Are We Overdiagnosing Mental Illnesses? Evidence from Randomly Assigned Doctors

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*Disclaimer: The views expressed in this paper do not necessarily reflect the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System
Motivation: Diagnosis of Mental Illness is Prevalent

▶ EU: 17.3% of adults in 2018 were diagnosed with a mental health problem
  ▶ Source: OECD/EU Health a Glance Report

▶ US: During 2011-2014, 12.7% of persons age 12 and over took antidepressant medication in the last month
  ▶ Source: National Health and Nutrition Examination Survey
The Question

Is mental illness over or under diagnosed?
Conceptual Framework

Patients have heterogeneous underlying mental health

Low                      Underlying Mental Health                      High
**Conceptual Framework**

Diagnosis is beneficial for patients with low mental health.

- **Net Benefit from Diagnosis**
  - Helped
  - Harmed

- **Underlying Mental Health**
  - Low
  - High
The role of a doctor is to assess the underlying mental health of a patient and diagnose all who fall below a threshold.
**Conceptual Framework**

**Underdiagnosis:** marginal patient has strictly positive benefit from diagnosis
Conceptual Framework

Overdiagnosis: marginal patient is harmed by diagnosis

Net Benefit from Diagnosis

Helped

Harm

Underlying Mental Health

Diagnosed

Low

High
Overdiagnosis: marginal patient is harmed by diagnosis

Helped

Net Benefit from Diagnosis

Low

Underlying Mental Health

High

Diagnosed

Over Diagnosed

Harmed
Our approach to assessing under or over diagnosis

- Measure the causal effect of a mental illness diagnosis on measure associated with welfare of a “marginal” patient
Our approach to assessing under or over diagnosis

- Measure the causal effect of a mental illness diagnosis on measures associated with welfare of a “marginal” patient

Two challenges:

1. How to measure the causal effect on the marginal (not average) patient
   - Exploit random assignment of doctors in Swedish military conscription
Our approach to assessing under or over diagnosis

- Measure the causal effect of a mental illness diagnosis on measures associated with welfare of a "marginal" patient

- Two challenges:
  1. How to measure the causal effect on the marginal (not average) patient
     - Exploit random assignment of doctors in Swedish military conscription
  2. How to adequately measure the welfare of the marginal patient
     - Wide range of health, economic and family outcomes over a twenty-year window after diagnosis
Preview of results

- Diagnosis has a detrimental effect on an 18-year-old man with marginal mental health
Preview of results

- Diagnosis has a detrimental effect on an 18-year-old man with marginal mental health

- Worse life outcomes over 20-year span after diagnosis

- Health outcomes:
  - Increased morbidity
  - More sick days
  - Higher probability of admission to hospital

- Labor market and family outcomes:
  - More likely to be unemployed
  - Less likely to be married
How can overdiagnosis harm a patient?

▶ Several channels are possible. For example:

▶ Treatment (pharmaceutical or otherwise) may have unintended side effects
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▶ Several channels are possible. For example:

▶ Treatment (pharmaceutical or otherwise) may have unintended side effects

▶ Labeling
  ▶ internally: changes self-view, change likelihood of seeking treatment in the future
  ▶ externally: changes the way other doctors assess and treat patients health, and also family and friends.
How can overdiagnosis harm a patient?

- Several channels are possible. For example:
  - Treatment (pharmaceutical or otherwise) may have unintended side effects
  - Labeling
    - internally: changes self-view, change likelihood of seeking treatment in the future
    - externally: changes the way other doctors assess and treat patients health, and also family and friends.
  - Military service
    - We will rule this out as primary channel in our setting
Idealized experiment

Two identical groups containing people with heterogeneous underlying mental health

Group A

Group B

Underlying Mental Health

Low | High
Idealized experiment

**Group A:** Examined for mental health by Doctor A, who applies a **strict standard** for diagnosing mental illness.

Diagnosed as mentally ill

Group A

---

Group B

---

Low  Underlying Mental Health  High
**Idealized experiment**

**Group B:** Examined for mental health by Doctor B, who applies a **lenient standard** for diagnosing mental illness.

- **Group A**: Diagnosed as mentally ill.
- **Group B**: Underlying mental health
  - Low
  - High

Diagnosed as mentally ill
**Experiment:** Compare outcomes for groups A and B

Any difference will be caused by differential diagnosis of marginal patients

Diagnosed as mentally ill

Group A

Group B

Diagnosed as mentally ill

Low Mental Health

High Mental Health

Underlying Mental Health
Requirements for ideal experiment

- **Counterfactual:** Groups A and B must be ex-ante *identical*
  - Random assignment of doctor will ensure this
  - Check empirically by comparing observable characteristics of each group
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- **Variation:** Doctors must vary in the mental illness threshold they apply
  - Check this empirically
  - Verify that leave-out propensity of diagnosing other patients predicts likelihood that a patient is diagnosed
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  - Check this empirically
  - Verify that leave-out propensity of diagnosing other patients predicts likelihood that a patient is diagnosed

- **Monotonicity:** Doctors agree on underlying ranking of mental health
  - Check this empirically
  - Why this matters....
**Monotonicity:** Doctors agree on underlying ranking of mental illness, but apply a different threshold for diagnosis.
Monotonicity

Experiment without monotonicity
Will potentially confound effect of failure to diagnose with diagnosis of non-marginal patients

Group A

Group B

Diagnosed as mentally ill

Diagnosed as mentally ill

Low

Underlying Mental Health

High
Setting: Swedish military service

- Sweden had mandatory military conscription from 1901 to 2010.
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- All male citizens report to their regional test office shortly around turning 18
  - Two days of cognitive and physical tests to determine if conscript was fit to serve
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- Sweden had mandatory military conscription from 1901 to 2010

- All male citizens report to their regional test office shortly around turning 18
  - Two days of cognitive and physical tests to determine if conscript was fit to serve

- As part of this process every conscript is examined by a doctor (GP) who assesses his physical and mental health
The Diagnosis Process

► Assignment of conscript to doctor is random:
  ► Several doctors work in each regional office
  ► After completing several other tests, conscripts place records in a box and are called in order by the next available doctor
The Diagnosis Process

- Assignment of conscript to doctor is random:
  - Several doctors work in each regional office
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- Doctors go through a standardized protocol (questions, vital signs) and use this to diagnose mental illness
  - The diagnosis includes a code which records the type of mental illness
  - Doctors also assign a severity score to their diagnosis on a scale of 1 to 9
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- Doctors do not provide treatment
  - If a conscript is diagnosed, he is informed of the diagnosis and is referred to a specialist outside of the military

Diagnosis lowers the probability of serving from 74% to 37%
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▶ Diagnosis lowers the probability of serving from 74% to 37%
**Types of mental illnesses diagnosed**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>All</th>
<th>Severe</th>
<th>Intermediate</th>
<th>Less severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>35%</td>
<td>23%</td>
<td>47%</td>
<td>30%</td>
</tr>
<tr>
<td>Psychosomatic disorders</td>
<td>29%</td>
<td>4%</td>
<td>52%</td>
<td>44%</td>
</tr>
<tr>
<td>Psychological development disorders</td>
<td>15%</td>
<td>84%</td>
<td>14%</td>
<td>2%</td>
</tr>
<tr>
<td>Neurosis, Anxiety disorders</td>
<td>12%</td>
<td>7%</td>
<td>30%</td>
<td>63%</td>
</tr>
<tr>
<td>Personality disorders</td>
<td>3%</td>
<td>83%</td>
<td>16%</td>
<td>1%</td>
</tr>
<tr>
<td>Addiction</td>
<td>3%</td>
<td>64%</td>
<td>31%</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
<td>65%</td>
<td>32%</td>
<td>2%</td>
</tr>
</tbody>
</table>

- **Diagnosis rate in our sample:** 2.84%
- **Examples:**
  - **Psychosomatic disorders**: Stress induced physical ailment such as ulcers and high blood pressure
  - **Psychological development disorders**: Autism, attention deficit/hyperactivity disorder
  - **Personality disorders**: Narcissistic personality disorder, paranoia
Sample and data

- Sample of Swedish males called to enlist between 1989 and 2001
  - Chosen to ensure consistency of diagnosis protocol throughout sample

- Only include a doctor in a year if she saw at least 500 conscripts in that year
- Only include conscripts who saw this set of doctors

The resulting analysis sample contains 410,146 conscripts assessed by 102 doctors

- We link each individual in the draft data to National medical board records (diagnosis, prescriptions, death, hospital admission)
- Statistics Sweden data on wealth, family and labor market outcomes
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Empirical strategy
Doctor leniency

We construct our instrument using a residualized, annual leave-out mean doctor leniency measure similar to that used to exploit variation in judge propensities for:

▶ Sentence length (Kling 2006)
▶ Juvenile incarceration (Aizer and Doyle 2015)
▶ Pretrial detention (Dobbie et al. (2018))

We account for two sources of non-random variation in the construction of our instrument:

▶ variation in diagnosis rates across recruitment centers
▶ variation in diagnosis rates over time
Let the diagnosis of mental illness after removing the effect of enlistment-center-by-year fixed effects $X_{ct}$ be denoted by

\[ \text{Draft \_ Diagnosis}_{ict} = \gamma X_{ct} + \varepsilon_i \]
Doctor leniency

Let the diagnosis of mental illness after removing the effect of enlistment-center-by-year fixed effects $X_{ct}$ be denoted by

$$Draft\_Diagnosis_{ict} = \gamma X_{ct} + \varepsilon_i$$

Then, we define $Z_{ict}$ as doctor $j$’s tendency to diagnose a mental illness for each individual $i$ in center $c$ in year $t$ as

$$Z_{ict} = \frac{\sum_{k \in N_{j,t}} \varepsilon_k - \varepsilon_i}{N_{c,j,t} - 1}$$

where $N_{cjt}$ is the total number of draftees $k$ attended by doctor $j$ in center $c$ in year $t$
Variation in Doctor leniency

This figure reports the first stage relationships between draftee mental illness diagnosis during conscript and the numerical value of Doctor leniency.

The solid line represents a local linear regression of mental illness on Doctor leniency.
Monotonicity: Variation in leniency should come from different tendency to diagnose marginal cases.

Group A

Diagnosed as mentally ill

Group B

Diagnosed as mentally ill

Low

Underlying Mental Health

High
Monotonicity: Leniency calculated separately on severe and mild diagnoses
**Monotonicity:** Among all people who are not diagnosed, those who saw the lenient doctor should have higher average health.
Monotonicity: Average mental health of subsample of undiagnosed conscripts

Subsample not diagnosed as mentally ill at the draft

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Mental Illness Diagnosis over next 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above median leniency</td>
<td>-0.00288***</td>
</tr>
<tr>
<td></td>
<td>(0.000652)</td>
</tr>
<tr>
<td>Observations</td>
<td>393,285</td>
</tr>
<tr>
<td>Dep. var mean</td>
<td>0.04369</td>
</tr>
</tbody>
</table>
Main Results
The effect of diagnosis on health at age 30 (2SLS)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Death up to age 30 (1)</th>
<th>Complete suicide up to age 30 (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft diagnosis</td>
<td>0.00764*</td>
<td>0.00118</td>
</tr>
<tr>
<td>Mental illness</td>
<td>(0.00460)</td>
<td>(0.00250)</td>
</tr>
<tr>
<td>Observations</td>
<td>407,162</td>
<td>405,273</td>
</tr>
<tr>
<td>% change</td>
<td>123</td>
<td>73</td>
</tr>
<tr>
<td>Dep. Var mean</td>
<td>0.0062</td>
<td>0.0016</td>
</tr>
<tr>
<td>Time x center FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nr of clusters</td>
<td>102</td>
<td>102</td>
</tr>
</tbody>
</table>
The effect of diagnosis on health at age 30 (2SLS)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Outpatient at age 30</th>
<th>Inpatient at age 30</th>
<th>Sick days at age 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>(3) 0.204***</td>
<td>(4) 0.0388*</td>
<td>(5) 10.74***</td>
</tr>
<tr>
<td>Draft diagnosis</td>
<td>(0.0587)</td>
<td>(0.0226)</td>
<td>(2.846)</td>
</tr>
<tr>
<td>Mental Illness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>404,909</td>
<td>404,909</td>
<td>397,566</td>
</tr>
<tr>
<td>% change</td>
<td>88</td>
<td>127</td>
<td>244</td>
</tr>
<tr>
<td>Dep. Var mean</td>
<td>0.2315</td>
<td>0.0305</td>
<td>4.4078</td>
</tr>
<tr>
<td>Time x center FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nr of clusters</td>
<td>102</td>
<td>102</td>
<td>102</td>
</tr>
</tbody>
</table>
The effect of diagnosis on labor market at age 30 (2SLS)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Unemployed at age 30 (1)</th>
<th>Income from work at age 30 (2)</th>
<th>Years of schooling at age 30 (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft diagnosis</td>
<td>0.153***</td>
<td>-42,020</td>
<td>-0.551</td>
</tr>
<tr>
<td>Mental Illness</td>
<td>(0.0503)</td>
<td>(30,920)</td>
<td>(0.644)</td>
</tr>
<tr>
<td>Observations</td>
<td>397,566</td>
<td>402,839</td>
<td>397,440</td>
</tr>
<tr>
<td>% change</td>
<td>136</td>
<td>-16</td>
<td>-4.3</td>
</tr>
<tr>
<td>Dep. Var mean</td>
<td>0.1125</td>
<td>266799.7621</td>
<td>12.7694</td>
</tr>
<tr>
<td>Time x center FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nr of clusters</td>
<td>102</td>
<td>102</td>
<td>102</td>
</tr>
</tbody>
</table>
The effect of diagnosis on wealth at age 30 (2SLS)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Wealth at age 28</th>
<th>1/Home owner &gt;0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Draft diagnosis</td>
<td>-382.4</td>
<td>-0.0482</td>
</tr>
<tr>
<td>Mental Illness</td>
<td>(36,590)</td>
<td>(0.149)</td>
</tr>
<tr>
<td>Observations</td>
<td>296,258</td>
<td>10,395</td>
</tr>
<tr>
<td>% change</td>
<td>-.53</td>
<td>-7.2</td>
</tr>
<tr>
<td>Dep. Var mean</td>
<td>71766.4522</td>
<td>0.6723</td>
</tr>
<tr>
<td>Time x center FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nr of clusters</td>
<td>74</td>
<td>102</td>
</tr>
</tbody>
</table>

Wealth= Financial Assets at Market Value
The effect of diagnosis on family structure at age 30 (2SLS)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Married at age 30</th>
<th>Divorced at age 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>(7)</td>
<td>(8)</td>
</tr>
<tr>
<td>Draft diagnosis</td>
<td>-0.101**</td>
<td>0.00964</td>
</tr>
<tr>
<td>Mental Illness</td>
<td>(0.0393)</td>
<td>(0.00893)</td>
</tr>
<tr>
<td>Observations</td>
<td>397,566</td>
<td>397,566</td>
</tr>
<tr>
<td>% change</td>
<td>-53</td>
<td>80</td>
</tr>
<tr>
<td>Dep. Var mean</td>
<td>0.1907</td>
<td>0.0121</td>
</tr>
<tr>
<td>Time x center FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nr of clusters</td>
<td>102</td>
<td>102</td>
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</tbody>
</table>
Results So Far

▶ Diagnosis at age 18 makes marginal patient worse off at age 30
Results So Far

- Diagnosis at age 18 makes marginal patient worse off at age 30

- Next: outcomes at other ages
Effect of diagnosis ages 18 to 38: death (2SLS)
Effect of diagnosis ages 18 to 38: health outcomes (2SLS)

<table>
<thead>
<tr>
<th>Health Outcomes</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
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<th>35</th>
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<tbody>
<tr>
<td>Death</td>
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<tr>
<td>Completed Suicide</td>
<td>+</td>
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<td>Inpatient</td>
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<td>Sick Days</td>
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Sign of all Statistically Significant 2SLS Estimates by Age
(Statistically Insignificant Estimates Left Blank)
### Effect of diagnosis ages 18 to 38: other outcomes (2SLS)

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<tbody>
<tr>
<td>Unemployed</td>
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<tr>
<td>Income from Work</td>
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#### Sign of all Statistically Significant 2SLS Estimates by Age

*Statistically Insignificant Estimates Left Blank*
Summary of Results

▶ Diagnosis at age 18 makes marginal patient worse off at all ages

▶ Health outcomes are worse
  ▶ Mortality
  ▶ Admission to hospital as an inpatient or outpatient
  ▶ Sick days

▶ Higher unemployment

▶ Lower probability of being married
How does diagnosis affect life outcomes?
Is the mechanism: diagnosis alters the probability of serving in the military?

- Conscripts diagnosed as mentally ill are 38.5 percentage points less likely to serve in the military
  - Is this why diagnosis affects life outcomes?
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- We separately measure the causal effect of serving in the military on the same set of outcomes
  - Borrow the identification strategy first used by:
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  - Is this why diagnosis affects life outcomes?

- We separately measure the causal effect of serving in the military on the same set of outcomes
  - Borrow the identification strategy first used by:

- Exploits random assignment of conscripts to officiator and variation in the influence of each officiator
  - Caveat: effect of service may be different for conscript with marginal mental health
The effect of Military Service, 2SLS

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<tr>
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<th>Sick days at age 30</th>
<th>Unemployed at age 30</th>
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<tbody>
<tr>
<td>1(Military service&gt;0)</td>
<td>-1.323</td>
<td>-0.0618***</td>
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<td>(1.840)</td>
<td>(0.0139)</td>
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<tr>
<td>Observations</td>
<td>256,770</td>
<td>256,770</td>
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<tr>
<td>% change</td>
<td>-30</td>
<td>-58</td>
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<tr>
<td>Dep. Var mean</td>
<td>4.4513</td>
<td>0.1068</td>
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<tr>
<td>Nr of clusters</td>
<td>70</td>
<td>70</td>
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</table>

- Multiplying these estimates by 38.5% and subtracting from original 2SLS estimates only partially offsets our estimated effects
- Example: Effect of diagnosis on number of sick days (unmediated by military service) becomes 10.2 days
Does the harmful effect of diagnosis come through increased exposure to antidepressants?

Figure 15: Event time evolution of 2SLS estimates for effect of mental illness diagnosis on future medical treatment

- Prozac was first prescribed in Sweden in 1991
Conclusion: Evidence points to overdiagnosis of mental illness

- First evidence of long-term effects of a mental illness diagnosis for the marginal patient
- Being diagnosed mentally ill at 18 has harmful effects on mortality, health, employment
  - Same conclusion at any horizon in the 20 years after diagnosis
  - This effect remains after removing the effect of diagnosis mediated by military service

- Diagnosis rate in our sample: 2.84%
- In the Swedish general population in 2014: 7.7% of 18-year-old men were diagnosed with a mental illness

Open questions:
- Other ages?
- What about for women?
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  - Other ages? What about for women?
Are We Overdiagnosing Mental Illnesses? 
Evidence from Randomly Assigned Doctors

Marieke Bos (Swedish House of Finance, SSE) and Andrew Hertzberg* (Philadelphia Fed) with Andrés Liberman (Stern, NYU)

July 2020

*Disclaimer: The views expressed in this paper do not necessarily reflect the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System