretation of the higher discordance of weekend and after hours ED visits in relation to quality of care is a bit too strong. Given that there is only one diagnosis field in the ED records and patients who are admitted are by definition being referred for more intensive care including diagnosis and treatment. Assessing whether these really are “missed” diagnoses or whether any patient harm ensues would require a different design.



We agree with the reviewer that the inadequate reliability in ED diagnosis might be attributable to only one diagnosis field in ED and patients will receive more intensive care including diagnosis and treatment following admission. Despite the inadequate reliability in ED diagnosis overall, we found visits occurring during holidays and weekends, and those during overnight shifts were associated with higher odds of diagnostic discordance between ED and hospital, which could not be explained by the fact that there was only one diagnosis filed in ED. Therefore, we have aimed to explain potential reasons for the weekend and timing effect, with supporting evidence from previously published literature. We have edited the 4<sup>th</sup> paragraph of the Discussion section as below:

“Given the inherent complexity in diagnosing mental health conditions, it is not surprising there is inadequate reliability in the diagnosis of specific types of mental health conditions. Diagnostic accuracy is further limited in ED given only one primary diagnosis code was available. .... Several factors might explain these associations, including the intensity of care and medical staff, the volume of ED visits at different times of the day and week, as well as potential impairment of physical and cognitive abilities of medical staff due to sleep deprivation especially during overnight shifts. (25, 26) Some adjustments to staffing models at the ED might be made to improve diagnosis accuracy. Future studies should further investigate whether increased diagnostic discordance associated with visit timing will result in adverse patient outcomes.”

#### **VERSION 2 – REVIEW**

<b>REVIEWER</b>	Sidra Goldman-Mellor University of California, Merced
<b>REVIEW RETURNED</b>	09-Jun-2019

<b>GENERAL COMMENTS</b>	The authors have adequately addressed my concerns; the manuscript's clarity and rationale have been improved and I have no further comments.
-------------------------	--

<b>REVIEWER</b>	Astrid Guttman ICES, Canada
<b>REVIEW RETURNED</b>	10-Jun-2019

<b>GENERAL COMMENTS</b>	The authors have addressed the concerns raised in the first review
-------------------------	--