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IEEE

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/WzIwLDEwMjY4MDg1XQ/ .
  --If you attended the call, please verify that your name is listed
  --If you 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 Stage2

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

- Existing templates for various schemas:

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/documentation/#/schema-docs/schema-library/schemas/omh_sleep-episode

❖Propose Modified and New Sleep Schemas

Review the Updated List

Review the Updated List of Mapping (1)

1	Schema ID	Schema Name	Priority	Complexity	Assignment	Sleep Attribute1 (unit	Sleep Attribute2 (unit	Sleep Attribute3 (unit	Sleep Attribute4 (unit	Sleep Attribute5 (unit	Associated Sleep Attribute(s)
2	2018-S1	sleep_onset_latency	3	Simple	SC	SOL (hrs, mins, secs)	Type of sleep (major, nap)---Required for aggregated SOL				WASO, Self-report
3	2018-S2	total_sleep_time	1	Simple	JS	TST (hrs, mins, secs)					TIB, SOL, WASO, Self-report
4	2018-S3	time_in_bed	2	Simple	PH	TIB (hrs, mins, secs)					TST, SOL, WASO, Self-report
5	2018-S4	wake_after_sleep_onset	4	Simple	CC	WASO (hrs, mins, secs)					SOL, AI, Self-report
6	2018-S5	arousal_rate	11	Simple	CC	AI (total counts /hr of sleep)					MA, WAK
7	2018-S6	sleep_stages	10	Complex	PH	DREM (hrs, mins, secs)	DDS (hrs, mins, secs)	DLS (hrs, mins, secs)	TST (hrs, mins, secs)		
8	2018-S7	deep_sleep_percentage	8	Moderate	CC	DDS (hrs, mins, secs)	TST (hrs, mins, secs)				DLS, DREM

Review/Discuss the Updated List of Mapping (2)

1	Schema ID	Schema Name	Priority	Complexity	Assignment	Sleep Attribute1 (unit	Sleep Attribute2 (unit	Sleep Attribute3 (unit	Sleep Attribute4 (unit	Sleep Attribute5 (unit	Associated Sleep Attribute(s)
9	2018-S8	light_sleep_percentage	9	Moderate	CC	DLS (hrs, mins, secs)	TST (hrs, mins, secs)				DDS, DREM
10	2018-S9	snore_count	7	Moderate	CC	SNS (counts)	SD (hrs, mins, secs)	TST (hrs, mins, secs)			AHI
11	2018-S10	obstructive_sleep_apnea	6	Complex	PH	AHI (counts/hr of slee	SNS (yes, no)	SD (hrs, mins, secs)	TST (hrs, mins, secs)	BP (surpine, side, facedown---Data type (Enum))	AI, SpO2, Resp
12	2018-S11	sleep_body_movement	5	Simple	PH	BM (counts)					DDS, DLS, AI
13	2018-S12	ambient_light	12	Simple	SC, CC	L (lux)	wavelength (nm)				TST, SOL, WASO, AI, WAK, DDS, DLS
14	2018-S13	ambient_temperature	12	Simple	SC	Atmp (°C, °F)					TST, SOL, WASO, AI, WAK, DDS, DLS
15	2018-S14	ambient_noise	12	Simple	PH	Snd (dB)					TST, SOL, WASO, AI, WAK, DDS, DLS

Review Drafted Quantitative Schemas and Sample Data

Schema Content

- 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 (1)

```
{
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2018-02-05T21:35:00Z",
            "end_date_time": "2018-02-05T39:05:00Z",
        }
    },
    "sleep_onset_latency": {
        "value": 17.5,
        "unit": "min"
    },
    "is_main_sleep": true
}

{
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2018-04-05T21:35:00Z",
            "end_date_time": "2018-05-05T22:00:00Z",
        }
    },
    "sleep_onset_latency": {
        "value": 15.25,
        "unit": "min"
    },
    "is_main_sleep": true,
    "descriptive_statistic": "average",
    "descriptive_statistic_denominator": "d"
}
```

Ambient_Temperature_Sample_Data (1)

```
{
    "ambient_temperature": {
        "value": 75,
        "unit": "F"
    },
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2015-02-05T06:00:00Z",
            "end_date_time": "2015-02-06T06:00:00Z"
        }
    },
    "descriptive_statistic": "average"
}

{
    "ambient_temperature": {
        "value": 75,
        "unit": "F"
    },
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2015-02-05T06:00:00Z",
            "end_date_time": "2015-02-06T06:00:00Z"
        }
    },
    "descriptive_statistic": "average"
}
```

Deep_Sleep_Percentage_Sample_Data (1)


```
{
  "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"
}
```

Light_Sleep_Percentage_Sample_Data (1)


```
{
  "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": "2019-02-06T06:00:00Z"
    }
  },
  "descriptive_statistic": "average",
  "descriptive_statistic_denominator": "week"
}
```

Wake_After_Sleep_Onset_Sample_Data (1)

```
{
  "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_Sample_Data (1)


```
{
  "ambient_light": [
    {
      "light_wavelength": {
        "value": 440,
        "unit": "nm"
      },
      "light_intensity": {
        "value": 9.8,
        "unit": "lux"
      }
    },
    {
      "light_wavelength": {
        "value": 453,
        "unit": "nm"
      },
      "light_intensity": {
        "value": 10.1,
        "unit": "lux"
      }
    },
    {
      "light_wavelength": {
        "value": 461,
        "unit": "nm"
      },
      "light_intensity": {
        "value": 10.8,
        "unit": "lux"
      }
    }
  ],
  "effective_time_frame": {
    "time_interval": {
      "start_date_time": "2019-02-05T23:00:00Z",
      "end_date_time": "2019-02-06T06:00:00Z"
    }
  },
  "descriptive_statistic": "average",
  "descriptive_statistic_denominator":"week"
}
```

Sleep_Body_Movement Schema (1)

```
// sleep-body-movement schema
// version: draft 0.2
// created: 6 January 2019
// modified: 9 January 2019
// proposed revisions:
{
    "$schema": "http://json-schema.org/draft-04/schema#",
    "type": "object",
    "description": "This schema represents body movement during sleep, a simple count of the number of times movement was detected during a sleep session.
    "references": [
        {
            "description": "The SNOMED code represents Movement observable (observable entity)",
            "url": "http://purl.bioontology.org/ontology/SNOMEDCT/363847004"
        }
    ],

    "definitions": {
        "movement_unit_value": {
            "$ref": "movement-unit-value-1.x.json" // new definition required?
        },
        "time_frame": {
            "$ref": "time-frame-1.x.json"
        },
        "descriptive_statistic": {
            "$ref": "descriptive-statistic-1.x.json"
        }
    },
    "properties": {
        "movement_count": {
            "type": "number"
        },
        "effective_time_frame": {
            "description": "Effective time frame is restricted to be a time interval. For an individual measurement, this is the interval of time between
            "allOf": [
                {
                    "$ref": "#/definitions/time_frame"
                },
                {
                    "required": ["time_interval"]
                }
```

Sleep_Body_Movement Schema (2)


```
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)

```
41                ]
42            },
43            "is_main_sleep": {
44                "type": "boolean"
45            },
46            "descriptive_statistic": {
47                "$ref": "#/definitions/descriptive_statistic"
48            },
49        },
50
51        "required": [
52            "movement_count",
53            "effective_time_frame",
54            "descriptive_statistic"
55        ]
56    }
```

Sleep_Body_Movement_Sample_Data (1)


```
{
    "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 (1)

```
// 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
    "type": "object",
    "references": [
        {
            "description": "The SNOMED code represents decibel sound perception level (qualifier value)",
            "url": "http://purl.bioontology.org/ontology/SNOMEDCT/259044001" // applicable?
        }
    ],

    "definitions": {
        "noise_unit_value": {
            "$ref": "noise-unit-value-1.x.json" // new definition required?
        },
        "time_frame": {
            "$ref": "time-frame-1.x.json"
        },
        "descriptive_statistic": {
            "$ref": "descriptive-statistic-1.x.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)",
```

```
41
42      "required": [
43          "ambient_noise",
44          "effective_time_frame",
45          "descriptive_statistic"
46      ]
47  }
```

Ambient_Noise _Sample_data(1)


```
{
    "ambient_noise": {
        "value": 70,
        "unit": "dBA"
    },
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2019-02-05T06:00:00Z",
            "end_date_time": "2019-02-06T06:00:00Z"
        }
    },
    "descriptive_statistic": "average"
}

{
    "ambient_noise": {
        "value": 30,
        "unit": "dBA"
    },
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2019-02-05T06:00:00Z",
            "end_date_time": "2019-02-06T06:00:00Z"
        }
    },
    "descriptive_statistic": "average"
}
```

Sleep _Apnea Schema(1)

```
// sleep-apnea schema
// version: draft 0.2
// created: 7 January 2019
// modified: 5 Febuary 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
    "type": "object",
    "references": [
        {
            "description": "The SNOMED code represents dApnea Hypopnea Index (assessment scale)",
            "url": "http://purl.bioontology.org/ontology/SNOMEDCT/716202005"
        }
    ],

    "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_seal": {
            "type": "number"
        },
        "mask_on_off": {
            "type": "number"
        },
        "ahi": {
            "type": "number"
        }
    },
```

Sleep _Apnea Schema(2)

```
schema for a list of aggregate measures)",
```

```
41
42      "required": [
43          "usage_hours",
44          "ahi"
45      ]
46  }
47
```

Arousal_Rate Schema (1)

```
{
    "$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.
    "references": [ ],

  "definitions": {
    "frequency_rate_value": {
      "$ref": "frequency-unit-value-1.x.json"
    },
    "time_frame": {
      "$ref": "time-frame-1.x.json"
    },
    "descriptive_statistic": {
      "$ref": "descriptive-statistic-1.x.json"
    }
  },
  "properties": {
    "arousal_rate": {
      "allOf": [
        {
          "$ref": "#/definitions/frequency_unit_value"
        },
        {
          "properties": {
            "number of times": {
            },
            "time_window": {
              "allOf": [
                {
                  "$ref": "#/definitions/duration"
                },
                {
                  "properties": {
                    "unit": {
                      "enum": [
                        "h"
                      ]
                    }
                  }
```

Arousal_Rate Schema (2)

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

```
                    }
                  ]
                }
              }
            }
          ]
        },
        "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
          "allOf": [
            {
              "$ref": "#/definitions/time_frame"
            },
            {
              "required": [ "time_interval" ]
            }
          ]
        },
        "is_main_sleep": {
          "type": "boolean"
        },
        "descriptive_statistic": {
          "$ref": "#/definitions/descriptive_statistic"
        }
      },

      "required": [
          "arousal_rate",
          "effective_time_frame"
      ]
}
```

```
 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.",
```

Arousal_Rate_Sample_Data Schema (1)

```
{
  "number_of_times": 3,
  "time_window": {
    "unit": "h"
  },
  "effective_time_frame": {
    "time_interval": {
      "start_date_time": "2019-02-05T22:00:00Z",
      "end_date_time": "2019-02-06T06:00:00Z"
    }
  },
  "descriptive_statistic": "average"
}
```

Snore_Count Schema (1)

```
{
    "$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
    "references": [ ],

  "definitions": {
    "duration_unit_value": {
      "$ref": "duration-unit-value-1.x.json"
    },
    "unit_value": {
      "$ref": "unit-value-1.x.json"
    },
    "time_frame": {
      "$ref": "time-frame-1.x.json"
    },
    "descriptive_statistic": {
      "$ref": "descriptive-statistic-1.x.json"
    },
    "descriptive_statistic_denominator": {
      "$ref": "descriptive-statistic-denominator-1.x.json"
    }
  },
  "properties": {
    "snore_durations": {
      "description": "An array of snore durations to describe each snore bouts during an entire sleep session (main or nap). The duration for each snore bout is the time
      "type": "array",
      "contains": {
        "all of": [
          {
            "$ref": "#/definitions/duration_unit_value"
          },
          {
            "properties": {
              "unit": {
                "enum": [
                  "sec",
                  "min",
                  "h"
                ]
```

Snore_Count Schema(2)

```
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 Schema (3)

```
41                  }
42                }
43              }
44            ]
45          }
46        },
47        "snore_count": {
48          "type": "integer"
49        },
50        "effective_time_frame": {
51          "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
52          "allOf": [
53            {
54              "$ref": "#/definitions/time_frame"
55            },
56            {
57              "required": [ "time_interval" ]
58            }
59          ]
60        },
61        "is_main_sleep": {
62          "type": "boolean"
63        },
64        "descriptive_statistic": {
65          "$ref": "#/definitions/descriptive_statistic"
66        },
67        "descriptive_statistic_denominator": {
68
69          "anyOf": [
70            {
71              "$ref": "#/definitions/descriptive_statistic_denominator"
72            },
73            {
74              "description": "If the value needed is a standard unit of duration, select from the duration-unit-value value set.",
75              "type": "string"
76            }
77          ]
78        }
79      },
80
```

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.",
```

```
81      "required": [
82          "snore_count",
83          "effective_time_frame"
84      ]
85  }
```

Snore_Count_Sample_Data (1)


```
{
  "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