Driving with Autism and ADHD

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Center for Injury Research and Prevention
CHOP Primary Care Patients With ADHD

Core Symptoms

- inattention
- hyperactivity
- impulsivity

Girls: 4%

Boys: 10%
Driving Behaviors Among Adolescents With ADHD

Simulator and In-Vehicle Technology Studies

Increased speeding

More impulsive

Less flexible to changing road conditions

More likely to exhibit illegal behavior

Fischer, 2007; Reimer, 2010; Merkely, 2013.
Few Epidemiologic Studies

Small clinic-based samples of males

Self-reported driving outcomes with long recall periods

Lack of adjustment (e.g., driving experience)

Almost all prior to Graduated Driver Licensing
Study Objective

Longitudinal study to examine risk of adverse driving outcomes among adolescents with community-identified ADHD over initial years of licensure.
Study Cohort

Born 1987-1997; NJ resident; Primary care patient; Age 12+ (n=18,595)

Without intellectual disability & ≥ 1 mo f/u (n=18,344)

ADHD: Diagnostic ICD-9-CM codes, CHOP visit or "problem list"

ADHD n = 2,479
No ADHD n = 15,865

Full Validation Study: Gruschow et al., Journal of Attention Disorders, 2017.
<table>
<thead>
<tr>
<th>Sample Characteristics</th>
<th>ADHD (N=2,479) Median (IQR)</th>
<th>No ADHD (N=15,865) Median (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at last visit</td>
<td>18.1 (16.5, 19.2)</td>
<td>17.9 (15.9, 18.9)</td>
</tr>
<tr>
<td>No. primary care visits</td>
<td>26 (15, 40)</td>
<td>18 (10, 31)</td>
</tr>
<tr>
<td>Age at end of study</td>
<td>21.6 (19.3, 24.2)</td>
<td>22.3 (19.7, 24.8)</td>
</tr>
<tr>
<td>Male</td>
<td>72%</td>
<td>48%</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>69%</td>
<td>60%</td>
</tr>
<tr>
<td>Presence of DBD</td>
<td>18%</td>
<td>3%</td>
</tr>
</tbody>
</table>
1. Licensing Rates

Adjusted for: sex, race/ethnicity, insurance payor, zip code household income and population density, birth year, disruptive behavioral disorder, primary care practice

Median licensure age
ADHD: 17.3
No ADHD: 17.0
## Licensing Rates

### Among Drivers Ultimately Licensed

<table>
<thead>
<tr>
<th></th>
<th>ADHD</th>
<th>No ADHD</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age at intermediate licensure</strong>, females</td>
<td>17.2 (17.0, 17.8)</td>
<td>17.0 (17.0, 17.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Age at intermediate licensure</strong>, males</td>
<td>17.4 (17.0, 17.8)</td>
<td>17.1 (17.0, 17.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Months, permit to intermediate</strong></td>
<td>8 (6, 11)</td>
<td>8 (6, 11)</td>
<td>0.32</td>
</tr>
<tr>
<td><strong>Months, intermediate to full</strong></td>
<td>14 (12, 23)</td>
<td>14 (12, 25)</td>
<td>0.15</td>
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</table>
Crash Risk

ADHD in Teens

Does ADHD raise the risk of car accidents and problem drinking?

Yes. Driving poses special risks for teens with ADHD. Teens with ADHD are two to four times more likely to have a car accident than teens without ADHD.
Crash Rates (Per 10k Drivers)
1 Month Post-Licensure

**Rate**

- **With ADHD**: 294.0
- **Without ADHD**: 187.6

**RR** = 1.62 (1.18, 2.23)

Rates adjusted for: age at licensure, month since licensure, sex, race/ethnicity, insurance payor, zip code household income and population density, disruptive behavior disorder, seizure disorder
Crash Risk: adjRR = 1.36
Crash Risk: $\text{adjRR} = 1.36$

**Implications for Practice**
- Move beyond rec. to "delay licensure"
- Efforts needed in pre-/early licensure
## Top 5 Crash Scenarios

*All Crashes within 24 months of Licensure*

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Rank</th>
<th>%</th>
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<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear end (index vehicle)</td>
<td>1</td>
<td>32.4</td>
<td>1</td>
<td>32.9</td>
</tr>
<tr>
<td>Right angle</td>
<td>2</td>
<td>19.4</td>
<td>3</td>
<td>16.2</td>
</tr>
<tr>
<td>With non-motor vehicle</td>
<td>3</td>
<td>17.6</td>
<td>2</td>
<td>16.8</td>
</tr>
<tr>
<td>Side swipe (same direction)</td>
<td>4</td>
<td>7.8</td>
<td>4</td>
<td>8.5</td>
</tr>
<tr>
<td>Backing</td>
<td>5</td>
<td>6.7</td>
<td>5</td>
<td>8.1</td>
</tr>
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</table>

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<tr>
<td>With ADHD</td>
<td></td>
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<td>1</td>
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<td>8.5</td>
<td>4</td>
<td>8.5</td>
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<td>Backing</td>
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<td>8.1</td>
<td>5</td>
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Driving Behaviors & Performance

- All crashes
- At-fault
- Peer passenger
- Single-vehicle
- Multiple passenger
- Early night
- Injury
- Late night
- Alcohol-related

Rate ratio:
- 12 months
- 48 months
Driving Behaviors & Performance

- All violations
- Moving violations
- Careless driving
- Speeding
- Electronic equipment use
- Alcohol/drug use
- Seat belt nonuse
- GDL restrictions
- Any license suspension

Rate ratio

12 months
48 months
Summary and Next Steps

Sustained increase in crash risk regardless of age at licensure that persists into early adulthood - but not 4 times

Foundational research needed to inform development of evidence-based guidelines and resources for healthcare providers and others

Moving beyond recommendation to take medication

Interventions to reduce risky driving behaviors
ASD: Transition From Adolescence to Adulthood

1 in 3 disconnected

1 in 4 socially isolated

1 in 3 no community participation in last year

Source: Roux et al., National Autism Indicators Report
Critical Skills for Driving

Visual

Executive functioning

Visual-cognitive

Motor coordination

Source: Classen 2013; Reimer 2013; Cox 2012; Sheppard 2010.
Small Simulator Studies

Autistic teens:

- divert gaze away from high-stimulus area
- identify fewer hazards
- show impaired fitness-to-drive abilities
- driving errors

Source: Reimer 2013; Cox 2015; Sheppard 2010; Brooks 2016.
Parent Surveys

63% interested in having teen drive

Driving was:
- Higher among teens with parent with prior experience
- Higher when driving goals in teen IEP
- Associated with college aspiration and paid job outside home

Source: Huang et al. 2012; Cox et al., 2012
CHOP Autism and Driving Study

Long-Term Goal
Inform need for and develop targeted interventions for families of autistic teens

Project Aim
Estimate rates of driver licensing and other driving outcomes
Study Cohort

Last seen at CHOP
> age 12
n = 52,713

Without intellectual disability
n = 52,222

No ASD
n = 51,613
98.8%

ASD
n = 609
1.2%

Intellectual Disability:
ICD-9-CM: 317/8/9 on CHOP visit or problem list

Autism:
ICD-9-CM: 299, 299.0, 299.8 on CHOP visit or problem list
<table>
<thead>
<tr>
<th>Demographics</th>
<th>No ASD (N=51,563)</th>
<th>ASD (N=609)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at end of study period</td>
<td>20.5 (18.4, 22.7)</td>
<td>19.6 (18.0, 21.4)</td>
</tr>
<tr>
<td>Male</td>
<td>51%</td>
<td>81%</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>71%</td>
<td>79%</td>
</tr>
<tr>
<td>Private-payor, last CHOP visit</td>
<td>82%</td>
<td>88%</td>
</tr>
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Cumulative Probability of Licensure
By Age Eligibility

Adjusted for: sex, race/ethnicity, payor, zip code household income and population density, birthyear; no interaction by sex.
Conditional Probability of Licensure
Among Teens w/ Permit, since Fully Eligible

2-year post-eligibility:
98% (no ASD) vs. 90% (ASD)
Key Findings & Implications

1. One in three with ASD licensed by age 21

2. Majority of these licensed at age 17

3. 90% of those who get permit become licensed within 2 years
Key Findings & Implications

1. One in three with ASD licensed by age 21

Licensing rates 1/3 \( \downarrow \) than parents interested 2/3

*Unknown to what extent this reflects:*
- Teen lack of interest
- Parent fear/concern
- Appropriate decision to remain unlicensed
- Lack of support and tools
Key Findings & Implications

3. **90%** of those who get permit become licensed within 2 years

*Bulk of families that decide not to pursue licensure make this decision before teen ever gets behind the wheel.*

*Period before permit eligibility is opportunity for clinicians to support a families during decision-to-drive process.*
Critical Research is Needed

1. How do families decide if autistic teen will drive?
2. How do we assist capable drivers' safety?
3. To what extent are professionals involved?
4. What happens when families decide teen won't drive?
5. How does risk of adverse outcomes compare to drivers without ASD?
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CHOP Autism and Driving Study

Long-Term Goal
Inform need for and develop targeted interventions for families of autistic teens

Project Aim
Explore how learning-to-drive process for autistic teens from driver educators' perspective
Participants & Recruitment

- Eligible participants: 17 CDRS or CDI who identified working with teens with ASD

- Sampling: Association for Driving Rehabilitation Specialists

- Interviews audio recorded over phone
Analysis

- Transcription to de-identify interviews
- Double coding, inter-coder reliability
- Coded & analyzed with NVivo 11
### Demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>13 (76%)</td>
</tr>
<tr>
<td>OT/CDRS/CDI</td>
<td>15 (88%)</td>
</tr>
<tr>
<td>≥15 years teaching</td>
<td>9 (53%)</td>
</tr>
<tr>
<td>Hospital-based facility</td>
<td>8 (47%)</td>
</tr>
<tr>
<td>Suburban</td>
<td>11 (64%)</td>
</tr>
</tbody>
</table>

- Worked with multitude of populations across diagnoses & disabilities
Parental Engagement

Fostering independence prior to lessons:

- Introducing pre-driving activities
- Including driving on IEP

"[His mother] goes, ‘Oh, I would never consider it… we tried once and he hit our car. He hit a tree. He couldn’t control the thing, and it would be unsafe for him to cut the lawn.’ And I’m like, what? And she was insistent… And I said, well, if he can’t cut the lawn, it’s probably gonna be a stretch to drive. And a little light went on in her head."
Parental Engagement

Critical partnership with educator, student, and family

Parent-led practice driving is necessary

"So a typical student gets... instruction for six hours. I multiply that by four [for autistic students]. And then the parents are supposed to provide about 50 hours... Multiply that by four... And so I can’t do all of the training... because it would be astronomical in terms of cost, but it also isn’t realistic. "
Individualize Approach

Assessments identify those with potential to succeed.

- Clinical & on-road assessment
- Adolescent life-skills checklist
- Decision: is student good candidate currently
What can educators do?

- Conduct comprehensive evaluations
- Provide consistent feedback to parents and students
- Think about communication prior to lessons
What are the best practices?

Time intensive process: students require 3-4x lessons

Educators employ diversity of strategies

- Commentary driving

- Simulators, apps
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Contract Information:

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Students

- 20 years old on average
- Varying levels of experience
- Most have driving on IEP or 504 plan
- Some licensed already
Driving Evaluations

1 hr clinical, 1 hr on-road assessment
Consult on medication
Family meeting
Reassess after 10 driving hours
Adolescent Life Skills Checklist

- Is teen responsible for chores at home?
- Can teen stay home alone?
- Do they know how to ride a bike?

"[The Adolescent Life Skills Checklist] is a roadmap to determining if they can be a candidate for driving in the future. So, work on these skills and if they get there, then you wanna come back to us and we’ll re-evaluate at that point."
Recommendations for Families

- Students are motivated when they are ready
- Introduce pre-driving activities before permit
- Encourage pre-driving teens to observe parents
- Think critically about teen's life skills before driving
- Plan ahead for steps after licensure
Longitudinal study of driver licensing rates among adolescents and young adults with autism spectrum disorder

Allison E Curry¹, Benjamin E Yerys¹,², Patty Huang¹ and Kristi B Metzger¹