



Healthcare Provider Directory Prototype





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Healthcare Provider Directory Prototype

- Purpose

- Explore the technical considerations required to build a healthcare directory for federal partners

- Goals

- Deliver working software that demonstrates multiple facets of a successful healthcare provider directory
 - Explore relevant standards: RESTful APIs, IHE HPD protocols, FHIR
 - Expose human and machine interfaces for maximum flexibility
 - Handle complex queries
 - Analyze approaches for information verification and reliability
- Explore implementing Call to Action from the Draft ONC Interoperability Roadmap

*“Block 4 Core Technical Standards and Functions, 2015-2017: ONC will recommend to CMS that **NPPES implement support for the provider directory information query API and data model as specified in the IHE HPD Profile.** CMS should maintain Direct addresses and ESI in NPPES”*

- Provide useful input to the FHA Healthcare Directory Workgroup efforts



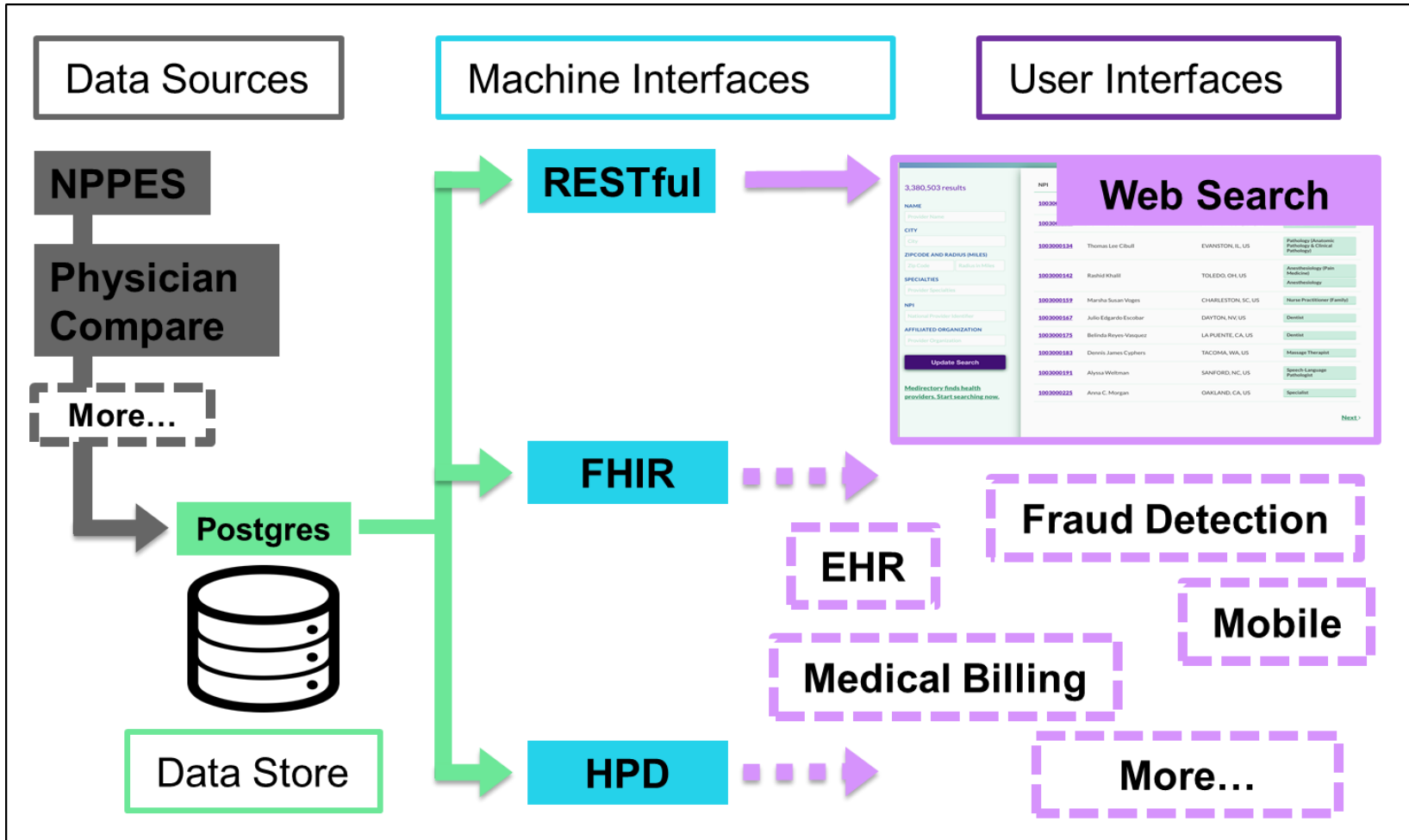


Prototype Functionality Implemented

- Data set populated using the NPPES provider and organization data and the Physician Compare organization mapping data
- Robust RESTful interface, designed for machine-to-machine communication, supporting
 - Search by basic information like name, location, specialty, and NPI
 - Complex queries using organizational relationships
 - Search using Boolean operators such as OR, AND, and NOT
 - Geospatial search, searching within a radius
- Web interface to demonstrate interactions with the RESTful interface, essentially a JavaScript client to the RESTful interface
- FHIR interface, supporting Practitioner and Organization FHIR resources
- IHE HPD protocol support (SOAP + DSML)



High Level Architecture



*Solid lines indicate implemented interfaces, dashed lines indicate potential interfaces





Machine Interface Implementations

1. Basic RESTful Interface
2. FHIR RESTful Interface
3. IHE HPD



Basic RESTful Interface

- Designed for machine-to-machine communication
- Simple example, searching for a provider by name and specialty

Request



GET /api/v1/providers?q=smith+pediatrics

Response



```
{
  "meta": {
    "totalResults": 850,
    "resultsPerPage": 10
  },
  "providers": [
    {
      "npi": 1366603326,
      "last_name_legal_name": "HERZOG",
      "first_name": "KATHERINE",
      "middle_name": "SMITH",
      ...
    }
  ]
}
```



RESTful Interface Complex Queries

- More complex example, parameterized searching for a provider by name, specialty, and organization

```
GET /api/v1/providers?name=smith&organization=hopkins&taxonomy=Pediatrics
```

```
{
  "meta": {
    "totalResults": 3,
    "resultsPerPage": 10
  },
  "providers": [
    {
      "npi": 1871525105,
      "last_name_legal_name": "SMITH-RESAR",
      "first_name": "LINDA",
      ...
    }
  ]
}
```




User Interfaces

- A single RESTful backend can support multiple user interfaces
 - Each user interface can be designed to target a different group of users with their own usage scenarios
 - A machine interface can also be integrated into existing tools and workflows in addition to supporting new tools
 - All interfaces can share the querying power of the backend interface
- The following slides show examples of one user interface built to communicate with and demonstrate the RESTful API



Basic Query

27,471 results

QUERY

Smith

Update Search

[Medirectory finds health providers. Start searching now.](#)

NPI	NAME	PRACTICE LOCATION	SPECIALTIES
1023083326	Larry Dean Smith	FORT MADISON, IA, US	Optometrist
1194883777	Robert Holland Smith	ROSWELL, GA, US	Dentist
1578538245	Carolyn Ruth Smith	FORT MADISON, IA, US	Optometrist
1598823213	Christopher Holland Smith	ROSWELL, GA, US	Dentist
1043378664	Frederick Jarden Meadows	ROSWELL, GA, US	Dentist
1295714145	Kristin Kay Maus	FORT MADISON, IA, US	Optometrist
1396991204	Kenisha Emica Hoyle-Smith	HEMPHILL, TX, US	Licensed Vocational Nurse
1790880094	Troy .L Smith	ALVA, OK, US	Optometrist Eyewear Supplier (Equipment, not the service)
1932495991	Daniel Ross Sliwinski	FORT MADISON, IA, US	Optometrist
1003215351	Tracy Lynn Turman	FORT SMITH, AR, US	Physical Therapist

[Next >](#)



Detailed Information

[← return to results](#)

[Medirectory finds health providers. Start searching now.](#)

♂ **David Lee Smith**

1083637961

GROUP AFFILIATIONS

[David L & Stanley J Smith Ptrs \(Smith Medical Clinic\)](#)

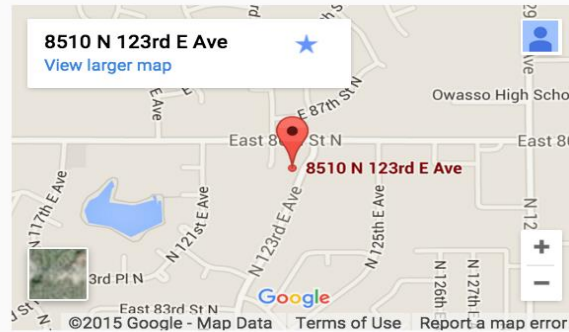
Direct Project SMTP david.smith@smithmedicalclinic.com

PRACTICE LOCATION INFORMATION

[\(918\) 272-1138](#)

(918) 274-2931

8510 North 123rd East Avenue
OWASSO, OK, 74055, US

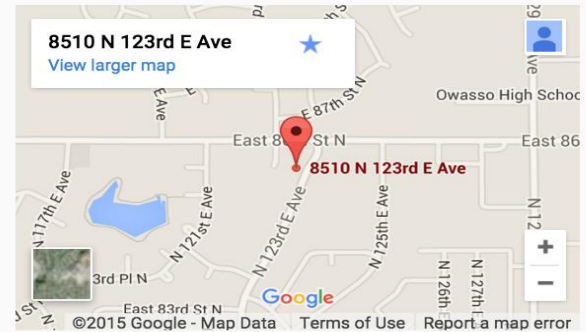


MAILING INFORMATION

[\(918\) 272-1138](#)

(918) 274-2931

8510 North 123rd East Avenue
OWASSO, OK, 74055, US



LICENSES

SPECIALTY

LICENSE NUMBER

STATE

Family Medicine

2231

OK



Complex Parameterized Query

3 results

NAME

CITY

ZIPCODE AND RADIUS (MILES)

SPECIALTIES

NPI

AFFILIATED ORGANIZATION

Update Search

[Medirectory finds health providers. Start searching now.](#)

NPI	NAME	PRACTICE LOCATION	SPECIALTIES
1871525105	Linda Smith-Resar	BALTIMORE, MD, US	Internal Medicine (Hematology & Oncology) Pediatrics (Pediatric Hematology-Oncology)
1043314214	Hermon W Smith	BALTIMORE, MD, US	Pediatrics
1669478335	Rachelle Ann Smith	BALTIMORE, MD, US	Internal Medicine Pediatrics

All results shown.



Searching For Organizations

17 results

ORGANIZATION NAME

CITY

ZIPCODE AND RADIUS (MILES)

SPECIALTIES

NPI

AFFILIATED PROVIDER

AUTHORIZED OFFICIAL

Update Search

[Medirectory finds health providers. Start searching now.](#)

NPI	NAME	PRACTICE LOCATION	SPECIALTIES
1649267170	Johns Hopkins University	BALTIMORE, MD, US	Pediatrics (Pediatric Gastroenterology)
1285621714	Johns Hopkins University	BALTIMORE, MD, US	Pediatrics (Pediatric Pulmonology)
1902072283	Hopkins County Physician Services	SULPHUR SPRINGS, TX, US	Obstetrics & Gynecology Urology Surgery Pediatrics Orthopaedic Surgery Otolaryngology (Plastic Surgery within the Head & Neck) Family Medicine
1568459097	Johns Hopkins University	BALTIMORE, MD, US	Pediatrics (Pediatric Emergency Medicine)
1659368181	Johns Hopkins University	BALTIMORE, MD, US	Pediatrics (Pediatric Rheumatology)
1023018413	Johns Hopkins University	BALTIMORE, MD, US	Pediatrics (Pediatric Allergy/Immunology)
1467639260	Johns Hopkins Community Physicians, Inc.	BALTIMORE, MD, US	Internal Medicine Pediatrics Obstetrics & Gynecology Family Medicine



Searching With Partial Information Using *

1 results

NAME

CITY

ZIPCODE AND RADIUS (MILES)

SPECIALTIES

NPI

AFFILIATED ORGANIZATION

Update Search

NPI	NAME	PRACTICE LOCATION	SPECIALTIES
1285870238	Susana George Kulangara	BROOKLYN, NY, US	Dentist

All results shown.

[Medirectory finds health providers. Start searching now.](#)



Searching With Uncertain Information Using OR

2 results

NAME

CITY

ZIPCODE AND RADIUS (MILES)

SPECIALTIES

NPI

AFFILIATED ORGANIZATION

Update Search

NPI	NAME	PRACTICE LOCATION	SPECIALTIES
1205072238	Murray Lee Kane	MIAMI, FL, US	Pediatrics
1215959515	Jason Marc Kane	CHICAGO, IL, US	Pediatrics (Pediatric Critical Care Medicine)

All results shown.

[Medirectory finds health providers. Start searching now.](#)



Geospatial Search

2 results

NAME

Smith

CITY

City

ZIPCODE AND RADIUS (MILES)

21202

0.5

SPECIALTIES

Pediatrics

NPI

National Provider Identifier

AFFILIATED ORGANIZATION

Provider Organization

Update Search

NPI	NAME	PRACTICE LOCATION	SPECIALTIES
1043314214	Hermon W Smith	BALTIMORE, MD, US	Pediatrics
1669478335	Rachelle Ann Smith	BALTIMORE, MD, US	Internal Medicine Pediatrics

All results shown.

[Medirectory finds health providers. Start searching now.](#)



Machine Interface Implementations

1. Basic RESTful Interface
2. FHIR RESTful Interface
3. IHE HPD Interface



FHIR RESTful Interface

- HL7 next generation standards framework
- Simple example, searching for a provider by name

Request



GET /fhir/practitioners.json?name=smith

Response



```
{
  "total": 21782,
  "entry": [
    {
      "resource": {
        "resourceType": "Practitioner",
        "name": {
          "resourceType": "HumanName",
          "use": "official",
          "text": "ZADIE SMITH",
          "family": [
            "SMITH"
          ],
        },
      },
    },
    ...
  ]
}
```



Machine Interface Implementations

1. Basic RESTful Interface
2. FHIR RESTful Interface
3. IHE HPD Interface



IHE HPD Interface

- SOAP and DSML based standards framework supporting Healthcare Provider Directories

The screenshot shows a web browser window with the address bar displaying `http://localhost:3000/hpd/endpoint`. The browser is displaying two panels of XML data. The left panel shows the request XML, and the right panel shows the response XML.

Request XML (Left Panel):

```
<soap-env:Envelope xmlns:soap-env="http://www.w3.org/2003/05/soap-envelope" xmlns:dsml="http://www.w3.org/2003/05/dsml" >
  <soap-env:Body>
    <dsml:batchRequest requestID="{=project.name}_">{=te
      <dsml:searchRequest dn="ou=HcProfessional,{#Proj
        <dsml:filter>
          <dsml:equalityMatch name="givenName">
            <dsml:value>Thomas</dsml:value>
          </dsml:equalityMatch>
        </dsml:filter>
        <!--dsml:attributes-->
        </dsml:attributes-->
      </dsml:searchRequest>
    </dsml:batchRequest>
  </soap-env:Body>
</soap-env:Envelope>
```

Response XML (Right Panel):

```
<soap:Envelope xmlns:soap="http://www.w3.org/2003/05/soap-envelope" xmlns:dsml="http://www.w3.org/2003/05/dsml" >
  <soap:Body>
    <dsml:batchResponse>
      <dsml:searchResponse>
        <dsml:searchResultEntry dn="">
          <dsml:attr name="givenName">
            <dsml:value>THOMAS</dsml:value>
          </dsml:attr>
          <dsml:attr name="sn">
            <dsml:value>CLAYTON</dsml:value>
          </dsml:attr>
          <dsml:attr name="pager"/>
          <dsml:attr name="uid"/>
          <dsml:attr name="mail"/>
          <dsml:attr name="hpdproviderlegaladdress"/>
          <dsml:attr name="hcspecialisation">
            <dsml:value/>
          </dsml:attr>
          <dsml:attr name="hpdproviderlanguagesupported"/>
          <dsml:attr name="hpdproviderpracticeaddress">
            <dsml:value>3230 STATE ROUTE 257 , SENECA, PA 163462
          </dsml:attr>
          <dsml:attr name="telephonenumber">
            <dsml:value>8146773881</dsml:value>
          </dsml:attr>
          <dsml:attr name="facsimiletelephonenumber">
            <dsml:value>8146773881</dsml:value>
          </dsml:attr>
          <dsml:attr name="cn"/>
          <dsml:attr name="initials"/>
          <dsml:attr name="description"/>
          <dsml:attr name="hcprofession">
            <dsml:value>Chiropractor</dsml:value>
          </dsml:attr>
          <dsml:attr name="hpdproviderbillingaddress"/>
          <dsml:attr name="objectclass"/>
          <dsml:attr name="hpdhasaservice"/>
          <dsml:attr name="hpdprovidermailingaddress">
            <dsml:value>PO BOX 406 , SENECA, PA 163460406</dsml:
          </dsml:attr>
          <dsml:attr name="hcidentifier"/>
          <dsml:attr name="mobile"/>
          <dsml:attr name="title">
            <dsml:value/>
          </dsml:attr>
          <dsml:attr name="gender">
            <dsml:value>M</dsml:value>
          </dsml:attr>
        </dsml:searchResultEntry>
      </dsml:searchResponse>
    </dsml:batchResponse>
  </soap:Body>
</soap:Envelope>
```

The browser interface includes a status bar at the bottom showing "response time: 2646ms (15789 bytes)" and "15:21".





Analysis of Machine Interface Approaches

Interface	Standards Basis	History Of Adoption	Domain Requirement Support	Ease of Development
IHE HPD	Only current standard directed primarily at supporting healthcare directories	Many pilot efforts have explored implementation	Extensions to the base standard (ie HPD+) have been created to address specific needs such as supporting the S&I Provider Directory data model, which includes ESI.	Use of SOAP and DSML creates significant development overhead
FHIR	Upcoming HL7 standard that supports healthcare directory concepts	Wide interest but not yet broadly adopted	Not targeted towards health care directory specific requirements, but can be extended using FHIR profiles	RESTful approach streamlines implementation, but use of profiles would add overhead
Basic REST	Uses common internet standards, but not formalized to healthcare directory domain	Widely used with broad success across many domains, though not necessarily specifically to healthcare directories	Can easily be tailored to domain specific needs like complex queries, complex provider and organization relationships, geospatial search, and ESI	Lowest implementation overhead of all approaches



Findings and Lessons Learned

- This prototype successfully demonstrated key technical considerations of a Healthcare Directory
 - Machine-to-machine interfaces provide the flexibility needed to support diverse usage scenarios and workflows
 - User interfaces with advanced functionality for complex queries and geospatial searching are straight forward to implement with a RESTful backend
- IHE HPD is significantly more difficult to implement than simpler RESTful approaches, including custom interfaces or FHIR based interfaces
 - Therefore, the ONC Interoperability Roadmap's Call to Action should favor RESTful approaches over IHE HPD implementations
- Using RESTful approaches covers the high-impact technical considerations from the FHA HcDir Workgroup



Challenges

- Data stewardship and governance is the primary challenge for developing a Provider Directory
 - Identifying good sources of existing data is difficult
 - Ensuring data validity and keeping data updated is a challenge
- Distinct target environments may have distinct querying requirements



Recommended Next Steps

- Conduct pilots of Healthcare Directories
 - Validate current understanding of requirements
 - Gain practical understanding of real world challenges, issues, costs, impacts, etc.
 - Get feedback from end users before large investments make it difficult to change directions
 - Learn best practices that can be applied to larger deployments
 - Ideally perform pilots at multiple sites with diverse usage scenarios to ensure lessons learned are broadly applicable



Project Deliverables

- The project completed September 2015
- Deliverable goals are to
 - Communicate all results and lessons learned
 - Transparently support any possible follow-on FHA or agency Healthcare Directory pilot projects
- Project deliverables include
 - Open source project source code
 - Complete instructions for setup or deployment
 - API documentation supporting developer integration
 - See <https://github.com/Medirectory/medirectory>
 - This final presentation documenting approach, results, lessons learned and recommended next steps