Improving cardiovascular health in sub-Saharan Africa

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Department of Medicine
Global Health Lecture Series
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Objectives

• Discuss trends in the field of global non-communicable diseases (NCDs)
• Summarize my research
• Highlight clinical issues of relevance to physicians caring for immigrants in Seattle
Outline

1. What’s the big deal about NCDs and global health?
2. What do we know about the burden of CVD in sub-Saharan Africa?
3. How can health systems in resource-limited settings respond to the dramatic rise in CVD?
Part 1.

What’s the big deal about NCDs and global health?
Changes in DALY rankings, 1990-2010

Murray CJL. Lancet 2012; 380:2212
# Top 20 risk factors for DALYs by region

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Global</th>
<th>High-income Asia Pacific</th>
<th>Western Europe</th>
<th>Australia</th>
<th>High-income North America</th>
<th>Central Europe</th>
<th>Southern Europe</th>
<th>East Asia</th>
<th>Central Latin America</th>
<th>South Asia</th>
<th>Central Asia</th>
<th>North Africa and Middle East</th>
<th>Caucasus</th>
<th>South Asia</th>
<th>Oceania</th>
<th>Southern Africa</th>
<th>Eastern Africa</th>
<th>Sub-Saharan Africa</th>
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<td>Tobacco smoking, including second-hand smoke</td>
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</table>

Lim SS. Lancet 2012; 380:2224-60.
CVD evolves with development

The epidemiological transition for CVD

- Pestilence and Famine
- Receding Pandemics
- Degenerative and Man-made Diseases
- Delayed Degenerative Diseases

- Public Health
- Nutrition
- Hypertension
  (Hem. Stroke)
- Tobacco
  Obesity/Lipids/DM
  (IHD, Stroke)
- Prevention
  Treatment
  (IHD, Stroke, CHF)

Life expectancy (years) vs % of deaths due to CVD

Figure courtesy of Tom Gaziano
Economic impact of CVD and diabetes

Proportion of CVD among working-age adults (35-64 y/o), 2000-2030 (courtesy of Tom Gaziano)

Table 2: Projected foregone national income due to heart disease, stroke, and diabetes, and cumulative GDP gains through achievement of a global goal of an additional 2% annual reduction in mortality due to chronic diseases, 2006-15

Abegunde DO. Lancet 2007; 370:1934
Leadership in academia: The Lancet NCD Action Group

Chronic Diseases 1

Preventing chronic diseases: how many lives can we save?

Kathleen Strong, Colin Mathers, Stephen Leeder, Robert Beaglehole

Chronic Diseases 5

Prevention of chronic diseases: a call to action

Robert Beaglehole, Shah Ebrahim, Srinath Reddy, Janet Voelte, Steve Leeder, on behalf of the Chronic Disease Action Group

Non-Communicable Diseases 1

Embedding non-communicable diseases in the post-2015 development agenda

George Alleyne, Agnes Binagwaho, Andy Haines, Selim Jahan, Rachel Nogrant, Ariella Rajhani, David Stockler, on behalf of The Lancet NCD Action Group

The post-2015 development agenda will build on the Millennium Development Goals (MDGs), in which health is a core component. This agenda will focus on human development, incorporate the components of the Millennium Declaration, and will be made sustainable by support from the social, economic, and environmental domains of activity, represented graphically as the strands of a triple helix. The approaches to prevention and control of non-communicable diseases (NCDs) have been elaborated in the political declaration of the UN high-level meeting on NCDs and governments have adopted a goal of 25% reduction in relative mortality from NCDs by 2025 (the 25 by 25 goal), but a strong movement is needed based on the evidence already available, enhanced by effective partnerships, and with political support to ensure that NCDs are embedded in the post-2015 human development agenda. NCDs should be embedded in the post-2015 development agenda, since they are leading causes of death and disability, have a negative effect on health, and, through their effect on the societal, economic, and the environmental domains, impair the sustainability of development. Some drivers of unsustainable development, such as the transport, food and agriculture, and energy sectors, also increase the risk of NCDs.
Leadership in civil society

http://www.ncdalliance.org/

http://www.ypchronic.org/

Welcome to the Young Professionals Chronic Disease Network (YP-CDN). YP-CDN is a global network of young professionals committed to promoting research, policy and advocacy work on non-communicable diseases (NCDs). Our interactive network is kindly hosted by Global Health Delivery Project. To join our network, please click here. Browse this site to learn more about us, what we do, our history, and various publications and reports authored by our members. You can also contact us by clicking here. Welcome!
WHO: towards collective action

United Nations High-Level Meeting on NCDs (Sept 2011)

- Committed governments to establish or strengthen NCD policies
- Strong language on prevention and lifestyle interventions
- Advocates for access to medicines, special attention to vulnerable populations (women/children, indigenous)
- Vague on resource commitments
- Weak on targets and timetables

http://www.who.int/nmh/events/un_ncd_summit2011/political_declaration_en.pdf
Individual countries largely left to develop their own NCD plans

Goal: population salt level <5g/day by 2020

http://www.actiononsalt.org.uk/
Part 2.

What do we know about the burden of CVD in sub-Saharan Africa?
GBD 2010

http://www.healthmetricsandevaluation.org/gbd/visualizations/gbd-cause-patterns
Experience “on the ground”

Figure 1 Causes of heart failure in sub-Saharan Africa: combined data from 12 hospital-based case series conducted between 1957 and 2005 involving 4549 patients from eight countries (Cameroon, Ghana, Kenya, Nigeria, Senegal, South Africa, Uganda and Zimbabwe). EMF, endomyocardial fibrosis.

Mayosi BM. Heart 2007; 93:1177
In an urban, contemporary setting

- All incident CVD presenting to Chris Hani Baragwanath Hospital (Soweto)
- Most cases were: hypertension, valvular disease, or cardiomyopathy
- 10% CAD
- High prevalence of CAD *risk factors*

Sliwa K. Lancet 2008; 371:919
Hypertensive heart disease

<table>
<thead>
<tr>
<th>Country</th>
<th>Awareness (%)</th>
<th>Treatment (%)</th>
<th>Control (%)</th>
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</thead>
<tbody>
<tr>
<td>Egypt (national)</td>
<td>37.5</td>
<td>23.9</td>
<td>8</td>
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<tr>
<td>Tanzania (urban and rural)</td>
<td>20.0</td>
<td>10.0</td>
<td>1.0</td>
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<tr>
<td>South Africa (national)</td>
<td>26.0 (men);</td>
<td>21 (men);</td>
<td>10 (men);</td>
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<tr>
<td></td>
<td>51.0 (women)</td>
<td>36 (women)</td>
<td>8 (women)</td>
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<tr>
<td>Ghana (urban)</td>
<td>39.0</td>
<td>18.0</td>
<td>4.0</td>
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<tr>
<td>Ghana (semi-urban and rural)</td>
<td>22.0</td>
<td>11.3</td>
<td>2.8</td>
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<tr>
<td>China (national)</td>
<td>44.2</td>
<td>28.2</td>
<td>8.1</td>
</tr>
<tr>
<td>Mozambique (national)</td>
<td>10.6 (men);</td>
<td>3.5 (men);</td>
<td>1.0 (men);</td>
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<td>18.4 (women)</td>
<td>11.2 (women)</td>
<td>4.8 (women)</td>
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<td>Vietnam</td>
<td>48.4</td>
<td>29.6</td>
<td>10.7</td>
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</table>

Data extracted from references 5, 20–25, and 32. Percentages are given to 1 decimal place when known, and as a whole number when more accurate values are not available. Awareness is the proportion of people with hypertension who are aware of their high blood pressure status. Treatment is the proportion of people with hypertension who are being treated for hypertension. Control is the proportion of people with hypertension who have their hypertension under control.

Table 3: Differences in the awareness, treatment, and control of hypertension between and within countries

Ibrahim MM. Lancet 2012; 380:613
Rheumatic heart disease

Figure 1: Prevalence of rheumatic heart disease in children aged 5–14 years
The circles within Australia and New Zealand represent indigenous populations (and also Pacific Islanders in New Zealand).

Carapetis JR. Lancet Infect Dis 2005; 5:687
Clinical take-home points

• A neglected disease of poverty
• PREVENTABLE
  – Primary: treat strep throat
  – Secondary: monthly PCN x 10 yr or until 21 y/o, whichever longer
• Suspect in younger African/Southeast Asian patients with cardiopulmonary complaints
• Stroke risk from AF is very high (ALL need warfarin)
• Ultimately becomes a surgical disease if untreated

Marijon E. Lancet 2012; 379:956
Watkins DA. Science 2009; 324(5923):37
Dilated cardiomyopathy

- Thiamine (beriberi)
- Alcohol abuse
- Myocarditis
- HIV
- Genetics
  - Troponin, dystrophin, lamin A/C, myosin, etc
  - Many “idiopathic” familial cases

Endomyocardial fibrosis

19.8% of adults with cardiac abnormalities

Mayosi BM. Heart 2007; 93:1177
Arrhythmogenic cardiomyopathy

• Also known as “ARVD”
• Mutations in desmosomes → RV arrhythmias and SCD
• May be as common as HCM in some regions
• Novel mutations found in SA, including founder effect

Watkins DA. Heart Rhythm 2009; 6:S13,15
CVD can be malignant in pregnancy

- Overall prevalence of 0.6% of pregnancies in South Africa
- Morbidity/mortality highest with cardiomyopathy and mitral stenosis
- Case-fatality rates vary by access to tertiary care (30% in Senegal)
- Perinatal mortality astronomical

**Table 2 Prevalence of antenatal heart diseases; maternal and perinatal outcomes**

<table>
<thead>
<tr>
<th>Study ID (Year)</th>
<th>Prevalence</th>
<th>Case-fatality rate</th>
<th>Perinatal mortality rate</th>
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<tr>
<td>Schoon et al. [12]</td>
<td>587</td>
<td>9146</td>
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<td>Divanovic and Buchmann [13]</td>
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<td>Schoon [14]</td>
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<td>Soma-Pillay et al. [10]</td>
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<td>Nqayana et al. [15]</td>
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Linguistic/cultural differences, “thrifty genes,” access to care... Applies to rural – urban migration within a country as well
Part 3.

How can health systems in resource-limited settings respond to CVD?
Prioritize the most effective and least expensive interventions

<table>
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<th>Risk factor/disease</th>
<th>Interventions</th>
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<tbody>
<tr>
<td>Tobacco use</td>
<td>- Raise taxes on tobacco</td>
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<td></td>
<td>- Protect people from tobacco smoke</td>
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<td></td>
<td>- Warn about the dangers of tobacco</td>
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<td></td>
<td>- Enforce bans on tobacco advertising</td>
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<tr>
<td>Harmful use of alcohol</td>
<td>- Raise taxes on alcohol</td>
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<td></td>
<td>- Restrict access to retailed alcohol</td>
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<td></td>
<td>- Enforce bans on alcohol advertising</td>
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<tr>
<td>Unhealthy diet and physical inactivity</td>
<td>- Reduce salt intake in food</td>
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<td>- Replace trans-fat with polyunsaturated fat</td>
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<td></td>
<td>- Promote public awareness about diet and physical activity (via mass media)</td>
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<tr>
<td>CVD and diabetes</td>
<td>- Provide counselling and multidrug therapy (including blood sugar control for diabetes mellitus) for people with medium-high risk of developing heart attacks and strokes (including those who have established CVD)</td>
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<tr>
<td></td>
<td>- Treat heart attacks (myocardial infarction) with aspirin</td>
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Select policies that can improve health and reduce private expenditures

Borrowing And Selling To Pay For Health Care In Low- And Middle-Income Countries

One in four households in forty developing countries resort to “hardship financing” to pay for health care.

by Margaret E. Kruk, Emily Goldmann, and Sandro Galea

ABSTRACT: Many families around the world make sizable out-of-pocket payments for health care. We calculated the frequency of borrowing money or selling assets to buy health services in forty low- and middle-income countries and estimated how various factors are associated with these coping strategies. The data represented a combined population of 3.66 billion, or 58 percent of the world’s population. On average, 25.9 percent of households borrowed money or sold items to pay for health care. The risk was higher among the poorest households and in countries with less health insurance. Health systems in developing countries are failing to protect families from the financial risks of seeking health care.


“FINANCIAL RISK PROTECTION”

Kruk ME. Health Affairs 2009; 28(4):1062
Between regions, results differ due to variations in epidemiology and health system capacity

<table>
<thead>
<tr>
<th>CVD prevention and treatment</th>
<th>Annual DALYs saved per 1 million population</th>
<th>WHO African sub-region AfrE ($ per DALY averted, relative to no intervention)</th>
<th>Incremental CER ($ per DALY averted, within intervention cluster)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CVD-1</strong> Reduced dietary salt intake - voluntary (15%)</td>
<td>276</td>
<td>0.16</td>
<td>591</td>
</tr>
<tr>
<td><strong>CVD-2</strong> Reduced dietary salt intake - legislated (30%)</td>
<td>509</td>
<td>0.16</td>
<td>321</td>
</tr>
<tr>
<td><strong>CVD-3</strong> Reduced population-level cholesterol via mass media campaign</td>
<td>471</td>
<td>0.27</td>
<td>581</td>
</tr>
<tr>
<td><strong>CVD-4</strong> Individual drug treatment for hypertension (SBP &gt; 140) + education</td>
<td>4,616</td>
<td>1.81</td>
<td>393</td>
</tr>
<tr>
<td><strong>CVD-5</strong> Individual drug treatment for hypertension (SBP &gt; 160) + education</td>
<td>3,317</td>
<td>0.47</td>
<td>141</td>
</tr>
<tr>
<td><strong>CVD-6</strong> Individual cholesterol treatment (&gt; 5.7 mmol/l)</td>
<td>1,862</td>
<td>1.37</td>
<td>734</td>
</tr>
<tr>
<td><strong>CVD-7</strong> Individual cholesterol treatment (&gt; 6.2 mmol/l)</td>
<td>2,346</td>
<td>0.78</td>
<td>592</td>
</tr>
<tr>
<td><strong>CVD-8</strong> Preventive multi-drug treatment (&gt;5% risk of CVD event)</td>
<td>5,817</td>
<td>2.33</td>
<td>401</td>
</tr>
<tr>
<td><strong>CVD-9</strong> Combination drug treatment (&gt;15% risk of CVD event)</td>
<td>4,504</td>
<td>0.56</td>
<td>212</td>
</tr>
<tr>
<td><strong>CVD-10</strong> Combination drug treatment (&gt;25% risk of CVD event)</td>
<td>3,689</td>
<td>0.51</td>
<td>139</td>
</tr>
<tr>
<td><strong>CVD-11</strong> Preventive multi-drug treatment (&gt;35% risk of CVD event)</td>
<td>3,163</td>
<td>0.33</td>
<td>104</td>
</tr>
<tr>
<td><strong>CVD-12</strong> Combination of population-based hypertension &amp; cholesterol control (CVD-1 + CVD-3)</td>
<td>989</td>
<td>0.37</td>
<td>370</td>
</tr>
<tr>
<td><strong>CVD-13</strong> Combination of individual-based hypertension &amp; cholesterol control (CVD-5 + CVD-7)</td>
<td>4,132</td>
<td>0.50</td>
<td>218</td>
</tr>
</tbody>
</table>

“Extended Cost-Effectiveness Analysis”

Entire economy

Health Sector

Disease or intervention

Cost-benefit analysis

Extended cost-effectiveness analysis (ECEA)

Cost-effectiveness analysis (CEA)
Development of a preliminary ECEA model to analyze South Africa’s salt legislation
Model components and steps

- Model population
- Salt intake
- Intervention
- CVD risk
- Health system + costs
- Deaths
Model population

• National Income Dynamics Survey, Wave 2 – nationally-representative, 7300 households
• Economic and basic health information (including blood pressure)
• Cohort of 1 million individuals over 40
• Separated into income quintiles

http://www.nids.uct.ac.za/home/
NIDS blood pressures by income quintile

Mean systolic BP calculated separately for hypertensives ($>140\text{mmHg}$) vs. non-hypertensives ($<140\text{mmHg}$) to capture differential effect sizes from salt reduction.
Salt policy effects

- Average baseline salt intake of 7.8-9.5g/day
- Combined effect of targeted food reductions and media campaign → 5g/day
- Blood pressure decreases linearly; effect more pronounced in hypertensives

Bertram MY. SAMJ 2012; 102(9): 744
He FJ. Cochrane 2004. CD004937.
CVD events

- Baseline death rates from IHD and stroke per GBD 2010
- Reductions in CVD mortality calculated using age-specific hazard ratios
- Changes in incidence calculated using CVD CFRs (not directly measured)

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Age at risk (years)</th>
<th>Number of deaths</th>
<th>Hazard ratio (95% CI) for 20 mm Hg lower usual systolic blood pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>40-49</td>
<td>414</td>
<td>0.86 (0.82-0.90)</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>1372</td>
<td>0.88 (0.85-0.91)</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>2939</td>
<td>0.90 (0.87-0.92)</td>
</tr>
<tr>
<td></td>
<td>70-79</td>
<td>4327</td>
<td>0.92 (0.89-0.94)</td>
</tr>
<tr>
<td></td>
<td>80-89</td>
<td>2636</td>
<td>0.94 (0.91-0.96)</td>
</tr>
<tr>
<td>IHD</td>
<td>40-49</td>
<td>1322</td>
<td>0.49 (0.45-0.53)</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>5594</td>
<td>0.50 (0.46-0.52)</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>10450</td>
<td>0.54 (0.50-0.58)</td>
</tr>
<tr>
<td></td>
<td>70-79</td>
<td>10852</td>
<td>0.60 (0.56-0.64)</td>
</tr>
<tr>
<td></td>
<td>80-89</td>
<td>5840</td>
<td>0.67 (0.63-0.71)</td>
</tr>
<tr>
<td>Other vascular</td>
<td>40-49</td>
<td>386</td>
<td>0.43 (0.38-0.48)</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>1377</td>
<td>0.47 (0.42-0.54)</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>2549</td>
<td>0.51 (0.46-0.56)</td>
</tr>
<tr>
<td></td>
<td>70-79</td>
<td>3227</td>
<td>0.64 (0.59-0.69)</td>
</tr>
<tr>
<td></td>
<td>80-89</td>
<td>2251</td>
<td>0.70 (0.65-0.75)</td>
</tr>
</tbody>
</table>

http://www.healthmetricsandevaluation.org
Economic effects

- Care-seeking behavior (yes/no) by quintile based on national surveys
- Location and level of care (public, private, tertiary, etc) assigned based on weighted average utilization by quintile
- Utilization modeled over 1 year for incident cases in cohort of 1 million
- Public sector expenses calculated directly from patient fee schedules and hospital medication costs (personal communication)
- Private sector expenses calculated from average total CVD expenditures per national insurance database, adjusted for average out-of-pocket expenditures on health


Moodley I. CVJSA 2006; 17(3):143
A note on the South African health system

- Out-of-pocket user fees are calculated on a sliding scale basis
- H0 status is “fully subsidized” and includes all using government grants (e.g., pensioners, veterans, disabled, officially unemployed, etc)
- About 41% of individuals with H0 status end up paying out-of-pocket
- H3 status reflects the “full” out-of-pocket cost of care, i.e., extent of government subsidies

<table>
<thead>
<tr>
<th></th>
<th>Stroke</th>
<th>IHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUBLIC H0</td>
<td>77</td>
<td>85</td>
</tr>
<tr>
<td>PUBLIC H1</td>
<td>188</td>
<td>208</td>
</tr>
<tr>
<td>PUBLIC H2</td>
<td>2846</td>
<td>4089</td>
</tr>
<tr>
<td>PUBLIC H3</td>
<td>15964</td>
<td>17470</td>
</tr>
<tr>
<td>PRIVATE INSURED</td>
<td>6649</td>
<td>9291</td>
</tr>
<tr>
<td>PRIVATE UNINSURED</td>
<td>46201</td>
<td>63571</td>
</tr>
</tbody>
</table>

Average out-of-pocket on acute CVD events (2011 ZAR)
Results
CVD cases averted

8975 cases of CVD in the entire population (12.5 million)
CVD deaths averted

4000 CVD deaths in the entire population (12.5 million)
Average per capita OOP averted

R36.7M (about $4M) in total out-of-pocket payments
Cases of catastrophic OOP averted

6600 cases of potentially impoverishing stroke or heart attack
Next steps

• Refine the model to capture incident hypertensive heart disease and end-stage renal disease
• Analyze the final salt legislation for comparative effects of various components (bread, media, etc)
• Apply ECEA method across NCD policies to highlight “trade-offs” and an “expansion pathway” for public spending
Financial risk protection trade-offs across priority conditions in Ethiopia
Future directions

• Empirical work on hardship financing for CVD in sub-Saharan Africa, “indirect costs”
• Improvements in models as quality of epidemiologic data improves
• Focus on cost-effective interventions for RHD and other neglected cardiovascular conditions
• Prioritize CVD screening and health promotion amongst pregnant women: the beginning of a “life-course approach” to NCDs
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Questions?
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