P1752 Sleep Schema Subgroup Meeting

Sponsored by IEEE Engineering in Medicine & Biology (EMB) Standards Committee

- 5 Feb 2019
- Teleconference
Attendance

• Put your name and affiliation in the chat window for attendance today.
• If you are joining only via phone, please email charlotte.chen@philips.com with “P1752 Sleep Schema Subgroup call” as subject.
• The document shows attendance is under https://ieee-sa.imeetcentral.com/omh/folder/WzlwLDEwMjY4MDg1XQ/.
  --If you attended the call, please verify that your name is listed.
  --If your name is not listed, either edit the document above or email charlotte.chen@philips.com.
Agenda

1. Attendance
2. Modified timelines
3. Update from the qualitative schema task group (15 mins)
4. Update from quantitative schema task group
    --- Review the updated list
    --- Review drafted quantitative schemas and sample data (40 mins)
5. Action Items
6. Q&A
Sleep Schema Subgroup Deliverables

• Clinically important sleep attributes
• Common sleep attributes of the existing relevant devices and apps
• Standard Comparison Report (Review and mapping)
• Proposed sleep schemas (modified and new) and use cases (quantitative and qualitative)

(1) Quantitative Measurement Schemas (including macrostructure, microstructure and etc.)

(2) Qualitative Measurement Schemas (including subjective sleep experience, other sleep related phenomena and etc.)
Timeline for Stage 2

July 23, 2018
Kick Off

- **Drafted/Start to review** Quantitative Sleep Schemas by **Feb 11, 2019**
- **Prepare** Qualitative Measure Schema Development by **Feb 5, 2019**

- **Completed** Quantitative Schemas and Use Cases on **Feb 25, 2019**
- **Drafted/Start to review** qualitative measure schemas **Feb 19, 2019**
- All the deliverables are ready by **Feb 28, 2019**
Qualitative Schema Task Group Updates (Banu)
Status

• Follow up of meeting held on Jan 8, 2019
  --- Survey to get consensus on using existing OmH framework
  --- Reached out to the Qualitative sub group
  --- Majority voted in favour of existing OmH framework (4 votes including Simona’s response)
Sleep Subgroup: qualitative measure schema task group

• The next steps for this task group:

(a) Start drafting the schema for survey; based on the OmH framework

(b) Identify additions / modifications in the framework to accommodate the 10 shortlisted Questionnaires
Quantitative Schema Task Group Updates

- Review the updated list
- Review the drafted quantitative schemas and sample data (30 mins)
Overview of Schema Development Tasks

- **Review and Understand the Existing Work (Open mHealth)**
  - Design principles:
    [http://www.openmhealth.org/documentation/#/schema-docs/schema-design-principles](http://www.openmhealth.org/documentation/#/schema-docs/schema-design-principles)
  - Existing templates for various schemas:
    [http://www.openmhealth.org/documentation/#/schema-docs/write-a-schema](http://www.openmhealth.org/documentation/#/schema-docs/write-a-schema)
  - Existing sleep schemas:
    [http://www.openmhealth.org/schema/omh/sleep-duration-2.0.json](http://www.openmhealth.org/schema/omh/sleep-duration-2.0.json)
    [http://www.openmhealth.org/documentation/#/schema-docs/schema-library/schemas/omh_sleep-episode](http://www.openmhealth.org/documentation/#/schema-docs/schema-library/schemas/omh_sleep-episode)

- **Propose Modified and New Sleep Schemas**
Review the Updated List
<table>
<thead>
<tr>
<th>Schema ID</th>
<th>Schema Name</th>
<th>Priority</th>
<th>Complexity</th>
<th>Assignment</th>
<th>Sleep Attribute1 (unit)</th>
<th>Sleep Attribute2 (unit)</th>
<th>Sleep Attribute3 (unit)</th>
<th>Sleep Attribute4 (unit)</th>
<th>Sleep Attribute5 (unit)</th>
<th>Associated Sleep</th>
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<tr>
<td>2</td>
<td>sleep_onset_latency</td>
<td>3</td>
<td>Simple</td>
<td>SC</td>
<td>SOL (hrs, mins, secs)</td>
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<td></td>
<td></td>
<td></td>
<td>WASO, Self-report</td>
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<td>1</td>
<td>Simple</td>
<td>JS</td>
<td>TST (hrs, mins, secs)</td>
<td></td>
<td></td>
<td></td>
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<td>TIB, SOL, WASO, Self-report</td>
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<td>time_in_bed</td>
<td>2</td>
<td>Simple</td>
<td>PH</td>
<td>TIB (hrs, mins, secs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TST, SOL, WASO, Self-report</td>
</tr>
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<td>wake_after_sleep_onset</td>
<td>4</td>
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<td>CC</td>
<td>WASO (hrs, mins, secs)</td>
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<td></td>
<td></td>
<td></td>
<td>SOL, A1, Self-report</td>
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<tr>
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<td>arousal_rate</td>
<td>11</td>
<td>Simple</td>
<td>CC</td>
<td>AI (total counts /hr of sleep)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MA, WAK</td>
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<tr>
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<td>sleep_stages</td>
<td>10</td>
<td>Complex</td>
<td>PH</td>
<td>DREM (hrs, mins, secs)</td>
<td>DDS (hrs, mins, secs)</td>
<td>DLS (hrs, mins, secs)</td>
<td>TST (hrs, mins, secs)</td>
<td></td>
<td>DLS, DREM</td>
</tr>
<tr>
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<td>8</td>
<td>Moderate</td>
<td>CC</td>
<td>DDS (hrs, mins, secs)</td>
<td>TST (hrs, mins, secs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schema ID</td>
<td>Schema Name</td>
<td>Priority</td>
<td>Complexity</td>
<td>Assignment</td>
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<td>Sleep Attribute 2 (unit)</td>
<td>Sleep Attribute 3 (unit)</td>
<td>Sleep Attribute 4 (unit)</td>
<td>Sleep Attribute 5 (unit)</td>
<td>Associated Sleep Attribute(s)</td>
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<td>9</td>
<td>Moderate</td>
<td>CC</td>
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<td>TST (hrs, mins, secs)</td>
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<td></td>
<td></td>
<td>DDS, DREM</td>
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<td>CC</td>
<td>SNS (counts)</td>
<td>SD (hrs, mins, secs)</td>
<td>TST (hrs, mins, secs)</td>
<td></td>
<td></td>
<td>AHI</td>
</tr>
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<td>obstructive_sleep_apnea</td>
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<td>Complex</td>
<td>PH</td>
<td>AHI (counts/hr of sleep)</td>
<td>SNS (yes, no)</td>
<td>SD (hrs, mins, secs)</td>
<td>TST (hrs, mins, secs)</td>
<td></td>
<td>BP (surprised, side, facedown—Data type (Enum))</td>
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<tr>
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<td>5</td>
<td>Simple</td>
<td>PH</td>
<td>BM (counts)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DDS, DLS, AI</td>
</tr>
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<td>13</td>
<td>ambient_light</td>
<td>12</td>
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<td>SC, CC</td>
<td>L (lux)</td>
<td>wavelength (nm)</td>
<td></td>
<td></td>
<td></td>
<td>TST, SOL, WASO, AI, WAK, DDS, DLS</td>
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<tr>
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<td>ambient_temperature</td>
<td>12</td>
<td>Simple</td>
<td>SC</td>
<td>Atmp (°C, °F)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TST, SOL, WASO, AI, WAK, DDS, DLS</td>
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<tr>
<td>15</td>
<td>ambient_noise</td>
<td>12</td>
<td>Simple</td>
<td>PH</td>
<td>Snd (dB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TST, SOL, WASO, AI, WAK, DDS, DLS</td>
</tr>
</tbody>
</table>
Review Drafted Quantitative Schemas and Sample Data
According to Open mHealth, each schema includes at least the following sections:

- schema header ("reference" section: SNOMED, LOINC, RxNORM, or UCUM)
- "definitions"
- "properties"
- "required"

Suggest the following:

- Start with these fields for developing a new schema;
- During schema development, we could create new/modify existing fields as needed;
Previous Drafted Schemas and Sample Data

--sleep_onset_latency sample data (Simona)
--ambient_temperature sample data (Simona)
--deep_sleep_percentage_sample_data
--light_sleep_percentage_sample_data
--wake_after_sleep_onset_sample_data
--ambient_light_sample_data
--sleep_body_movement and sample data(Paul)
Sleep_Onset_Latency_Sample_Data

```json
{
  "effective_time_frame": {
    "time_interval": {
      "start_date_time": "2016-02-05T21:35:00Z",
      "end_date_time": "2016-02-05T39:05:00Z"
    },
    "sleep_onset_latency": {
      "value": 17.5,
      "unit": "min"
    },
    "is_main_sleep": true
  }
}
```

```json
{
  "effective_time_frame": {
    "time_interval": {
      "start_date_time": "2018-04-05T21:35:00Z",
      "end_date_time": "2018-04-05T39:05:00Z"
    },
    "sleep_onset_latency": {
      "value": 15.25,
      "unit": "min"
    },
    "is_main_sleep": true,
    "descriptive_statistic": "average",
    "descriptive_statistic_denominator": "d"
  }
}
```
`ambient_temperature": {
  "value": 75,
  "unit": "°F"
},
"effective_time_frame": {
  "time_interval": {
    "start_date_time": "2015-02-05T00:00:00Z",
    "end_date_time": "2015-02-06T00:00:00Z"
  },
  "descriptive_statistic": "average"
},

"ambient_temperature": {
  "value": 1.75,
  "unit": "°F"
},
"effective_time_frame": {
  "time_interval": {
    "start_date_time": "2015-02-05T00:00:00Z",
    "end_date_time": "2015-02-06T00:00:00Z"
  },
  "descriptive_statistic": "average"}
{ "deep_sleep_percentage": { "value": 35, "unit": "%" }, "deep_sleep_duration": { "value": 168, "unit": "min" }, "effective_time_frame": { "time_interval": { "start_date_time": "2019-02-05T22:00:00Z", "end_date_time": "2019-02-06T06:00:00Z" } }, "descriptive_statistic": "average", "descriptive_statistic_denominator": "week" }


```json

"light_sleep_percentage": {
  "value": 50,
  "unit": "%"
},

"light_sleep_duration": {
  "value": 240,
  "unit": "min"
},

"effective_time_frame": {
  "time_interval": {
    "start_date_time": "2019-02-05T22:00:00Z",
    "end_date_time": "2019-02-05T06:00:00Z"
  }
},

"descriptive_statistic": "average",
"descriptive_statistic_denominator": "week"

```
Wake_After_Sleep_Onset_Sample_Data

```json
{
    "wake_after_sleep_onset": {
        "value": 35,
        "unit": "min"
    },
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2019-02-05T22:00:00Z",
            "end_date_time": "2019-02-06T06:00:00Z"
        }
    },
    "descriptive_statistic": "average",
    "descriptive_statistic_denominator": "week"
}
```
{ "ambient_light": [  
  { "light_wavelength": {  
  "value": 440,  
  "unit": "nm"  
  },  
  "light_intensity": {  
  "value": 9.8,  
  "unit": "lux"  
  }  
  },  
  { "light_wavelength": {  
  "value": 453,  
  "unit": "nm"  
  },  
  "light_intensity": {  
  "value": 38.1,  
  "unit": "lux"  
  }  
  },  
  { "light_wavelength": {  
  "value": 461,  
  "unit": "nm"  
  },  
  "light_intensity": {  
  "value": 18.8,  
  "unit": "lux"  
  }  
  }  
},  
  "effective_time_frame": {  
  "time_interval": {  
  "start_date_time": "$date1",  
  "end_date_time": "$date2"  
  }  
  },  
  "descriptive_statistic": "average",  
  "descriptive_statistic_denominator": "week"}
Sleep_Body_Movement Schema (1)
This may be construed as an indicator of restlessness or sleep quality."

when the person began a sleep session and when it ended. For a summary measurement, this is the interval of time between the beginning of the first measurement and t
Sleep_Body_Movement Schema (3)

```json
{
  "movement_count": {
    "type": "integer"
  },
  "effective_time_frame": {
    "type": "string"
  },
  "is_main_sleep": {
    "type": "boolean"
  },
  "descriptive_statistic": {
    "$ref": "#/definitions/descriptive_statistic"
  }
}
```

"required": [
  "movement_count",
  "effective_time_frame",
  "descriptive_statistic"
]
```json
{
    "body_movement_count": {
        "value": 30
    },
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2019-02-05T06:00:00Z",
            "end_date_time": "2019-02-06T06:00:00Z"
        }
    },
    "descriptive_statistic": "total"
}
```
New Drafted Schemas and Sample Data

--ambient_noise and sample data (Paul)
--sleep_apnea (Paul)
--arousal_rate and sample data
--snore_count and sample data
// ambient-noise schema
// version: draft 0.1
// created: 6 January 2019
// modified:
// proposed revisions:

{
    "$schema": "http://json-schema.org/draft-04/schema#",
    "description": "This schema represents the ambient noise, either a single measurement, or the result of aggregating several measurements made over time."
}

"references": [
    {
        "description": "The SNOMED code represents decibel sound perception level (qualifier value)"
    },
    "u-l": "http://purl.bioontology.org/ontology/SNOMEDCT/250444001" // applicable?
]

"definitions": {
    "noise_unit_value": {
        "$ref": "#definitions/noise-unit-value.jx.json" // new definition required?
    },
    "time_frame": {
        "$ref": "#definitions/time-frame.jx.json"
    },
    "descriptive_statistic": {
        "$ref": "#definitions/descriptive-statistic.jx.json"
    }
}

"properties": {
    "ambient_noise": {
        "$ref": "#definitions/temperature_unit_value"
    },
    "effective_time_frame": {
        "$ref": "#definitions/time_frame"
    },
    "descriptive_statistic": {
        "$ref": "#definitions/descriptive_statistic"
    }
}
Ambient_Noise Schema (2)

over time (see Descriptive schema for a list of aggregate measures).
Ambient_Noise_Sample_data(1)
// sleep-apnea schema
// version: draft 0.2
// created: 7 January 2019
// modified: 5 February 2019
// proposed revisions:

"$schema": "http://json-schema.org/draft-04/schema#",
"description": "This schema represents obstructive sleep apnoea either as a measurement or several measurements made over time (see Descriptive statistic).",
"type": "object",
"references": [
  {
    "description": "The SNOMED code represents a sleep Apnoea Hypopnea Index (assessment scale)",
    "url": "http://purl.bioontology.org/ontology/SNOMEDCT/71928005"
  }],

"definitions": {
  "time_frame": {
    "$ref": "time-frame-1.x.json"
  },
  "descriptive_statistic": {
    "$ref": "descriptive-statistic-1.x.json"
  }
},

"properties": {
  "usage_hours": {
    "$ref": "#/definitions/time_frame"
  },
  "mask_size": {
    "type": "number"
  },
  "mask_on_off": {
    "type": "number"
  },
  "ahhi": {
    "type": "number"
  }
},

schema for a list of aggregate measures)"},

"required": [
  "usage_hours",
  "ahi"
]
}
Arousal_Rate Schema (1)

```json
{
    "$schema": "http://json-schema.org/draft-04/schema#",
    "type": "object",
    "description": "This schema represents the arousals rate during a sleep session (main or nap), a number of awakenings between 3-15 secs detected per hour during a sleep session."
}
```

```json
"properties": {
    "arousal_rate": {
        "allOf": [
            {
                "$ref": "#/definitions/frequency_unit_value"
            }
        ]
    }
}
```

```json
"properties": {
    "number_of_times": {
    
    "properties": {
        "time_window": {
            "allOf": [
                {
                    "$ref": "#/definitions/duration"
                }
            ]
        }
    }
}
```

```json
"properties": {
    "unit": {
        "enum": [
            "h"
        ]
    }
```
Arousal_Rate Schema (2)

It may be used to measure the degree of sleep fragment.

```json

"effective_time_frame": {
  "description": "Effective time frame is restricted to be a time interval. For an individual measurement, this is the interval of time between when the person began a sleep session and when it ended. For a summary measurement, this is the interval of time between the beginning of the first measurement and the end of the last measurement."
}
```

"is_main_sleep": {
  "type": "boolean"
}

"descriptive_statistic": {
  "$ref": "#/definitions/descriptive_statistic"
}

"required": [
  "arousal_rate",
  "effective_time_frame"
]
```
Arousal_Rate_Sample_Data Schema (1)

```json
{
    "number_of_times": 3,
    "time_window": {
        "unit": "h"
    },
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2019-02-05T22:00:00Z",
            "end_date_time": "2019-02-05T05:00:00Z"
        }
    },
    "descriptive_statistic": "average"
}
```
Snore_Count Schema (1)

```json
{
  "$schema": "http://json-schema.org/draft-04/schema#",
  "type": "object",
  "description": "This schema represents the snore count in a sleep session (main sleep or nap), i.e., the number of snore bouts during a sleep session. It can be used when the count is related to overall sleep episodes.

  "definitions": {
    "duration_unit_value": {
      "$ref": "#/definitions/duration_unit_value.1.x.json"
    },
    "unit_value": {
      "$ref": "#/definitions/unit_value.1.x.json"
    },
    "time_frame": {
      "$ref": "#/definitions/time_frame.1.x.json"
    },
    "descriptive_statistic": {
      "$ref": "#/definitions/descriptive_statistic.1.x.json"
    },
    "descriptive_statistic_denominator": {
      "$ref": "#/definitions/descriptive_statistic_denominator.1.x.json"
    }
  },
  "properties": {
    "snore_durations": {
      "description": "An array of snore durations to describe each snore bouts during an entire sleep session (main or nap). The duration for each snore bout is the time it takes for the snoring to occur."
    },
    "contains": {
      "all_of": [{
        "$ref": "#/definitions/duration_unit_value"
      }]
    },
    "properties": {
      "unit": {
        "enum": [
          "sec",
          "min",
          "h"
        ]
      }
    }
  }
}
```
for a single measurement, or for the result of aggregating measurements over time. However, the result of aggregating measurements would only be meaningful if they have the same type of sleep.

interval between the snoring start time and the stop time.
"snore_count": {
  "type": "integer"
},
"effective_time_frame": {
  "description": "Effective time frame is restricted to be a time interval. For an individual measurement, this is the interval of time between when the person began a sleep"
},
"is_main_sleep": {
  "Type": "boolean"
},
"descriptive_statistic": {
  "$ref": "#/definitions/descriptive_statistic"
},
"descriptive_statistic_denominator": {
  "anyOf": [
    "$ref": "#/definitions/descriptive_statistic_denominator"
  ],
  "description": "If the value needed is a standard unit of duration, select from the duration-unit-value value set.",
  "type": "string"
Snore_Count Schema (4)

session and when it ended. For a summary measurement, this is the interval of time between the beginning of the first measurement and the end of the last measurement.

```json
"required": [
  "snore_count",
  "effective_time_frame"
]
```
```json
{
    "snore_durations": [
        {
            "value": 3,
            "unit": "min"
        },
        {
            "value": 1,
            "unit": "min"
        },
        {
            "value": 5,
            "unit": "min"
        },
        {
            "value": 2,
            "unit": "min"
        },
        {
            "value": 3,
            "unit": "min"
        },
        {
            "value": 1,
            "unit": "min"
        }
    ],
    "snore_count": 6,
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2019-02-05T23:00:00Z",
            "end_date_time": "2019-02-06T06:00:00Z"
        }
    },
    "descriptive_statistic": "average"
}
```
Action Items

- Finish drafting the quantitative schemas by Feb. 10, 2019
- Start to draft subjective schema for shortlisted questionnaires on Feb. 6, 2019
Future Meetings

- Continue with Tuesdays at 8:30 AM Pacific / 11:30 AM Eastern
- Upcoming meetings
  - March 5, 2019
Adjournment