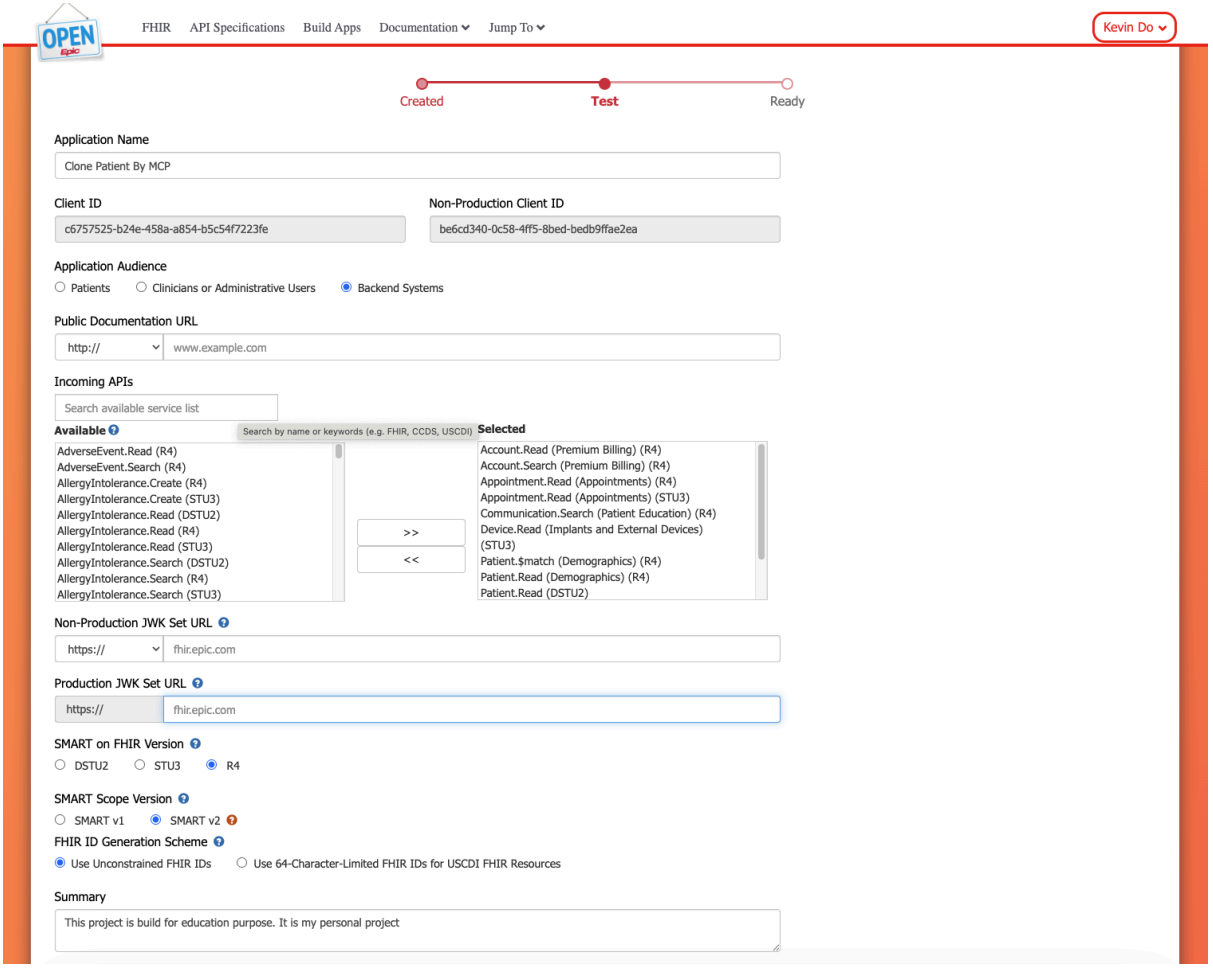
Epic setup

Create sandbox app

Go to Build App -> Create



Enter the application name and select the API you want to use. We'll use the **Patient.Read (R4)** API to perform a patient search.

Using a JWT to Obtain an Access Token for a Backend Service

Create public private key for JWT token : OpenSSL

You can create a new private key named `privatekey.pem` using OpenSSL with the following command:

```
openssl genrsa -out /path_to_key/privatekey.pem 2048
```

Make sure the key length is at least 2048 bits.

For backend apps, you can export the public key to a base64 encoded X.509 certificate named `publickey509.pem` using this command:

```
openssl req -new -x509 -key /path_to_key/privatekey.pem -out
/path_to_key/publickey509.pem -subj '/CN=myapp'
```

Where `'/CN=myapp'` is the subject name (for example the app name) the key pair is for. The subject name does not have a functional impact in this case but it is required for creating an X.509 certificate.

Publish public key

You must implement and expose an endpoint that Epic can call to obtain your public key, which is used to verify your JWT signatures.

Note: Youcan use ngrok to expose endpoint to allow Epic call and verified private key **at least once**

```
using System.Security.Cryptography.X509Certificates;
using DotNetEnv;

var builder = WebApplication.CreateBuilder(args);
var app = builder.Build();

Env.Load("../.env");

var keyId = Environment.GetEnvironmentVariable("EPIC:KEYID");

string home =
Environment.GetFolderPath(Environment.SpecialFolder.UserProfi
le);
string pemPath = Path.Combine(home, "publickey509.pem");

string pem = File.ReadAllText(pemPath);
var cert = X509Certificate2.CreateFromPem(pem);


// Extract RSA public key
using var rsa = cert.GetRSAPublicKey();

// Export modulus/exponent for JWK
var parameters = rsa.ExportParameters(false);
```

```
string Base64UrlEncode(byte[] input) =>
   Convert.ToBase64String(input)
       .TrimEnd('=')
       .Replace('+', '-')
       .Replace('/', '_');

var jwk = new
{
   kty = "RSA",
   kid = keyId,
   use = "sig",
   alg = "RS384", // must match your signing algorithm
   n = Base64UrlEncode(parameters.Modulus),
   e = Base64UrlEncode(parameters.Exponent)
};

app.MapGet("/.well-known/jwks.json", () => new { keys = new[]
{ jwk } });

app.Run();
```

Create JWT and make http request call

```
string home =
Environment.GetFolderPath(Environment.SpecialFolder.UserProfi
le);
string pemPath = Path.Combine(home, "privatekey.pem");
string pem = File.ReadAllText(pemPath);
var rsa = RSA.Create();
rsa.ImportFromPem(pem);

var credentials = new SigningCredentials(new
RsaSecurityKey(rsa), SecurityAlgorithms.RsaSha384);

var payload = new JwtPayload
{
```

```
   { "iss", _config["EPIC:CLIENT_ID"] },
   { "sub", _config["EPIC:CLIENT_ID"] },
   { "aud", _config["EPIC:AUDIENCE"] },
   { "kid", _config["EPIC:KID"]},
   { "jti", Guid.NewGuid().ToString() },
   { "exp",
DateTimeOffset.UtcNow.AddMinutes(4).ToUnixTimeSeconds() }
};
```

Note: The exp claim in the JWT must be set to a time no more than **5 minutes** after the token is issued. A value between **1 and 4 minutes** is recommended to ensure the JWT remains valid.

```
var header = new JwtHeader(credentials);
   var jwt = new JwtSecurityToken(header, payload);

   var handler = new JwtSecurityTokenHandler();
   var assertion = handler.WriteToken(jwt);

   var content = new FormUrlEncodedContent(new[]
   {
       new KeyValuePair<string, string>("grant_type",
"client_credentials"),
       new KeyValuePair<string, string>("client_id",
_config["EPIC:CLIENT_ID"]),
       new KeyValuePair<string,
string>("client_assertion_type",
"urn:ietf:params:oauth:client-assertion-type:jwt-bearer"),
       new KeyValuePair<string, string>("client_assertion",
assertion )
   });


   var response = await
_client.PostAsync("https://fhir.epic.com/interconnect-fhir-oa
uth/oauth2/token", content);
   var responseBody = await
response.Content.ReadAsStringAsync();
   if (!response.IsSuccessStatusCode)
```

```
    {
        Console.WriteLine($"Epic token request failed:
{response.StatusCode} - {responseBody}");
        throw new Exception($"Epic token request failed:
{response.StatusCode} - {responseBody}");
    }
    using var doc = JsonDocument.Parse(responseBody);
    return
doc.RootElement.GetProperty("access_token").GetString();
}
```

MCP Server

MCP server tools:

```
using System.ComponentModel;
using System.Globalization;
using ModelContextProtocol.Server;

namespace McpServer.Tools;

[McpServerToolType]
public class GetPatientDataTool
{
    private readonly IEpicClient _epicClient;
    private readonly IPostgresService _postgresService;

    public GetPatientDataTool(IEpicClient epicClient,
IPostgresService postgresService)
    {
        _epicClient = epicClient;
        _postgresService = postgresService;
    }

    [McpServerTool, Description("This tools help get access
```

```
token")]
    public async Task<string> GetAccessToken()
    {
        try
        {
            return await _epicClient.GetAccessToken();
        }
        catch (Exception ex)
        {
            return ex.Message;
        }
    }

    [McpServerTool, Description(
         "This tool helps get patient data, extract json
result string to show how many patient found and " +
         "detail of information found, after that prompt to
the user if they want to use the tool to persist data into
postgres, keep result of this tools to be the input of
Persist Data Tool call")]
    public async Task<string> GetPatientInformation(string
family, string given, string birthdate, string accessToken)
    {
        try
        {
            if (string.IsNullOrEmpty(family) ||
string.IsNullOrEmpty(given) ||
string.IsNullOrEmpty(birthdate))
            {
                return "Bad request these field cannot be
null";
            }

            if (!DateTime.TryParseExact(
                    birthdate,
                    "yyyy-MM-dd",
                    CultureInfo.InvariantCulture,
                    DateTimeStyles.None,
                    out _))
```

```
            {
                return "Bad request the birth date format must
be yyyy-MM-dd";
            }


            return await
_epicClient.GetInformationOfPatient(family, given, birthdate,
accessToken);

        }
        catch (Exception ex)
        {
            return ex.Message;
        }
    }

    [McpServerTool,
     Description(
         "This tool help persistence data for patient. This
use input which is the result from Get Patient Information
tool and also use given and family name from this call. This
tool cannot be called if user haven't made any successfully
call to register")]
    public async Task<string> PersistPatientInformation(string
family, string given, string jsonResult)
    {
        try
        {
            return await
_postgresService.PersistPatentData(family, given,
jsonResult);
        }
        catch (Exception ex)
        {
            return ex.Message;
        }
    }
}
```

Epic Client

```
using System.IdentityModel.Tokens.Jwt;
using System.Net.Http.Headers;
using System.Security.Cryptography;
using System.Text.Json;
using Microsoft.IdentityModel.Tokens;

namespace McpServer;

public class EpicClient : IEpicClient
{
   private readonly IConfiguration _config;
   private readonly HttpClient _client;
   private readonly ILogger<EpicClient> _logger;

   public EpicClient(IConfiguration config,  HttpClient
client, ILogger<EpicClient> logger)
   {
       _config = config;
       _client = client;
       _logger = logger;
   }

   public async Task<string> GetAccessToken()
   {
       string home =
Environment.GetFolderPath(Environment.SpecialFolder.UserProfi
le);
       string pemPath = Path.Combine(home, "privatekey.pem");
       string pem = File.ReadAllText(pemPath);
       var rsa = RSA.Create();
       rsa.ImportFromPem(pem);

       var credentials = new SigningCredentials(new
RsaSecurityKey(rsa), SecurityAlgorithms.RsaSha384);

       var payload = new JwtPayload
       {
```

```
            { "iss", _config["EPIC:CLIENT_ID"] },
            { "sub", _config["EPIC:CLIENT_ID"] },
            { "aud", _config["EPIC:AUDIENCE"] },
            { "kid", _config["EPIC:KID"]},
            { "jti", Guid.NewGuid().ToString() },
            { "exp",
DateTimeOffset.UtcNow.AddMinutes(4).ToUnixTimeSeconds() }
        };

        var header = new JwtHeader(credentials);
        var jwt = new JwtSecurityToken(header, payload);

        var handler = new JwtSecurityTokenHandler();
        var assertion = handler.WriteToken(jwt);

        var content = new FormUrlEncodedContent(new[]
        {
            new KeyValuePair<string, string>("grant_type",
"client_credentials"),
            new KeyValuePair<string, string>("client_id",
_config["EPIC:CLIENT_ID"]),
            new KeyValuePair<string,
string>("client_assertion_type",
"urn:ietf:params:oauth:client-assertion-type:jwt-bearer"),
            new KeyValuePair<string,
string>("client_assertion", assertion )
        });


        var response = await
_client.PostAsync("https://fhir.epic.com/interconnect-fhir-oa
uth/oauth2/token", content);
        var responseBody = await
response.Content.ReadAsStringAsync();
        if (!response.IsSuccessStatusCode)
        {
            Console.WriteLine($"Epic token request failed:
{response.StatusCode} - {responseBody}");
            throw new Exception($"Epic token request failed:
```

```
{response.StatusCode} - {responseBody}");
        }
        using var doc = JsonDocument.Parse(responseBody);
        return
doc.RootElement.GetProperty("access_token").GetString();
    }

    public async Task<string> GetInformationOfPatient(string
family, string given, string birthdate, string accessToken)
    {
        if (string.IsNullOrEmpty(_config["EPIC:HOST"]))
        {
            _logger.LogError("Cannot get the EPIC:HOST
environment key value");
            throw new Exception("The epic host is not found in
the environment");
        }

        _client.DefaultRequestHeaders.Add("Accept",
"application/fhir+json");
        _client.DefaultRequestHeaders.Authorization =  new
AuthenticationHeaderValue("Bearer", accessToken);

        string url = _config["EPIC:HOST"] +
"api/FHIR/R4/Patient?" +
$"family={family}&given={given}&birthdate={birthdate}";
        _logger.LogInformation("Epic host request received:
{url}", url);
        var response = await _client.GetAsync(url);
        return await response.Content.ReadAsStringAsync();
    }
}
```

Note: The Patient Search method requires family, given and birthdate as the minimum parameters.

PostgresService

```
using McpServer.DbContext;
using McpServer.Model;

namespace McpServer;

public class PostgresService : IPostgresService
{
   private readonly ApplicationDbContext _context;

   public PostgresService(ApplicationDbContext context)
   {
       _context = context;
   }
   public async Task<string> PersistPatentData(string family,
string given, string data)
   {
       var patientData = new Patient() { FamilyName = family,
GivenName = given, Data = data };
       await _context.Patients.AddAsync(patientData);
       await _context.SaveChangesAsync();
       return "Successfully persisted patient data";
   }
}
```

Flow Builder configuration

MCP Tools HTTP SSE

```
Name = whatever_name
URL = HOST/sse
```