A Computer Adaptive Testing (CAT) approach to Patient Reported Outcomes (PROs)
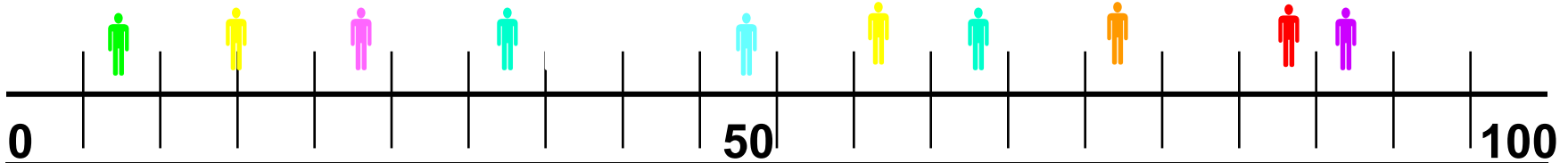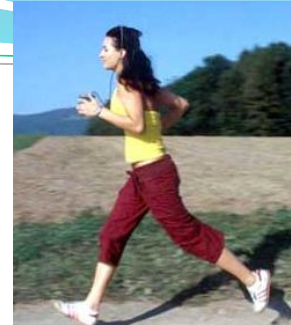
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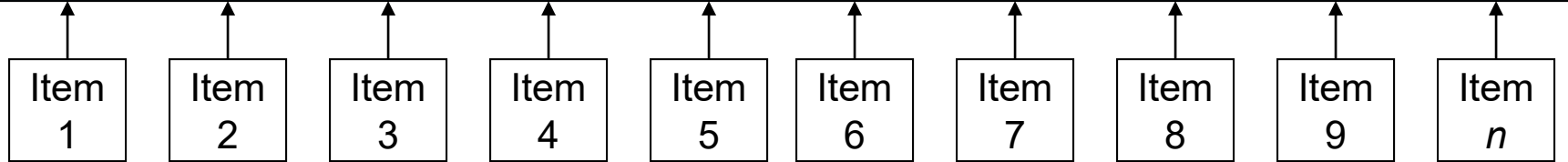
What are Patient-Reported Outcomes?

- Any report of the status of a patient's health condition that comes directly from the patient, without interpretation of the patient's response by a clinician or anyone else[1]

- Examples of PROs:
  - Pain, fatigue, sexual functioning, depressive symptoms
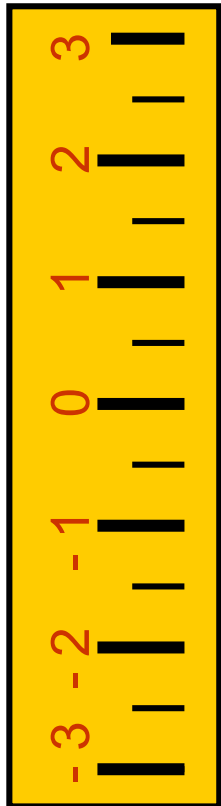
[1]FDA *Guidance for Industry* 2009

Physical Functioning Item Bank

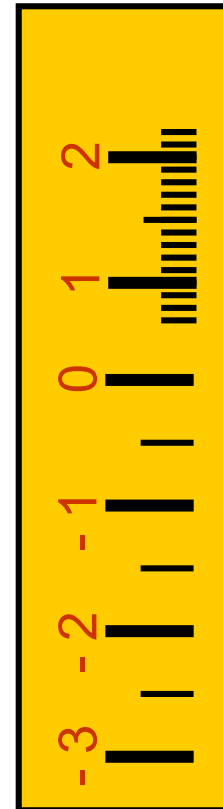| Item 1 | Item 2 | Item 3 | Item 4 | Item 5 | Item 6 | Item 7 | Item 8 | Item 9 | Item n |

- Are you able to run five miles?
- Are you able to run or jog for two miles?
- Are you able to walk a block on flat ground?
- Are you able to walk from one room to another?
- Are you able to stand without losing your balance for 1 minute?
- Are you able to get in and out of bed?

Static vs. dynamic approach

Questionnaire
with a wide range -
but low precision

Questionnaire
with a wide range -
high precision

PROMIS SF v1.0 - Phys. Function 10a
(n=10)

PROMIS Bank v1.1 - Physical Function
(n=124)

Computerized Adaptive Tests

- Utilize a large bank of items
- After participant answers first item, estimated score is calculated.
- CAT then selects from bank best item (targeting where patient is at) and re-calculates score with next response.
- Continues until stopping rule is met (e.g., # of items, size of error)
- NOT just simple branching – requires software and scoring/administration algorithm

PROMIS and Assessment Center

- Patient Reported Outcomes Measurement Information System (PROMIS)

http://www.nihpromis.org

- Turn-key software solution for CAT administration of PROMIS Item banks.
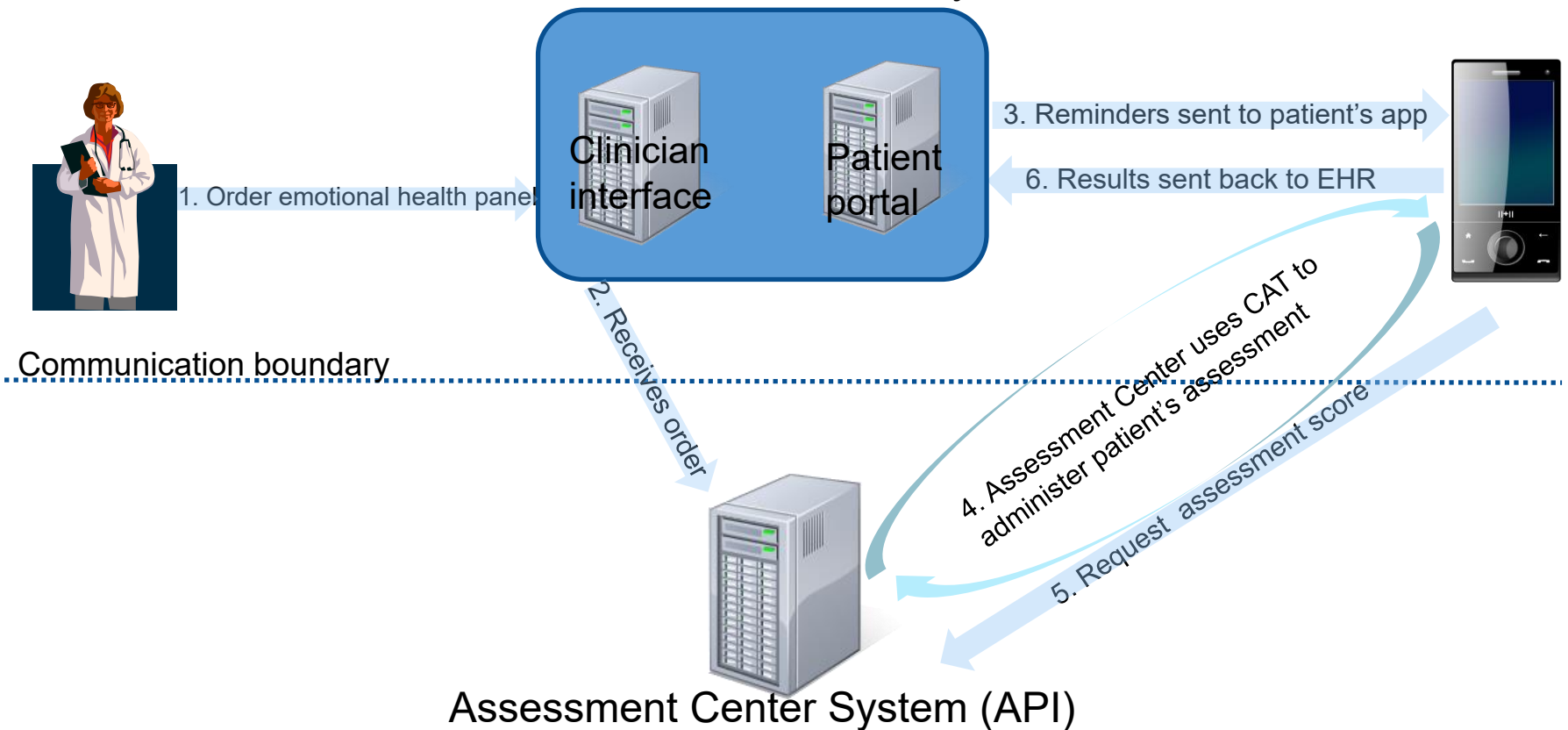
https://www.AssessmentCenter.net

Clinical Use Case

- How can I use this in a mHealth solution or integrate this with an Electronic Health Record (EHR)?

- Routine physical exam
  - Order complete blood panel

  - Psycho-social panel/screening

Case study walk through

Electronic Health Record System

3. Reminders sent to patient's app

6. Results sent back to EHR

Clinician interface

Patient portal

1. Order emotional health panel

2. Receives order

Communication boundary

4. Assessment Center uses CAT to administer patient's assessment

5. Request assessment score

Assessment Center System (API)

API Features

- What instruments are available?

- How do I order a participant assessment?

- How do I administer an instrument to a participant?

- How do I get the participant score?

> **Read about how to use the APIs:**
> - Form APIs
> - Calibration APIs
> - Starting an Assessment APIs
> - Administering an Assessment APIs
> - Scoring an Assessment APIs
> - Usage APIs

API General Instructions

- All request use basic authentication
- All keys are [Universally unique identifier](#) (UUID)
- Naming convention for versioning will be Year-Month
- Response Format can be designated by .json or .xml

- Based on twilio (http://www.twilio.com/docs/api/rest)

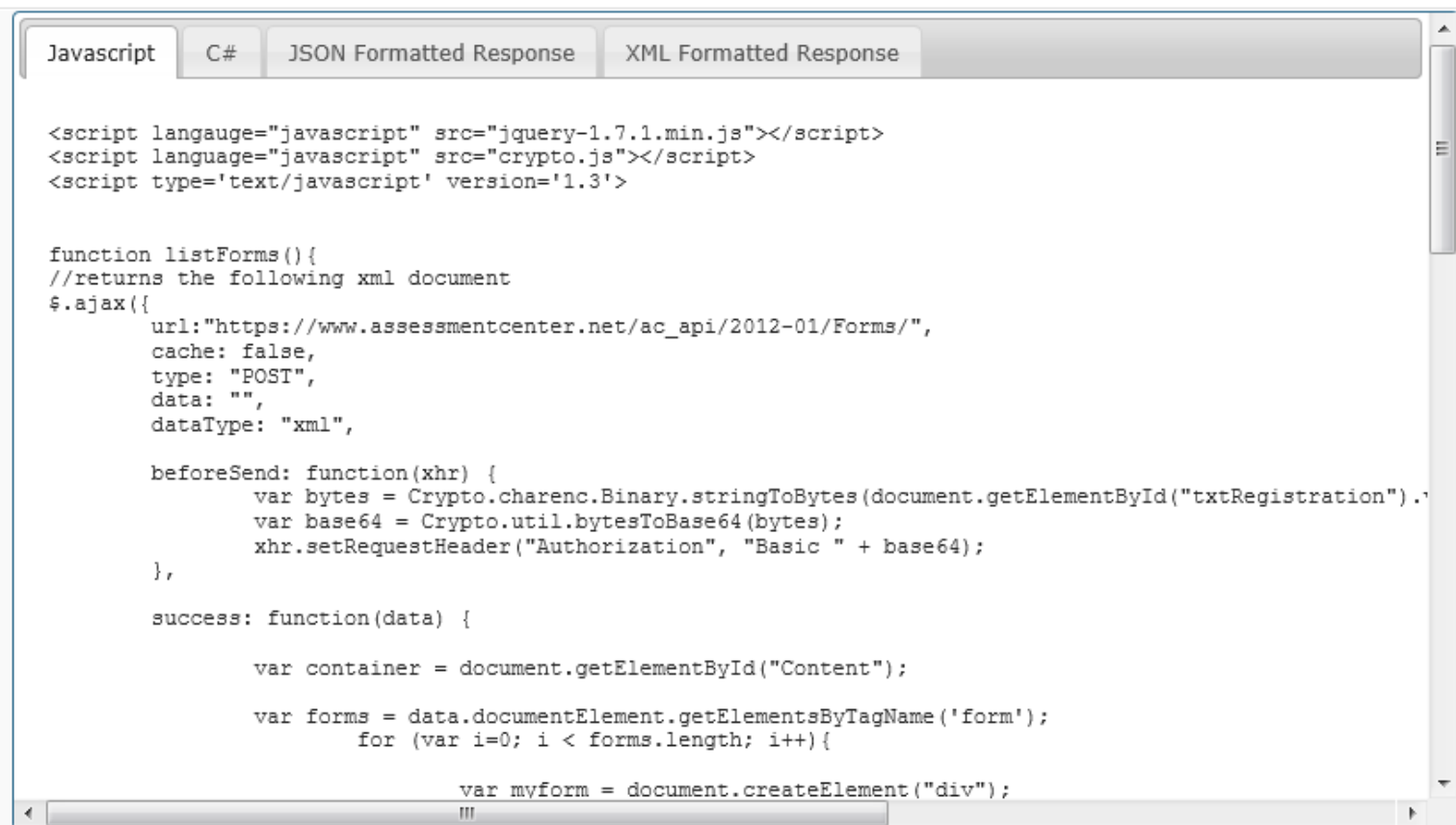[https://www.AssessmentCenter.net/ac_api/2012-01/Forms/.json](#)
(Returns an array of all Item banks that are available through the API)

[https://www.AssessmentCenter.net/ac_api/2012-01/Forms/D2FA612D-...-.xml](#)
(Returns the content of the PROMIS Bank V1.0 Anger)

API sample/documentation

Sample code for https://www.assessmentcenter.net/ac_api/2012-01/Forms

```
<script langauge="javascript" src="jquery-1.7.1.min.js"></script>
<script language="javascript" src="crypto.js"></script>
<script type='text/javascript' version='1.3'>


function listForms(){
//returns the following xml document
$.ajax({
        url:"https://www.assessmentcenter.net/ac_api/2012-01/Forms/",
        cache: false,
        type: "POST",
        data: "",
        dataType: "xml",

        beforeSend: function(xhr) {
                var bytes = Crypto.charenc.Binary.stringToBytes(document.getElementById("txtRegistration").
                var base64 = Crypto.util.bytesToBase64(bytes);
                xhr.setRequestHeader("Authorization", "Basic " + base64);
        },

        success: function(data) {

                var container = document.getElementById("Content");

                var forms = data.documentElement.getElementsByTagName('form');
                        for (var i=0; i < forms.length; i++){

                                var myform = document.createElement("div");
```

API Example - Registration

- User Registration process will Email a User ID and Token which will be used for all Basic Authentication

- Email will contain an activation link

API Example - Instrument

Return all available Instrument

- https://AssessmentCenter.net/AC_API/2012-01/Forms/.json

```
{
    "Form": [
        {
            "OID": "8D79D960-EC12-4242-AE66-03EF8EF4D61D",
            "Name": "PROMIS Bank v2.0 – Social Isolation"
        }, …
    ]
}
```

Return a single Instrument

- https://AssessmentCenter.net/AC_API/2012-01/Forms/{OID}.json

OID = Unique Identifier of the specific resource

```
{ "Items": [{"ID": "1698bR1",
            "Elements": [
            {  "ElementOID": "C08BDEB7-358E-4CB6-BD43-54A234D2D75A",
            "Map": [
            {"Description": "Never",
              "FormItemOID": "F6EE37A6-9778-4E5A-86A3-183D3A370FD3",
              "ItemResponseOID": "66C35D32-BD2A-4090-86F1-FF305A94A2DB",
```
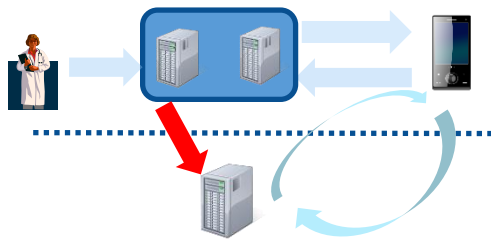
API Example - Assessment Order

Task: How to administer an Anger assessment

Resource: Assessments

Request:
https://www.AssessmentCenter.net/ac_api/2012-01/**Assessments/D2FA612D-...8C.json**

Response:
```
{
    "OID":"901a493b-7a6e-4711-b483-82ab100fe430",
    "UID":""
    "Expiration":"10/21/2012 12:13:57 PM"
}
```
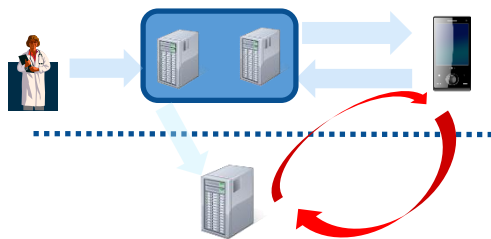
API Example - Participant Administration

Task: How to present an item to the participant

Resource: Participant

Request:
https://www.AssessmentCenter.net/ac_api/2012-01/**Participant/901A-...30.json**

Returned API results

In the past 7 days

I felt fearful

| Never |
| Rarely |
| Sometimes |
| Often |
| Always |

Response:
```
{
    "FormItemOID":"..",
    "ItemOID":"..",
    "Elements": [.., {I felt fearful}]
    "Map": [{Never},{Rarely},…]
}
```

API Example - Scores
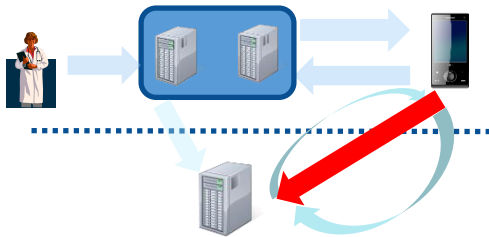
Task: How to retrieve the results of an assessment
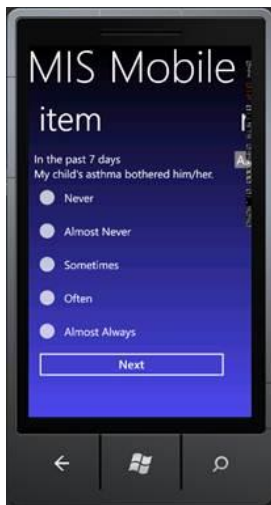
Resource: Results

Request:
https://www.AssessmentCenter.net/ac_api/2012-01/**Results/901A-...30.json**

Response:
{ **"DateFinished":".. ",**
   "FormItemOID":".. ", **"Theta":"…", " StdError":"…"**,
   "ItemOID":",
   "ElementOID":"…"
}

Early Adopters/Beta users

Dennis R. Crain, MN
Microsoft Research

Andrew B Martin PhD
Stanford University

Gabe Saravia
Northwestern University

Ming-Chih Kao
Stanford University

Next Steps

- Cloud installation

- Privacy/Security