Leveraging HL7 FHIR for Smart Guidelines: Advancing Use of WHO Guidelines in the Digital Age
Introduction

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COVID-19 has highlighted the importance of strengthening health systems with digital technologies

However...

How do we know the content in these digital solutions are aligned to what WHO is recommending?
Today, WHO guidelines can take years to be fully adopted by member states, and accuracy can be compromised during adaptation.

- **World Health Organization (WHO)**: Develops guidelines using global evidence base.
- **Ministry of Health (MoH)**: Adapts guidelines into national guidelines comprising procedures, protocols, datasets and indicators.
- **Implementation & Technology Partners**: Translate national guidelines into digital solutions.
- **Health Workforce**: Deliver and document health services in accordance with national guidelines.
- **Health Service Users**: Access quality person-centered care, delivered in accordance with national directives on guideline use.

Today’s guidelines are:

- **Not integrated quickly or fully into practice**
- **Resource intensive to adapt and scale to broader use**
- **Difficult to update or digitize with fidelity**
- **Infrequently digitized with interoperability and indicator standards**
This is further complicated with digital leading to questionable results

MOH and their implementation partners need detailed specifications for digitizing guidelines so that they are not misinterpreted

Today’s digitized guidelines are
- Not always accurate
- Not fully trusted
- Not cost-efficient
- Uncoordinated
- Not transparent
- Not scalable
- Not interoperable
- Opaquely & inadequately represented in digital solutions
The WHO envisions a future where everyone in the world benefits fully and immediately from clinical, public health, and data use guidelines.
Introducing Smart Guidelines...

Smart Guidelines are a new approach to representing and implementing clinical, public health, and data recommendations in the digital age. At their heart, Smart Guidelines are a comprehensive set of digital health components (e.g., standards, code libraries, algorithms, technical and operational specifications) that transform the guideline adaptation and implementation process to preserve fidelity and accelerate uptake.
So, how do we get there?
Each “Layer” offers Smart Guideline components

**L1: Narrative**
- Living guidelines approach
- Digital curation of recommendations
- Panels include medical informatics experts

**L2: Operational**
- Human-readable operational components
- Structured workflows
- Decision-support documentation
- Data dictionaries
- Specificity of user(s), beneficiaries

**L3: Machine Readable**
- FHIR IG based on Clinical Practice Guidelines IG
- Standard terminologies, value sets, calculations for decision-support and indicator population and data exchange

**L4: Executable**
- Fully executable software tools
- Mechanism for real-time updates

**L5: Dynamic**
- Advanced analytics for greater local relevance and precision
- AI-based decision support
- Continuous improvement of software code

**EXISTING MODEL WITH ENHANCEMENTS**
**PREPARING TO GO DIGITAL**
**INTEROPERABLE DIGITAL COMPONENTS**
**CUSTOMIZABLE SOFTWARE**
**ADVANCED ANALYTICS FOR PRECISION HEALTH**
# Smart Guidelines - Busting the Myths

<table>
<thead>
<tr>
<th>Smart Guidelines are NOT</th>
<th>Smart Guidelines ARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>✗ A digital app version of the guidelines</td>
<td>✓ A pathway, or systematic approach, to digitizing guidelines (complementing <em>living guidelines</em>)</td>
</tr>
<tr>
<td>✗ Bound to a specific digital solution, product, or platform</td>
<td>✓ A set of generic components applicable to many digital systems</td>
</tr>
<tr>
<td>✗ Just a clinical solution, or data solution</td>
<td>✓ An operational hybrid of clinical and data recommendations intertwined</td>
</tr>
<tr>
<td>✗ A way to push ministries into specific software solutions</td>
<td>✓ A way to give ministries control over the digital products and services they implement</td>
</tr>
<tr>
<td>✗ A singular solution to system interoperability and health information exchange</td>
<td>✓ Data standards that enable health information exchange between numerous solutions, and enabling consistent calculation of metrics</td>
</tr>
<tr>
<td>✗ Only about digital</td>
<td>✓ An approach to improve guideline curation and use, even without digitization</td>
</tr>
</tbody>
</table>
Smart Guidelines provide a pathway to advance guideline use, even if a country is not yet fully digital.
Illustrative example:
ANAEMIA & IRON FOLIC ACID SUPPLEMENTATION Recommendations from the WHO recommendations on antenatal care for a positive pregnancy experience

Source: https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/anc-positive-pregnancy-experience/en/
### L1: Narrative

**EXISTING MODEL WITH ENHANCEMENTS**

Current guideline format in L1

<table>
<thead>
<tr>
<th>Iron and folic acid supplements</th>
<th><strong>A.2.1:</strong> Daily oral iron and folic acid supplementation with 30 mg to 60 mg of elemental iron and 400 μg (0.4 mg) of folic acid is recommended for pregnant women to prevent maternal anaemia, puerperal sepsis, low birth weight, and preterm birth.</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>A.2.2:</strong> Intermittent oral iron and folic acid supplementation with 120 mg of elemental iron and 2800 μg (2.8 mg) of folic acid once weekly is recommended for pregnant women to improve maternal and neonatal outcomes if daily iron is not acceptable due to side-effects, and in populations with an anaemia prevalence among pregnant women of less than 20%.</td>
<td>Context-specific recommendation</td>
</tr>
<tr>
<td>Anaemia</td>
<td><strong>B.1.1:</strong> Full blood count testing is the recommended method for diagnosing anaemia in pregnancy. In settings where full blood count testing is not available, on-site haemoglobin testing with a haemoglobinometer is recommended over the use of the haemoglobin colour scale as the method for diagnosing anaemia in pregnancy.</td>
<td>Context-specific recommendation</td>
</tr>
</tbody>
</table>
Current guideline format in L2
- Each ‘variable’ must be encoded to a standard terminology (ICD, ICHI, ICF, LOINC)
- In spreadsheet formats

### Decision ID

**ANC.DT.23 Anaemia, Iron & Folic Acid Supplementation**

**Business Rule**
Testing for anaemia is recommended for all pregnant women. Regardless of test results, iron and folic acid supplementation is recommended. The amount of iron and folic acid supplementation will vary depending on anaemia diagnosis, population prevalence of anaemia, and whether the woman has side effects due to iron and folic acid supplementation.

### Workflow

**A. Registration**

1. **Rapid (RAM) signs needing assessment and management?**
   - **Yes:** Proceed to **B. First contact**
   - **No:** Proceed to **C. Danger referral?**

2. **Danger referral?**
   - **Yes:** Proceed to **D. Pregnancy confirmed?**
   - **No:** Proceed to **E. Not pregnant?**

**B. First contact**

3. **Pallor present?**
   - **Yes:** Proceed to **F. Anaemia counselling conducted**
   - **No:** Proceed to **G. Anaemia counselling conducted**

**C. Pregnancy confirmed?**

4. **Gestational age**
   - **<= 12 weeks:** Proceed to **H. Anaemia diagnosis**
   - **> 12 weeks:** Proceed to **I. Anaemia diagnosis**

**D. Danger referral?**

5. **Pallor present?**
   - **Yes:** Proceed to **J. Anaemia counselling conducted**
   - **No:** Proceed to **K. Anaemia counselling conducted**

**E. Not pregnant?**

6. **Anaemia diagnosis**
   - **Positive for Anaemia:** Proceed to **L. Anaemia counselling conducted**
   - **Negative for Anaemia:** Proceed to **M. Anaemia counselling conducted**

### Decision Table

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Action</th>
<th>Output</th>
<th>Type of iron supplement dosage provided</th>
<th>Amount of daily dose of folic acid prescribed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood haemoglobin test result &lt; 11 g/dl</td>
<td>ANC 10.4 Diagnosis &amp; treatment</td>
<td>Anaemia diagnosis = Positive for Anaemia</td>
<td>Daily</td>
<td>2.8 mg</td>
</tr>
<tr>
<td>Blood haemoglobin test result &gt;= 11 g/dl</td>
<td>ANC 10.4 Diagnosis &amp; treatment</td>
<td>Anaemia diagnosis = Negative for Anaemia</td>
<td>Daily</td>
<td>2.8 mg</td>
</tr>
<tr>
<td>Blood haemoglobin test conducted = FALSE</td>
<td>ANC.10.4 Diagnosis &amp; treatment</td>
<td>Anaemia counselling conducted</td>
<td>60mg</td>
<td>2.8 mg</td>
</tr>
<tr>
<td>Blood haemoglobin test result &lt; 11 g/dl</td>
<td>ANC.10.5 Nutrition supplementation</td>
<td>Anaemia counselling conducted</td>
<td>60mg</td>
<td>2.8 mg</td>
</tr>
<tr>
<td>Blood haemoglobin test result &gt;= 11 g/dl</td>
<td>ANC.10.5 Nutrition supplementation</td>
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</table>

**Output Annotations**

- **ANC.10.5 Nutrition:** Provided.
- Please refer to iron sources listed below for additional guidance that can be provided.
- Due to the population’s high anaemia prevalence, a daily dose of 60 mg of ferrous sulphate, 360 mg of ferrous fumarate, or 1000 mg of ferrous gluconate is also recommended.
- The equivalent of 60 mg of elemental iron equals 600 mg of ferrous sulphate heptahydrate, 180 mg of ferrous fumarate, or 1000 mg of ferrous gluconate.
- Please refer to iron sources listed below for additional information that can be provided.
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### Iron Sources

1. Iron-rich foods: Red meat, shellfish, eggs, nuts, legumes, and dark green leafy vegetables.
2. Fortified cereals and bread.
3. Iron supplements: Elemental iron (e.g., ferrous sulphate, ferrous fumarate, ferrous gluconate).

**Note:** Please consult with a healthcare provider for specific guidance on iron and folic acid supplementation during pregnancy.
L3: Machine-readable INTEROPERABLE DIGITAL COMPONENTS

Guideline format in L3

Guideline in software code

Text from Guideline (L1)

Structured logic from Digital Accelerator Kit (L2)
How it will work

**WHO**
- Develops global guidelines using evidence base

**Ministry of Health**
- Adapts guidelines into national guidelines comprising procedures, protocols, datasets and indicators

**Implementation & Technology Partners**
- Translate national guidelines into digital solutions

**Health Workforce**
- Deliver and document health services in accordance with the most up to date national guidelines

**Health Service Users**
- Access quality person-centered care, delivered in accordance with national directives on guideline use

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**How WHO will support this ecosystem**

- **Digital Guidelines Exchange** (L1 – L2)
- **Smart Guidelines Authoring & Testing Platform** (L2 – L3)
- **Android FHIR Software Development Kit (SDK)** (L3 – L4)
- **Application Programming Interface (API)** (L4)
- **Terminology Services** (L4)
Thank you!