Learning Objectives

1. To have a basic understanding of Obstructive Sleep Apnea and its prevalence.

2. To have an understanding of how to identify patients at risk for OSA.

3. To have a basic understanding of diagnostic tests (sleep studies) for OSA.

4. To understand how to select patients for treatment of OSA with oral appliances
Disclosure

I have no actual or potential conflicts of interest in relation to this program/presentation.

David W. Kohls, APNP
Obstructive Sleep Apnea

- Repeated apneas and hypopneas due to collapse of the upper airway during sleep.
  - Apnea - No airflow for 10 seconds or more with no change in effort
  - Hypopnea - Decreased airflow of at least 30 % with a 4% oxygen desaturation
  - AHI - Number of apnea/hypopnea events per hour of sleep
    - 0-5 Normal
    - 5-15 Mild
    - 15-30 Moderate
    - > 30 Severe
Respiratory Effort Related Arousal (RERAS) – Sleep disturbance caused by upper airway narrowing causing increased effort to breathe

Respiratory Disturbance Index (RDI) = Apneas + Hypopneas + RERAS/TST
Prevalence of OSA

- Prevalence appears to be high, but it is not clear
- Approximately 42 million American adults have SDB
- 1 in 5 has mild OSA
- 1 in 15 has severe OSA
- 9% of middle-aged women and 25% of middle-aged men suffer from OSA
- Most patients are asymptomatic or unaware of the indicators
- At least 75% of patients with OSA remain undiagnosed
Prevalence increases with age

- Less than 10% at age 40
- Approximately 20% at age 60

Increases in the incidence of obesity
Increasing Rate of Discovery

- Wisconsin Sleep Cohort Study 1988-2011
  - 10% of adults 30-60 years old had clear evidence of OSA

- The Sleep Heart Health Study in the late 1990’s
  - Approximately 17% of adults had OSA

- The National Sleep Foundation Poll in 2005
  - As many as 25% of American adults are at high risk for OSA
Prompts to seek medical attention
STOP-Bang Questionnaire
For the Assessment of Obstructive Sleep Apnea Risk

Name: ________________________________

Have you been previously diagnosed with sleep apnea? Yes No

If so, are you currently using CPAP to treat your OSA? Yes No

Please answer the following eight questions Yes or No

- Snoring: Do you snore loudly?
- Tiredness/Fatigue: Do you often feel sleepy during the day, even after a "good" night's sleep?
- Observed Apnea: Have you ever been told you stop breathing during your sleep?
- Pressure: Do you have or are you being treated for hypertension?
- BMI: Do you weigh more for your height than is shown on the table at the right?
- Age: Are you over 50 years old?
- Neck size: Is your neck size more than 15 1/4" or 40 cm?
- Gender: Are you a male?

Score: Total number of "yes" answers _____

Interpretation:

- High risk of OSA: answered yes to 3 or more questions
  Please take this form to your physician to discuss your sleep related concerns

- Low risk of OSA: answered yes to 0-2 questions
  Talk with your physician if you have other sleep complaints

Chung et al. "STOP Questionnaire: A Tool to Screen Patients for Obstructive Sleep Apnea," Anesthesiology, 2008; 108:581-585

Please take this form with you and bring it to your physician to discuss your sleep concerns

This screening questionnaire is not a substitute for professional medical advice, and should not be used to diagnose or treat a health problem. Please consult your primary care physician or healthcare provider if you have any questions or concerns.
Berlin Questionnaire
Sleep Apnea

Height (m) _____ Weight (kg) _____ Age _____ Male / Female

Please choose the correct response to each question.

Category 1

1. Do you snore?
   □ a. Yes
   □ b. No
   □ c. Don’t know
   If you answered ‘yes’:

2. You snoring is:
   □ a. Slightly louder than breathing
   □ b. As loud as talking
   □ c. Louder than talking

3. How often do you snore?
   □ a. Almost every day
   □ b. 3-4 times per week
   □ c. 1-2 times per week
   □ d. 1-2 times per month
   □ e. Rarely or never

4. Has your snoring ever bothered other people?
   □ a. Yes
   □ b. No
   □ c. Don’t know

5. Has anyone noticed that you stop breathing during your sleep?
   □ a. Almost every day
   □ b. 3-4 times per week
   □ c. 1-2 times per week
   □ d. 1-2 times per month
   □ e. Rarely or never

Category 2

6. How often do you feel tired or fatigued after your sleep?
   □ a. Almost every day
   □ b. 3-4 times per week
   □ c. 1-2 times per week
   □ d. 1-2 times per month
   □ e. Rarely or never

7. During your waking time, do you feel tired, fatigued or not up to par?
   □ a. Almost every day
   □ b. 3-4 times per week
   □ c. 1-2 times per week
   □ d. 1-2 times per month
   □ e. Rarely or never

8. Have you ever nodded off or fallen asleep while driving a vehicle?
   □ a. Yes
   □ b. No
   If you answered ‘yes’:

9. How often does this occur?
   □ a. Almost every day
   □ b. 3-4 times per week
   □ c. 1-2 times per week
   □ d. 1-2 times per month
   □ e. Rarely or never

Category 3

10. Do you have high blood pressure?
    □ Yes
    □ No
    □ Don’t know
Scoring Berlin Questionnaire

The questionnaire consists of 3 categories related to the risk of having sleep apnea. Patients can be classified into High Risk or Low Risk based on their responses to the individual items and their overall scores in the symptom categories.

Categories and Scoring:

Category 1: items 1, 2, 3, 4, and 5;
Item 1: if 'Yes', assign 1 point
Item 2: if 'c' or 'd' is the response, assign 1 point
Item 3: if 'a' or 'b' is the response, assign 1 point
Item 4: if 'a' is the response, assign 1 point
Item 5: if 'a' or 'b' is the response, assign 2 points

Add points. Category 1 is positive if the total score is 2 or more points.

Category 2: items 6, 7, 8 (item 9 should be noted separately).
Item 6: if 'a' or 'b' is the response, assign 1 point
Item 7: if 'a' or 'b' is the response, assign 1 point
Item 8: if 'a' is the response, assign 1 point

Add points. Category 2 is positive if the total score is 2 or more points.

Category 3 is positive if the answer to item 10 is 'Yes' or if the BMI of the patient is greater than 30kg/m².
(BMI is defined as weight (kg) divided by height (m) squared, i.e., kg/m²).

High Risk: if there are 2 or more categories where the score is positive.
Low Risk: if there is only 1 or no categories where the score is positive.

Additional Question: item 9 should be noted separately.
THE EPWORTH SLEEPINESS SCALE

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently try to work out how they would have affected you. Use the following scale to choose the most appropriate number for each situation:

| 0 = no chance of dozing |
| 1 = slight chance of dozing |
| 2 = moderate chance of dozing |
| 3 = high chance of dozing |

<table>
<thead>
<tr>
<th>SITUATION</th>
<th>CHANCE OF DOZING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td></td>
</tr>
<tr>
<td>Watching TV</td>
<td></td>
</tr>
<tr>
<td>Sitting inactive in a public place (e.g., theater or a meeting)</td>
<td></td>
</tr>
<tr>
<td>As a passenger in a car for an hour without a break</td>
<td></td>
</tr>
<tr>
<td>Lying down to rest in the afternoon when circumstances permit</td>
<td></td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td></td>
</tr>
<tr>
<td>Sitting quietly after a lunch without alcohol</td>
<td></td>
</tr>
<tr>
<td>In a car, while stopped for a few minutes in traffic</td>
<td></td>
</tr>
</tbody>
</table>

To check your sleepiness score, total the points. Check your total score to see how sleepy you are.

A Score of 10 or More Indicates EDS
Comparison of Screening Questionnaires for OSA

- Berlin, STOP-Bang, Stop, Epworth Sleepiness Scale
- 234 patients completed questionnaire and underwent polysomnography
- Sensitivity to predict OSA
  - STOP-BANG – 97.55%
  - Berlin – 95.07%
  - STOP – 91.67%
- Low Specificity
  - 26.32%, 25%, and 25%, respectively
Epworth Sleepiness Scale

- Highest specificity – 75%
- But the lowest sensitivity – 72.55%

*Comparison of Four Questionnaires for Screening Obstructive Sleep Apnea, Egyptian J of Chest Diseases and Tuberculosis, Vol 61,Issue 4, Oct 2012, 433-441*
Many patients minimize or do not recognize the indicators of OSA

Bed partners or caregivers generally are better at identifying snoring, abnormal breathing, and EDS

Figure 1. The Mallampati score:
Class 1. Complete visualization of the soft palate
Class 2. Complete visualization of the uvula
Class 3. Visualization of only the base of the uvula
Class 4. Soft palate is not visible at all
For every 1-point increase in the score, the odds of having OSA increase by more than 2-fold.

The AHI increases by more than 5 events per hour.

Physical Examination: Mallampati Score as an Independent Predictor of Obstructive Sleep Apnea, Sleep, Vol. 29, No. 7, 2006
Testing For OSA

- Four Types of Monitoring Devices Have Been Defined
Type 1 Devices

- Considered the Gold Standard Form of Testing
- Technician Attended, Overnight Polysomnography
Polysomnography

Sleep Monitoring
- Includes Pulse Oximetry
- Additional Options
  - Transcutaneous CO2
  - Esophageal Pressure
  - Forearm EMG
Let’s Review: Obstructive Apnea

Snoring at the end of the apneas & arousal
The bottom six channels represent about 5 minutes of data and show the information used to document apnea type. The channels from top to bottom are:
1. oxyhemoglobin saturation (SaO₂),
2. thoracic movement,
3. abdominal movement
4. pulse rate
5. CPAP pressure, and
6. nasal airflow

Let’s Review: Central Apnea

“THOR” and “ABD” leads show no respiratory effort
# ST. VINCENT HOSPITAL SLEEP DISORDERS CENTER
## POLYSOMNOGRAPHY REPORT

**Patient Name:**

**Study Date:** 06/09/2003

**ID:**

**DOB:**

**Height:** 6'7"

**Weight:** 160 lbs.

**Referring Physician:** Reynolds

**Scorer:** Laurie

**Start/End Time:** 11:19 PM - 6:57 AM

### DIAGNOSTIC

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<tr>
<th>Minutes</th>
<th>%</th>
<th># of Breathing Related Arousalas</th>
<th># of Central Apneas</th>
<th># of Obstructive Apenas</th>
<th># of Mixed Apenas</th>
<th># of Hypopneas</th>
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<td>4</td>
<td>97</td>
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<td></td>
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<tr>
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<tr>
<td>REM</td>
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<td>5.2%</td>
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</table>

**Respiration Time (TRT):**

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<th>Minutes</th>
<th>%</th>
<th># of Breathing Related Arousalas</th>
<th># of Central Apneas</th>
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**Sleep Latency:** 3.5 minutes

**Wakefulness:** 26.6 minutes

**Total Time Out of Bed:** 0.05 minutes

**Awakenings Total:** 21

**Awakenings > 1 Min.:** 7

**Total # Stage Shifts:** 84

### POST-TREATMENT

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<th>Minutes</th>
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<tr>
<td>REM</td>
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**Movement Time:**

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**Tot. Recording Time (TRT):**

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<th>%</th>
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**Apnea Index per Hour of Sleep (TST/60):** 61.0

**Respir. Dist. Index per Hour of Sleep (TST/60):** 63.4

**Lowest O2 Saturation %:** 70

**Baseline Saturation:** 96

**Total Periodic Leg Movements in Sleep (PLMS):** 0

**Total PLMS with Arousal:** 0

**EEG (C4C3, O2O1, A2A1):**

<table>
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<tr>
<th>Parameters</th>
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<tbody>
<tr>
<td>EOG</td>
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<tr>
<td>EMG: Chin</td>
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<tr>
<td>Respirate</td>
</tr>
<tr>
<td>Snore Mic.</td>
</tr>
<tr>
<td>ET CO2</td>
</tr>
<tr>
<td>Arms (Motion Detectors)</td>
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**PLMS Index (PLMS/TST/60):** 0.0

**Sleep Efficiency (TST/TRT x 100):**

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**Wakefulness:** 23.0 minutes

**Total Time Out of Bed:** 0.0 minutes

**Awakenings Total:** 18

**Awakenings > 1 Min.:** 4

**Total # Stage Shifts:** 97

**Sleep Efficiency (TST/TRT x 100):** 92.3%

**Total PLMS with Arousal:** 0

**PLMS Index (PLMS/TST/60):** 0.0

**EEG (C4C3, O2O1, A2A1):**

<table>
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<td>Arms (Motion Detectors)</td>
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**Number of Respiratory Events Per:**

<table>
<thead>
<tr>
<th>Body Position</th>
<th>Supine</th>
<th>Prone</th>
<th>Left</th>
<th>Right</th>
<th>REM</th>
<th>NREM</th>
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<tbody>
<tr>
<td>Obstructive</td>
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<td>0</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>89</td>
</tr>
<tr>
<td>Mixed</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Central</td>
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<td>0</td>
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<th>Prone</th>
<th>Left</th>
<th>Right</th>
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<td>0</td>
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**Tech Notes:** Patient was tested for 7.6 hours with standard polysomnography, of which he slept 6.7 hours. A short sleep latency was scored. The pt. Snored. Obstructive apneas were scored. CPAP +5 was started and titrated up to +9. In the morning the pt. Stated that he had slept better than he usually does at home.
Type 2 Devices

- Can Record The Same Variables As Type 1 Devices
- Done Outside Of The Sleep Lab And They Are Unattended Studies
Type 3 Devices

- Four to seven variables measured
  - Two respiratory variables - effort and airflow
  - A cardiac variable - heart rate or ECG
  - Oxyhemoglobin saturation via pulse oximetry
  - Some devices detect snoring, body position, or movement
  - Sleep stages are typically not measured
  - Unattended studies
ApneaLink - Report of 5/17/2016 1:35 PM

Treating physician
David Kohls APNP

Patient data
First name: 
Last name: 
Street: 
City, ST, Zip: 
Phone: 

Recording
Date: 5/13/2016
Start: 5:07 PM
End: 5:36 AM
Duration: 5 h 49 min

Evaluation
Start: 9:07 PM
End: 5:20 AM
Duration: 6 h 13 min

AHI*

- Normal range
- Suspected pathological breathing disorder

Analysis (Flow evaluation period: 8 h 10 min / SpO2 evaluation period: 8 h 11 min)

Indices

<table>
<thead>
<tr>
<th>Index</th>
<th>Normal</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHIm</td>
<td>&lt; 5 / h</td>
<td>&lt; 5 / h</td>
</tr>
<tr>
<td>Apnea index</td>
<td>54</td>
<td>237</td>
</tr>
<tr>
<td>LAI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OA1</td>
<td>64</td>
<td>332</td>
</tr>
<tr>
<td>CA1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAI</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Hypopnea index</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>% Flow lim. Br. without Sn (FL):</td>
<td>14</td>
<td>25</td>
</tr>
<tr>
<td>% Flow lim. Br. with Sn (FL):</td>
<td>21</td>
<td>65</td>
</tr>
</tbody>
</table>

ODI Oxygen Desaturation Index*:

<table>
<thead>
<tr>
<th>Index</th>
<th>Normal</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODI</td>
<td>&lt; 5 / h</td>
<td>No. of desaturations: 420</td>
</tr>
</tbody>
</table>
| Average saturation | 90 | Saturation < 90%: 175 min (28%)
| Lowest desaturation | 63 | Saturation < 90%: 103 min (21%)
| Lowest saturation | 63 | Saturation < 85%: 64 min (9%)
| Baseline saturation | 93 | Saturation < 90%: 156 min (32%)
| Minimum pulse | 78 | Saturation < 85%: 143 min (29%)
| Maximum pulse | 52 | Proportion of probable CS episodes: 0%
| Average pulse | 78 | Analysis status: Edited manually

Notes:
- AHIm and ODI are used as references for abbreviations and normal standard parameters.

Analysis parameters used (Default):
- Apnea (20%, 10%, 5%, 1%, 50%, 20%, 10%, 5%, 1%)
- Hypopnea (20%, 10%, 5%, 1%, 50%, 20%, 10%, 5%, 1%)
- Breathing (5%, 5%, 3%, 5%, 3%, 5%, 5%)
- Desaturation (1%).

Comments
Edit Comments
Type 4 Devices

- Record One Or Two Variables
  - Airflow
  - Pulse Oximetry
  - Unattended By A Technician
- A Novel CMS Defined Type 4 Device Measures Arterial Tonometry, Oximetry, Snoring, Actigraphy, And Body Position.
Sleep Study Report

Sleep Summary
Start Study Time: 9:03:06PM
End Study Time: 6:00:13AM
Total Study Time: 8 hrs, 57 min
Sleep Time: 8 hrs, 8 min
% REM of Sleep Time: 27.7

Oxygen Saturation Statistics
Mean: 91 Minimum: 78 Maximum: 97
Mean of Desaturations Nadir (%) 89
Oxygen Desaturat. %:
4-0 10-20 >20 Total
Events Number: 154 3 0 157 Total
Total: 98.1 1.9 0.0 100.0
Oxygen Saturation:<90 <98 <95 <80 <70
Pulse Rate Statistics during Sleep (BPM)
Mean: 70 Minimum: 49 Maximum: 108

Respiratory Indices

<table>
<thead>
<tr>
<th>REM</th>
<th>NREM</th>
<th>All Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>pRDI:</td>
<td>33.6</td>
<td>22.0</td>
</tr>
<tr>
<td>pAHI:</td>
<td>30.9</td>
<td>20.6</td>
</tr>
<tr>
<td>ODI:</td>
<td>24.2</td>
<td>17.6</td>
</tr>
</tbody>
</table>

Indices are calculated using valid sleep time of 8 hrs, 5 min.
pRDI/pAHI are calculated using all desaturations ≥ 4%.

PAT Respiratory Events

Snore / Body Position

Oxygen Saturation / Pulse Rate (BPM)

Wake / Sleep stages
PAP Therapy is the Gold Standard Treatment for OSA

- Air pressure, measured in cmH2O, is used to splint the upper airway open
Adherence to PAP Therapy

- 50-60% of patients are adherent to PAP therapy
- 29-83% of patients are non-adherent to PAP therapy
- The decision is usually made during the first week of therapy
- Use increases gradually once the decision to adhere is made
- The average use of PAP therapy is approximately five hours per night
PAP or No PAP?

- 2006 AASM Practice Parameters
- PAP therapy is an option in mild OSA
- Mixed results in studies of outcome
- PAP reduces AHI, but does not necessarily reduce BP or improve EDS, mood, or quality of life
- Of 32 patients with AHI < 10, ten had improved quality of life at 4 weeks
- At 3 months, only 4 continued to adhere to PAP therapy
PAP or No PAP?

- Important to correlate AHI with symptoms and co-morbidities
- As many as 25% of sleep patient have more than one sleep disorder
- Consultation and patient education with a sleep specialist
Oral Appliances

- AASM/AADSM 2015 Guidelines
- OA should be prescribed, rather than no therapy, for patients requesting treatment for primary snoring (STANDARD)
- A qualified dentist should use a custom, titratable device (GUIDELINE)
- Consider OA for patients who are intolerant of PAP therapy or prefer alternative therapy (STANDARD)
- Qualified dentist provides oversight of treatment and periodic follow up visits with sleep specialist (GUIDELINE)
- Follow up testing (GUIDELINE) (24)
Oral Appliances (cont.)

- Most Effective For Mild to Moderate OSA
- AHI Above 30 – About 50% effective
- On Average, Resolution of OSA (AHI < 5) Occurs in About 48% of Patients (Range – 29 to 71%)
- Approximately One-third of Patients Experience No Therapeutic Benefit
- On PSG, The Effectiveness of PAP is Superior
- However, Many Patients Prefer Oral Appliances and Report Greater Adherence to Therapy
  - This May Counteract the Inferiority Over PAP to Reduce AHI

Patient Selection For Treatment With An Oral Appliance
Favorable Factors

- Less severe disease
- Supine-predominant OSA
- Younger age, female gender
- Lower BMI and neck circumference
- Shorter soft palate length
- Greater angle between the cranial base and mandibular plane
- A retrognathic mandible (Class 2 malocclusion)
- These factors = a higher likelihood of success, but are not universal

Who Should Not Be Considered A Candidate For An OA

- Patients with Central Sleep Apnea
- Patients with sleep related hypoventilation
  - COPD, obesity-related hypoventilation, neuromuscular disease, drug-induced hypoventilation
- Patients with poor dentition or who are edentulous
- Patients with acute TMJ derangement or disc displacement


- Patients who require objective monitoring for their occupations
- Patients with prior orthodontic correction
Obstacles

- Insurance Coverage
- Awareness Among Healthcare Professionals and Patients
Summary

- Oral Appliances Can Be A Very Effective Alternative To PAP Therapy

- Improving Awareness of This Among Health Care Providers and Patients Has The Potential To Help A Significant Number Of Patients With OSA Who Would Otherwise Remain Untreated And At Risk For Reduced Quality Of Life And Significant Health Consequences

- A Collaborative Relationship Between Dentists and Sleep Medicine Specialists Is The Key
Thank You
References


References (cont.)
