Topics

1. Epidemiology and Pathogenesis
2. Prevention
3. Treatment Goal
4. Co-morbidities
5. Special considerations
6. Medication use
7. Hypo and hyperglycemia
Epidemiology and Pathogenesis
Diabetes in Older Adults: A Consensus Report

M. Sue Kirkman, MD, Vanessa Jones Briscoe, PhD, NP, CDE, Nathaniel Clark, MD, MS, RD, Hermes Florez, MD, MPH, PhD, Linda B. Haas, PHC, RN, CDE, Jeffrey B. Halter, MD, Elbert S. Huang, MD, MPH, Mary T. Korytkowski, MD, Medha N. Munshi, MD, Peggy Soule Odegard, BS, PharmD, CDE, Richard E. Pratley, MD, and Carrie S. Swift, MS, RD, BC-ADM, CDE

defined as those aged ≥ 65 years
Diabetes is more common in elderly

In 2011, diabetes in those aged 65–74 (21.8%) was more than 13 times that of people <45 years (1.6%).

Same in Thailand

http://nheso.or.th
Life Expectancy is Longer

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
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<th>2090</th>
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<th>2100</th>
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</thead>
<tbody>
<tr>
<td>Years</td>
<td>68.9</td>
<td>70.1</td>
<td>71.1</td>
<td>71.9</td>
<td>72.8</td>
<td>73.6</td>
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<td>76.7</td>
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<td>79.8</td>
<td>80.4</td>
<td>80.9</td>
<td>81.4</td>
<td>81.8</td>
<td>82.2</td>
</tr>
</tbody>
</table>

Prevalence is increasing with aging even if incident is leveling off
## Older vs. Younger Onset

<table>
<thead>
<tr>
<th></th>
<th>Older</th>
<th>Younger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glycemia</td>
<td>More postprandial</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower HbA$_{1c}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/3 missed by HbA$_{1c}$, FBG</td>
<td></td>
</tr>
<tr>
<td>Insulin need</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td>Retinopathy</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td>CVD</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>Neuropathy</td>
<td>Same</td>
<td>Same</td>
</tr>
</tbody>
</table>
Older adults have more complications

Heart disease or Stroke

www.cdc.gov/diabetes
End Stage Renal Disease

www.cdc.gov/diabetes
Lower Extremity Amputation

www.cdc.gov/diabetes
ลดลงของการหลั่ง Insulin ตามอายุ
ภาวะ insulin resistance ตามอายุ
มีไขมันเพิ่มมากขึ้น
การออกกําลังกายที่ลดลง
ยา
กรรมพันธุ์
ความเจ็บป่วยอื่นที่พบรวม
**Think if primary or secondary prevention will be useful**

**Table 4—Criteria for testing for diabetes in asymptomatic adult individuals**

1. Testing should be considered in all adults who are overweight (BMI ≥ 25 kg/m²*) and have additional risk factors:
   - physical inactivity
   - first-degree relative with diabetes
   - high-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
   - women who delivered a baby weighing > 9 lb or were diagnosed with GDM
   - hypertension (≥ 140/90 mmHg or on therapy for hypertension)
   - HDL cholesterol level < 35 mg/dL (0.90 mmol/L) and/or a triglyceride level > 250 mg/dL (2.82 mmol/L)
   - women with polycystic ovarian syndrome
   - A1C ≥ 5.7%, IGT, or IFG on previous testing
   - other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans)
   - history of CVD

2. In the absence of the above criteria, testing for diabetes should begin at age 45 years.

3. If results are normal, testing should be repeated at least at 3-year intervals, with consideration of more frequent testing depending on initial results (e.g., those with prediabetes should be tested yearly) and risk status.

*At-risk BMI may be lower in some ethnic groups.
### Diagnostic Criteria

**Table 2—Criteria for the diagnosis of diabetes**

A1C ≥ 6.5%. The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay.*

OR

FPG ≥ 126 mg/dL (7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h.*

OR

Two-hour PG ≥ 200 mg/dL (11.1 mmol/L) during an OGTT. The test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.*

OR

In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose ≥ 200 mg/dL (11.1 mmol/L).

*In the absence of unequivocal hyperglycemia, result should be confirmed by repeat testing.
Diabetes Prevention
• 3819 adults with IGT randomized to placebo, metformin, or intensive life style
• Life style group lost 7% of their body weight, with 150 minutes per week of aerobic exercise
Diabetes Treatment Goal
<table>
<thead>
<tr>
<th>Trial</th>
<th>Participants</th>
<th>FU (yr)</th>
<th>A1C levels</th>
<th>Results</th>
</tr>
</thead>
</table>
| UKPDS    | 3,867 new DM Age < 65 | 20      | 7.0 vs 7.9 | • Less microvascular cx  
• Post-trial FU showed less CVD and mortality “metabolic legacy” |
| ACCORD   | 10,251 w/CVD or risks Age 62 A1C 8.1 | 3.5     | 6.4 vs. 7.5 | • Death in intensive Rx (HR 1.22), more in <65 yr  
• More hypoglycemia and adverse effects in ≥ 65 |
| ADVANCE  | 11,140 w/ micro/ macro vascular ds Age 66 A1C 7.5% | 5       | 6.5 vs. 7.3 | • No ↓ in macrovascular events, same for all age  
• 21% reduction in nephropathy |
| VADT     | 1,791 Age 60 A1C 9.0% | 6       | 6.9 vs 8.4 | • No difference in cardiovascular events  
• Those with DM duration <15 yr did better |
- Major reduction occurred in those without previous CVD
- Risks may outweigh the risk in some
  - Very long DM duration
  - Hx severe hypoglycemia
  - Advanced CVD
  - Advanced age/ Frailty
Survival as a function of $\mathrm{HbA}_{1c}$ in people with type 2 diabetes: a retrospective cohort study

Craig J Currie, John R Peters, Aodán Tynan, Marc Evans, Robert J Heine, Oswaldo L Bracco, Tony Zagar, Chris D Poole

Retrospective cohort, 27965 participants
Mean age 64 years

Figure 1: Adjusted hazard ratios for all-cause mortality by $\mathrm{HbA}_{1c}$ deciles in people given oral combination and insulin-based therapies. Cox proportional hazards models were used, with the $\mathrm{HbA}_{1c}$ base case scenario. Vertical error bars show 95% CIs, horizontal bars show $\mathrm{HbA}_{1c}$ range. Red circle = reference decile. *Truncated at lower quartile. †Truncated at upper quartile. Metformin plus sulphonylureas (A); and insulin-based regimens (B).
## Table 1. A Framework for Considering Treatment Goals for Glycemia, Blood Pressure, and Dyslipidemia in Older Adults with Diabetes

<table>
<thead>
<tr>
<th>Patient Characteristics/Health Status</th>
<th>Rationale</th>
<th>Reasonable A1C Goal (A Lower Goal May Be Set for an Individual if Achievable without Recurrent or Severe Hypoglycemia or Undue Treatment Burden)</th>
<th>Fasting or Preprandial Glucose (mg/dL)</th>
<th>Bedtime Glucose (mg/dL)</th>
<th>Blood Pressure (mmHg)</th>
<th>Lipids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy (Few coexisting chronic illnesses, intact cognitive and functional status)</td>
<td>Longer remaining life expectancy</td>
<td>&lt;7.5%</td>
<td>90–130</td>
<td>90–150</td>
<td>&lt;140/80</td>
<td>Statin unless contraindicated or not tolerated</td>
</tr>
<tr>
<td>Complex/intermediate (Multiple coexisting chronic illnesses(^a) or 2+ instrumental ADL impairments or mild to moderate cognitive impairment)</td>
<td>Intermediate remaining life expectancy, high treatment burden, hypoglycemia vulnerability, fall risk</td>
<td>&lt;8.0%</td>
<td>90–150</td>
<td>100–180</td>
<td>&lt;140/80</td>
<td>Statin unless contraindicated or not tolerated</td>
</tr>
<tr>
<td>Very complex/poor health (Long-term care or end-stage chronic illnesses(^b) or moderate to severe cognitive impairment or 2+ ADL dependencies)</td>
<td>Limited remaining life expectancy makes benefit uncertain</td>
<td>&lt;8.5(^c)</td>
<td>100–180</td>
<td>110–200</td>
<td>&lt;150/90</td>
<td>Consider likelihood of benefit with statin (secondary prevention more so than primary)</td>
</tr>
</tbody>
</table>

\(^{a}\) \(^{b}\) \(^{c}\) JAGS 2012
© 2012 by the American Diabetes Association and the American Geriatrics Society
Co-morbidities
Lipid Goals

• Study in older adults (70-82 yr) with and without diabetes showed 15% reduction in CAD with pravastatin

• Primary prevention in diabetes patients showed 20% reduction in CV events across age groups.

• Secondary prevention showed reduction in all age group

• Effects emerge 1-2 years

• Statin should be used in all patients unless very limited life expectancy.
Efficacy and safety of cholesterol-lowering treatment: prospective meta-analysis of data from 90 056 participants in 14 randomised trials of statins

*Cholesterol Treatment Trialists’ (CTT) Collaborators*

<table>
<thead>
<tr>
<th>Groups</th>
<th>Events (%)</th>
<th>RR (CI)</th>
<th>Heterogeneity/trend test</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Treatment</td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(45 002)</td>
<td>(45 054)</td>
<td></td>
</tr>
<tr>
<td>Previous disease:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-MI</td>
<td>1681 (11.7%)</td>
<td>2207 (15.4%)</td>
<td>0.78 (0.74–0.84)</td>
</tr>
<tr>
<td>Other CHD</td>
<td>568 (8.7%)</td>
<td>744 (11.4%)</td>
<td>0.77 (0.68–0.87)</td>
</tr>
<tr>
<td>None</td>
<td>1088 (4.5%)</td>
<td>1469 (6.1%)</td>
<td>0.72 (0.66–0.80)</td>
</tr>
<tr>
<td>Age (years):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤65</td>
<td>1671 (6.1%)</td>
<td>2344 (8.5%)</td>
<td>0.74 (0.69–0.79)</td>
</tr>
<tr>
<td>&gt;65</td>
<td>1666 (9.5%)</td>
<td>2076 (11.9%)</td>
<td>0.81 (0.76–0.88)</td>
</tr>
<tr>
<td>Sex:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2686 (7.8%)</td>
<td>3630 (10.6%)</td>
<td>0.76 (0.72–0.80)</td>
</tr>
<tr>
<td>Female</td>
<td>651 (6.1%)</td>
<td>790 (7.3%)</td>
<td>0.82 (0.73–0.93)</td>
</tr>
<tr>
<td>Treated hypertension:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2038 (8.2%)</td>
<td>2596 (10.4%)</td>
<td>0.79 (0.74–0.84)</td>
</tr>
<tr>
<td>No</td>
<td>1299 (6.4%)</td>
<td>1824 (9.1%)</td>
<td>0.75 (0.70–0.81)</td>
</tr>
<tr>
<td>History of diabetes:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>776 (8.3%)</td>
<td>979 (10.5%)</td>
<td>0.78 (0.69–0.87)</td>
</tr>
<tr>
<td>No</td>
<td>2561 (7.2%)</td>
<td>3441 (9.6%)</td>
<td>0.77 (0.73–0.81)</td>
</tr>
</tbody>
</table>
Blood Pressure

• SBP 120 vs 140 ➔ no benefit for CV risks, but +benefit in stroke reduction
• DBP less than 70 may be associated with higher mortality
• Goal should be <140/90 mmHg
Aspirin

• In general, this should be offered in all older adults with diabetes

• But the effect of primary prevention in adults $\geq 65$ yr needs to be weighed against bleeding risk

• Bleeding risk is higher in older patients

• So greatest benefit should be in those with high CV risk and low bleeding risk
Chronic Complications Screening

• Diabetes duration can vary (older vs younger onset).

• In general → Follow regular guidelines

• For those with short life expectancy, focus on complications which may worsen functional impairment:
  - foot ulcers
  - amputation
  - visual impairments
Special considerations
Diabetes and Dementia

- Hyperglycemia is associated with cognitive dysfunction
- Hypoglycemia and cognitive dysfunction have bidirectional interaction
Mobility Problem

- Neuropathy, gait imbalance
- Fall and fracture risk

www.cdc.gov/diabetes
Polypharmacy

- **Lantus SoloStar** (Insulin Glargine U-100) QD
- **Simvastatin Tablets** QD
- **Glipizide Tablets USP** BID AC
- **Losartan Tablets** QD
- **Metformin Tablets** BID PC
- **Aspirin Tablets** QD PC
ปัญหาที่ทำให้ผู้สูงอายุไม่สามารถปฏิบัติตามการรักษาได้ตามแผน

- จำไม่ได้ว่ารับประทานยาหรือยัง
- จำไม่ได้ว่าต้องกินยาใดบ้าง บ่อยเพียงใด
- มีปัญหาเรื่องคำาใช้จ่าย
- มีการใช้ยาหลายชนิด
- กลัวเรื่องยามีราคาแพง
- ผู้ป่วยอยู่บ้านคนเดียว
- ต้องกินยาวันละหลายครั้ง
- ผู้ป่วยไม่สามารถฉีดยาได้
Visual and Hearing Impairment

Visual Impairment

www.cdc.gov/diabetes
Nutrition Issues

- Risk for undernutrition, anorexia
- Altered taste and smell
- Dental issues
- MNT is useful
- May use small frequent meals, change food texture, add liquid supplement
- Weight loss alone without exercise may worsen sarcopenia, decrease bone density and worsen nutrition deficit
Needs in DSMS

- Sensation impairment
- Cognition
- Involve family/ friends
- Speak in simple terms
- Speak to the patients
- Frequent visits
- Focusing on one skill at a time
- Use handouts, hands-on, demonstration, models
My Syringe Injection Profile

<table>
<thead>
<tr>
<th>When to Take</th>
<th>Hour</th>
<th>Dose</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lunch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dinner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Suggestion For Syringe Selection
   - Find the number of units you inject on color spectrum below
   - Injected volume: scale 1:2
   - 10 U to 100 U

2. Match color of the units you are taking with syringe capacity below for the appropriate syringe size for your dose
   - 3/10 mL/cc 30 Units
   - 1/2 mL/cc 50 Units
   - 1 mL/cc 100 Units

3. Circle needle lengths. Both require Pinch Up
   - 8 mm
   - 12.7 mm

4. Pinch-Up Technique
   - Correct Technique
   - Incorrect Technique

5. Site Selection
   - Rotate Within Sites
   - Rotate within sides
   - Change sides
   - Move the place of the injection by about a finger's width from last injection point
Physical Fitness

• Lower muscle mass with age
• Lower muscle mass with longer DM duration, higher HbA₁c
• At similar BMI → could have higher fat mass
• Physical activity intervention can help improve psychological well being and self-rated physical health.
Effect of a lifestyle intervention on change in cardiorespiratory fitness in adults with type 2 diabetes: results from the Look AHEAD Study

JM Jakicic, SA Jaramillo, A Balasubramanyam, B Bancroft, JM Curtis, A Mathews, M Pereira, JG Regensteiner and PM Ribi, Look AHEAD Study Group

Table 5  Influence of gender, race, insulin use, diabetes severity, HbA1c, smoking history, metabolic syndrome, BMI, waist circumference and treatment assignment on percent change in fitness adjusted for baseline METs

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgroup</th>
<th>N</th>
<th>Overall</th>
<th>DSE</th>
<th>ILI</th>
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<tbody>
<tr>
<td></td>
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<td>LS, mean (s.e.)</td>
<td>P-value</td>
<td>LS, mean (s.e.)</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45–55 years</td>
<td>1362</td>
<td>17.25 (0.70)</td>
<td>&lt;0.0001</td>
<td>8.24 (0.96)</td>
</tr>
<tr>
<td></td>
<td>56–65 years</td>
<td>2274</td>
<td>13.12 (0.54)</td>
<td></td>
<td>6.18 (0.74)</td>
</tr>
<tr>
<td></td>
<td>66–76 years</td>
<td>739</td>
<td>8.09 (0.96)</td>
<td></td>
<td>−0.15 (1.28)</td>
</tr>
</tbody>
</table>

Older adults improved their fitness with ILI but less than young adults.

Other Issues

- Depression $\rightarrow$ higher mortality
- Urinary incontinent
- Sleep and appetite disturbances
- Pain
- Shared- decision making $\rightarrow$ functional status and independence
- Long term care facility $\rightarrow$ inconsistent food, malnutrition, prolonged use of SS, risk for severe hyperglycemia
- Hospitalization $\rightarrow$ similar goal (F 100-140, PP 180), may allow up to 200, careful during transition to home
• Less than 5-10 years = unlikely to benefit from intensive control
• Higher comorbidities = less likely to benefit

Medication Use
Pharmacotherapy

- Increased risk of hypoglycemia (reduced renal function)
- Complex regimen
- High cost
- Polypharmacy
<table>
<thead>
<tr>
<th>Medication</th>
<th>Benefit</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metformin</td>
<td>Low risk of hypo</td>
<td>• GI intolerance</td>
</tr>
<tr>
<td></td>
<td>Low cost</td>
<td>• Reduced dose for CrCl 30-60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Do not use in CrCl &lt; 30</td>
</tr>
<tr>
<td>SU</td>
<td>Low cost</td>
<td>• High risk of hypo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Do not use glyburide</td>
</tr>
<tr>
<td>α glucosidase inhibitor</td>
<td>PP hyperglycemia</td>
<td>• Frequent dosing</td>
</tr>
<tr>
<td></td>
<td>Low risk of hypo</td>
<td>• GI side effects</td>
</tr>
<tr>
<td>TZD</td>
<td>Low risk of hypo</td>
<td>• Weight gain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fracture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CHF, fluid retention</td>
</tr>
<tr>
<td>Medication</td>
<td>Benefit</td>
<td>Risk</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td><strong>DPP-IV</strong></td>
<td>Well tolerated</td>
<td>• High cost</td>
</tr>
<tr>
<td></td>
<td>Low risk of hypo</td>
<td></td>
</tr>
<tr>
<td><strong>GLP-1 agonist</strong></td>
<td>Target PP</td>
<td>• High cost</td>
</tr>
<tr>
<td></td>
<td>Low risk for hypo</td>
<td>• GI side effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Injection</td>
</tr>
<tr>
<td><strong>Insulin</strong></td>
<td>Hypoglycemia</td>
<td>• Requires manual and dexterity</td>
</tr>
<tr>
<td></td>
<td>Long acting</td>
<td>• Analog → high cost</td>
</tr>
<tr>
<td></td>
<td>maybe better</td>
<td></td>
</tr>
<tr>
<td><strong>SGLT-2</strong></td>
<td>Low risk for hypo</td>
<td>• High cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• UTI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fluid and electrolyte loss</td>
</tr>
</tbody>
</table>
Hypo and Hyperglycemia
Hypoglycemia

• Hypoglycemia is under reported, symptoms maybe less specific.
• Hypoglycemia in pt with CVD is linked to higher mortality
• Assess patients for hypoglycemia regularly by asking the patient and caregiver about symptoms or signs and reviewing blood glucose logs.
• In type 2 DM, hypoglycemia risk is linked more to treatment strategies than to achieved lower A1C (e.g., a patient with a low A1C on metformin alone may be at lower risk of than a patient with a high A1C on insulin).
• If recurrent or severe hypoglycemia occurs, strongly consider changing therapy and/or targets.
• Need education: prevention, detection and treatment
Thresholds for hypoglycemia symptoms vary with age

Based on data in non-diabetic patients with no family history of diabetes

# Risks of hypoglycemia in elderly

<table>
<thead>
<tr>
<th>Disease related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomic neuropathy and adrenergic blocking agents</td>
</tr>
<tr>
<td>Cognitive impairment</td>
</tr>
<tr>
<td>Endocrine deficiency syndrome(s)</td>
</tr>
<tr>
<td>Hepatic dysfunction</td>
</tr>
<tr>
<td>Poor nutrition</td>
</tr>
<tr>
<td>Recent hospitalization</td>
</tr>
<tr>
<td>Renal insufficiency</td>
</tr>
<tr>
<td>Lifestyle-related</td>
</tr>
<tr>
<td>Dietary errors</td>
</tr>
<tr>
<td>Alcohol intake</td>
</tr>
<tr>
<td>Others</td>
</tr>
<tr>
<td>Therapy with sulfonylureas or insulin</td>
</tr>
<tr>
<td>Tight glycemic control</td>
</tr>
<tr>
<td>Complex regimens</td>
</tr>
<tr>
<td>Polypharmacy</td>
</tr>
<tr>
<td>Sedative agents</td>
</tr>
</tbody>
</table>

Modified from Hornic and Aron 2008[20]
Hyperglycemia

• Undertreatment has risk, even with those with short life expectancy
• BG > 180-200 → glycosuria
• Dehydration
• E’lyte abnormalities
• Urinary incontinence
• Dizziness, Fall
• Hyperglycemic crisis (hyperosmolar syndrome) has a high mortality
Summary

1. Epidemiology and Pathogenesis
2. Prevention
3. Treatment Goal
4. Co-morbidities
5. Special considerations
6. Medication use
7. Hypo and hyperglycemia
Thank you