Objectives

At the conclusion participants will:
1. ...be able to list the most common sources of acquired brain injury.
2. ...be able to describe how the impact to certain parts of the brain affects independence and response to treatment.
3. ...know how to screen for a history of brain injury in persons they serve.

What is Acquired Brain Injury

An acquired brain injury (ABI) is an injury to the brain that is not hereditary, congenital, degenerative, or induced by birth trauma:
- Traumatic brain injury (TBI)
- Cerebrovascular Accident (CVA; e.g., stroke, TIA, aneurysm)
- Tumors
- Anoxic/hypoxic brain injury (e.g., respiratory arrest [including opioid overdose], heart attack, drowning)
- Infections & encephalopathies
- Poisoning (e.g., drugs, metals, toxins)
### Why is TBI important for aging and disability populations?

1. Earlier TBI is related to later life falls & dementia.
2. Some younger people with more severe TBI do well initially but decline in function with time, requiring more supports to remain independent.
3. People with primary disabilities other than TBI also have experienced TBIs, some of which can affect their success living in the community.
Ohio Department of Health/CDC Behavioral Risk Factors Surveillance System (BRFSS)

- 110,000 non-institutionalized adults in Ohio report they:
  - currently have a disability
  - have had at least one moderate or severe TBI in their lifetime
- 3.5 times more likely to have a disability with a history of moderate or severe TBI

Ohio Benefits LTSS Questionnaire

a. Thinking about any injuries you have had in your lifetime, were you ever knocked out or did you lose consciousness?  
   ___ Yes ___ No (If NO, STOP HERE)

b. What was the longest time you were knocked out or unconscious?  
   (Choose just one; if you are not sure please make your best guess.)
   ___ knocked out or lost consciousness for less than 30 min
   ___ knocked out or lost consciousness between 30 min and 24 hrs
   ___ knocked out or lost consciousness for 24 hrs or longer

c. How old were you the first time you were knocked out or lost consciousness? ___ years old

OBLTSS Questionnaire
October 2017-February 2021

- 53,000 callers given screening questions
- 10.4% of those asked had experienced at least 1 TBI with loss of consciousness sometime in their life
- 2.8% of those asked had experienced at least 1 moderate or severe TBI in their lifetime
  > 4 callers per day have a history of TBI with loss of consciousness
  > 1 caller per day had at least 1 moderate or severe TBI in their lifetime
How Representative?

<table>
<thead>
<tr>
<th></th>
<th>21-59 years old</th>
<th>60+ years old</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild TBI</td>
<td>Mod/Severe</td>
</tr>
<tr>
<td>Ohio BRFSS</td>
<td>13.3%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Ohio LTSSQ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Re-cap

- Acquired brain injury (ABI) occurs after birth and is not degenerative
- While stroke often thought of as most common, traumatic brain injury (TBI) affects more people
- Recent pandemics (opioids, COVID-19) impart brain damage due to anoxia/hypoxia
- While strokes and tumors have focal effects on the brain, TBI, anoxia/hypoxia, infections and poisoning have diffuse effects that leave a specific fingerprint

Traumatic Brain Injury (TBI)

“...an insult to the brain caused by an external force that results in an altered state of consciousness and one or more impairments of brain functioning. Effects may be temporary or permanent.”
Traumatic Brain Injury (TBI)

“...an insult to the brain caused by an external force that results in an altered state of consciousness and one or more impairments of brain functioning. Effects may be temporary or permanent.”
Traumatic Brain Injury (TBI)

“...an insult to the brain caused by an external force that results in an altered state of consciousness and one or more impairments of brain functioning. Effects may be temporary or permanent.”

ODH estimates for annual rates of TBI in Ohio*

2,639 Deaths
10,543 Hospitalizations
109,817 Emergency Department Visits
?? Receiving Other Medical Care or No Care

* Ohio Department of Health Vital Statistics and Ohio Hospital Association Discharge Data 2017

123,000 TBIs receive medical attention each year in Ohio

123,000 TBIs receive medical attention each year in Ohio

16
17
18
Poll Question*

TBI is...
A. A life altering injury for survivors and their families, profoundly impacting the patient’s functional status.
B. A very common injury that is essentially inconsequential to the individual’s functional status following recovery.
C. Both A and B and everywhere in between.

*Thanks D. Arciniegas & H. Wortzel for this slide

Continuum of TBI Severity

Least severe
Mild TBI (concussion)
Any LOC

Moderate TBI
LOC ≥ 30 minutes

Severe TBI

Dazed, confused, gap in memory
Loss of Consciousness (LOC)
Coma

Most severe

Not Just Severity of Injury

• Cumulative effects from multiple TBIs
  – number and/or spacing?
TBI due to Blasts—the “signature injury” of combat in Iraq and Afghanistan

- Can blast forces alone cause mild TBI?
- If so, is it the same pathology as TBI caused by mechanical forces?
- What about multiple blasts?

Groups Who May Have Multiple Mild TBI’s

- Military personnel, particularly those with combat deployment in OEF/OIF
- Athletes, particularly boxers, football players & hockey players
- Victims of intimate partner violence and childhood physical abuse
- People who misuse and abuse substances
- Other vulnerable populations (e.g., psychiatric disorders, homeless, inmates)
Not Just Severity of Injury

- Cumulative effects from multiple TBIs
  - number and/or spacing?
- Age at injury
  - childhood but also with normal aging
- How recent
- When combined with other neurological conditions

Re-cap

- TBI occurs when an external force causes an alteration in consciousness
- Effects can be temporary or permanent
- Range from mild to severe
- A concussion is a mild TBI
- Mild TBIs may have cumulative effects or interact with normal development

What are the effects of TBI?
Long-Term Consequences of Mild TBI

Depression*
Aggression*
Post-concussive symptoms*
Completed suicide
PTSD (combat acquired only)
Progressive dementia (with LOC only)
Parkinsonism (with LOC only)
Ocular & visual motor disturbances
Unprovoked seizures

*Highest evidence of an association

Adjusted Odds* of Disability by Severity of Worst Lifetime TBI

* Compared to Ohioans with no TBI with loss of consciousness, adjusted for age, gender, and neuroticism.
State of Ohio (Corrigan et al., 2017; Yi et al., 2018; Manchester et al., 2020; Bogner et al., 2020)

Lifetime history of TBI with loss of consciousness

- More likely to have a disability (AOR=2.5)
- More likely to have fair or poor general health (AOR=2.0)
- More likely to sleep < 7 hours per night (AOR=1.5)
- More likely diagnosed with a chronic disease (AOR=2.0)
- More likely depression in one’s lifetime (AOR=2.1)
- More days of poor mental health (AOR=2.0)
- More likely to binge drink (AOR=1.5)
- More likely to engage in heavy drinking (AOR=1.7)
- More likely to smoke cigarettes (AOR=1.7)

*Adjusted for sex, age and race/ethnicity

<table>
<thead>
<tr>
<th>Lifetime History of TBI:</th>
<th>Any TBI</th>
<th>TBI with LOC</th>
<th>Mod/Sev TBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population of adults (~Whiteneck et al.; ~3-state average)</td>
<td>43%*</td>
<td>23%**</td>
<td>4%**</td>
</tr>
</tbody>
</table>

SUD treatment (Corrigan & Bogner) | 65% | 53% | 17% |
<table>
<thead>
<tr>
<th>Lifetime History of TBI:</th>
<th>Any TBI</th>
<th>TBI with LOC</th>
<th>Mod/Severe TBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population of adults (Whiteneck et al.; 3-state average)</td>
<td>43%*</td>
<td>23%**</td>
<td>4%**</td>
</tr>
<tr>
<td>SUD treatment (Corrigan &amp; Bogner)</td>
<td>65%</td>
<td>53%</td>
<td>17%</td>
</tr>
<tr>
<td>Psychiatric inpatients (Burg et al.)</td>
<td>68%</td>
<td>36%</td>
<td>20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lifetime History of TBI:</th>
<th>Any TBI</th>
<th>TBI with LOC</th>
<th>Mod/Severe TBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population of adults (Whiteneck et al.; 3-state average)</td>
<td>43%*</td>
<td>23%**</td>
<td>4%**</td>
</tr>
<tr>
<td>SUD treatment (Corrigan &amp; Bogner)</td>
<td>65%</td>
<td>53%</td>
<td>17%</td>
</tr>
<tr>
<td>Psychiatric inpatients (Burg et al.)</td>
<td>68%</td>
<td>36%</td>
<td>20%</td>
</tr>
<tr>
<td>Prisoners (*Shrioma et al.; **Bogner &amp; Corrigan)</td>
<td>60%*</td>
<td>50%*</td>
<td>14%**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lifetime History of TBI:</th>
<th>Any TBI</th>
<th>TBI with LOC</th>
<th>Mod/Severe TBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population of adults (Whiteneck et al.; 3-state average)</td>
<td>43%*</td>
<td>23%**</td>
<td>4%**</td>
</tr>
<tr>
<td>SUD treatment (Corrigan &amp; Bogner)</td>
<td>65%</td>
<td>53%</td>
<td>17%</td>
</tr>
<tr>
<td>Psychiatric inpatients (Burg et al.)</td>
<td>68%</td>
<td>36%</td>
<td>20%</td>
</tr>
<tr>
<td>Prisoners (*Shrioma et al.; **Bogner &amp; Corrigan)</td>
<td>60%*</td>
<td>50%*</td>
<td>14%**</td>
</tr>
<tr>
<td>Homeless (*Hwang et al.; ~Bremner et al., Solliday-McRoy et al.)</td>
<td>53%*</td>
<td>47%**</td>
<td>12%*</td>
</tr>
</tbody>
</table>
### Lifetime History of TBI:

<table>
<thead>
<tr>
<th></th>
<th>Any TBI</th>
<th>TBI with LOC</th>
<th>Mod/Sev TBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population of adults (*Whiteneck et al.; ~3-state average)</td>
<td>43%*</td>
<td>23%**</td>
<td>4%**</td>
</tr>
<tr>
<td>SUD treatment (Corrigan &amp; Bogner)</td>
<td>65%</td>
<td>53%</td>
<td>17%</td>
</tr>
<tr>
<td>Psychiatric inpatients (Burg et al.)</td>
<td>68%</td>
<td>36%</td>
<td>20%</td>
</tr>
<tr>
<td>Prisoners (*Shrioma et al.; **Bogner &amp; Corrigan)</td>
<td>60%*</td>
<td>50%*</td>
<td>14%**</td>
</tr>
<tr>
<td>Homeless (*Hwang et al.; **Bremner et al., Solliday-McRoy et al.)</td>
<td>53%*</td>
<td>47%**</td>
<td>12%*</td>
</tr>
</tbody>
</table>

---

**Persons with TBI more likely prescribed opioids**
- Headache and orthopedic pain common with TBI
- Persons with persistent post-concussive syndrome more likely prescribed opioids

**Persons with TBI more susceptible to addictive influence of opioids**

**Persons with TBI have more challenges for successful treatment**

---

### Suicide and Prior History of TBI

- **Swedish mortality N=2.6 M** (Fazel et al., 2014)
  - prior TBI vs same sex & age (AOR=3.3)
  - prior TBI vs uninjured siblings (AOR=2.3)
- **Danish suicides N=7.4 M** (Madsen et al., 2018)
  - prior TBI vs same sex, age & era (IRR=2.6)
  - prior severe TBI vs same sex, age & era (IRR=3.4)
- **U.S. suicides N=270,074** (Ahmedani et al., 2018)
  - prior TBI vs same sex, age, psychiatric dx & SUD (AOR=8.8) [the highest of all co-morbid conditions]
COVID-19 and Brain Injury

- Exposure
  - Lower SES communities
  - Congregate living: jails & prisons, nursing homes
- Vulnerability to greater illness
  - Pre-existing poorer health & chronic conditions
  - Selection factors when resources limited
- Shutdown related issues
  - Loneliness: “Welcome to my world”
  - Telehealth: remoteness, cost, complexity
- Secondary (if not primary?) damage to brain

Why is TBI be associated with behavioral problems?

The “Fingerprint” of TBI

Frontal areas of the brain, including the frontal lobes, are the most likely to be injured as a result of TBI, regardless the point of impact to the head
The brain is set into motion along multiple axial planes.

Interior Skull Surface

Bony ridges

Injury from contact with skull

Areas of contusion in (Courville, 1950)

Loss of gray matter one year post-injury (Bigler, 2007)
**Axial Diffusivity**  **Mean Diffusivity**

**Diffusion Tensor Imaging**  
(Mustafi et al., 2018)

**Simplified Brain Behavior Relationships**

Frontal Lobes
- Initiation
- Problem solving
- Judgment
- Inhibition of impulse
- Planning/anticipation
- Self-monitoring
- Motor planning
- Personality/ emotions
- Awareness of self
- Organization
- Concentration
- Mental flexibility
- Speaking
 Regardless where the impact is on the head, the frontal lobes are most likely injured in TBI.

Anoxic/hypoxic and other diffuse brain injuries also affect functions of the frontal lobes.

Frontal lobes are critical to behavioral control and, in turn, success in society.

Greater impulsivity and disinhibition may result from changes in how rewards and consequences are processed.

Whether working in mental health, substance abuse, aging & disability, criminal justice or other service systems, it is worthwhile to know whether the person you are working with has had a TBI.
How can you determine if a person has had a TBI?

Issues Detecting a Lifetime History of TBI
- Capture from medical encounters
  - medical treatment often may not be sought
  - lifetime records not available
  - mild TBI often missed in Emergency Departments
- Biomarkers
  - imaging, neuropsych assessment specific but not sensitive
  - proteomics very acute only and sensitive but not specific
- Retrospective self-report
  - cannot self-diagnose
  - not aware of injury ("telescoping," poor memory, too young)

Gold Standard

Selected Methods of Eliciting Self-report
- TBI-TAC identified 20 different tools being used
- DVBIC Brief TBI Screen (BTBIS; Schwab et al.)
- TBI Questionnaire (TBIQ; Diamond et al.)
- Brain Injury Screening Questionnaire (BISQ; Gordon et al.)
- OSU TBI Identification Method (OSU TBI-ID; Corrigan & Bogner)
- Boston Assessment of Traumatic Brain Injury Lifetime (BAT-L; Fortier et al.)
Selected Methods of Eliciting Self-report

- TBI-TAC identified 20 different tools being used
- DVBIC Brief TBI Screen (BTBIS; Schwab et al.)
- TBI Questionnaire (TBQ; Diamond et al.)
- Brain Injury Screening Questionnaire (BISQ; Gordon et al.)
- OSU TBI Identification Method (OSU TBI-ID; Corrigan & Bogner)
- Boston Assessment of Traumatic Brain Injury Lifetime (BAT-L; Fortier et al.)
OSU TBI Identification Method

• Structured interview designed to elicit lifetime history of TBI.
• Avoids misunderstanding about what a TBI is by eliciting injuries, then determining if altered consciousness occurred.
• Provides more information than simple “yes/no”

Training at: wexnermedical.osu.edu/TBIScreen
Individuals with a history of TBI are more likely to:

- Struggle with current life stressors
- Have difficulty adapting to new situations
- Have problems following through on recommendations from health care providers

The goal of Step 2 is to elicit further details about injuries to the head or neck and to determine if there was a loss of consciousness.

In Step 2, probe and record details including age, loss of consciousness, and memory gaps for each injury. It is important to ask the question and record information separately for each injury in Step 1.
OSU TBI-ID: Step 1

5 Questions:

The goal of these questions is to help recall injuries to the head or neck by reminding the respondent about hospital visits and probing for common causes of TBI.

Do not be concerned about whether a TBI occurred, only if it was possible.
OSU TBI-ID: Step 2

Determine if a TBI occurred

Were you knocked out or did you lose consciousness (LOC)?
  • If yes, how long?
  • If no, were you dazed or did you have a gap in your memory from the injury?

How old were you?

OSU TBI-ID: Step 3

Determine if there were any periods with repeated blows to the head

Have you ever had a period of time in which you experienced multiple, repeated impacts to your head (e.g., history of abuse, contact sports, military duty)?
  • If yes, what was the typical or usual effect—were you knocked out (Loss of Consciousness—LOC)?
  • If no, were you dazed or did you have a gap in your memory from the injury?

What was the most severe effect?
How old were you?
John D. Corrigan, PhD
Ohio State University

---

**Key Considerations: Problematic Lifetime Exposure**

- A person may be more likely to have ongoing problems if they have any of the following:
  - **WORST**
    - One moderate or severe TBI
  - **FIRST**
    - TBI with loss of consciousness before age 15
  - **MULTIPLE**
    - Had 2 or more TBIs close together, including a period of time when they experienced multiple blows to the head
  - **RECENT**
    - A mild TBI in recent weeks or a more severe TBI in recent months
  - **OTHER SOURCES**
    - Any TBI combined with another way that their brain function has been impaired

---

**Worst was a moderate TBI**
- First with loss of consciousness before 15 years old
- Had a period of multiple blows to the head
Red Flags

- WORST: One moderate or severe TBI
- FIRST: TBI with loss of consciousness in childhood
- MULTIPLE: 2 or more TBIs close together, including a period of time when they experienced multiple blows to the head
- RECENT: A mild TBI in the last weeks or a more severe TBI in the last months
- OTHER SOURCES: Any TBI combined with another way that their brain function has been impaired

Ohio Benefits LTSS Questionnaire

a. Thinking about any injuries you have had in your lifetime, were you ever knocked out or did you lose consciousness? ___ Yes ___ No (IF NO, STOP HERE)

b. What was the longest time you were knocked out or unconscious? (Choose just one; if you are not sure please make your best guess.)
   ___ knocked out or lost consciousness for less than 30 min
   ___ knocked out or lost consciousness between 30 min and 24 hrs
   ___ knocked out or lost consciousness for 24 hrs or longer

c. How old were you the first time you were knocked out or lost consciousness? ___ years old

Red Flags

- WORST: One moderate or severe TBI
- FIRST: TBI with loss of consciousness in childhood
- Also, could add questions to get at anoxic/hypoxic ABI as well other diagnosed sources of brain impairment.
Problematic History of Brain Injury

Person may have difficulty:
  • accessing services
  • remaining engaged in services
  • knowing what supports are needed
  • consistently using supports
due to barriers created by cognitive and/or behavioral weaknesses that result from damage to the frontal lobes of the brain.

Neurocognitive Functions

Attention
Processing
Memory
Executive Function

Initiation
Impulsivity
Planning & Organization
Mental Flexibility
Self-Awareness
Problem = Processing

The time it takes to think through and understand new information or concepts can be affected when a person has had a TBI. This does not mean they cannot understand – they may just need more time to understand.

What to Look For

- Only picks up a portion of instructions or conversations
- Has difficulty keeping up with a conversation
- May tire easily
- May appear to “zone out”
- May appear passive or unmotivated
- Is sometimes referred to as “lazy”

Accommodating Problems with Processing

- Keep it Simple: It’s easy for someone with processing problems to get lost in a conversation. Simplify information and provide one idea or task at a time.
- Check In: Frequently check for understanding by asking the person to repeat back instructions or ideas.
- Slow it Down: Make sure to provide sufficient time for the person to process and respond. Count silently to yourself after asking a question to allow extra time for the person to process the question.
RESOURCES

Ohio Brain Injury Program
OSU TBI-ID Training: <http://wexnermedical.osu.edu/ovcprofessionals>
Accommodating TBI: 
Case consultation: OhioBrainInjury@osumc.edu or 614-366-3877

Brain Injury Association of Ohio
Helpline: (800) 444-6443 (toll-free)
Website: www.biaoh.org

Other Informative Websites
Ohio Brain Injury Program: ohiobraininjury.org
WETA Brainline: www.brainline.org

New Program Coming Soon!!!
Ohio Brain Injury Connection
“Person-centered resource facilitation”
Virtual
Statewide
Free

Phases of Engagement
1. Why calling (presenting goal/request, r/o crisis)
2. Identify lifetime history of brain injury
3. Engage in “Lifeline” exploration of the role of brain injuries in their life
4. Elicit remainder social and medical history
5. Identify accommodations
6. Assist in articulating short- and long-term plan (including the role of the program in that plan)
7. Identify brain health opportunities
### Implications for AAAs

- **Train staff**—what is an acquired brain injury, how to screen, how to accommodate
- **Screen**—use the LTSSQ screening data or establish own procedure for routine screening
- **Collaborate**—work with the Ohio Brain Injury Program and the Brain Injury Association of Ohio for programmatic improvement and individual case consultation

---

**THANK YOU**

---