

FHIR를 활용한 환자 데이터 통합 및 호흡기 분석 백엔드 App 개발



2024. 7. 12 (금)

인트인

방호배 AI 서비스 개발 파트장

문대은 선임

질병 선택 개요

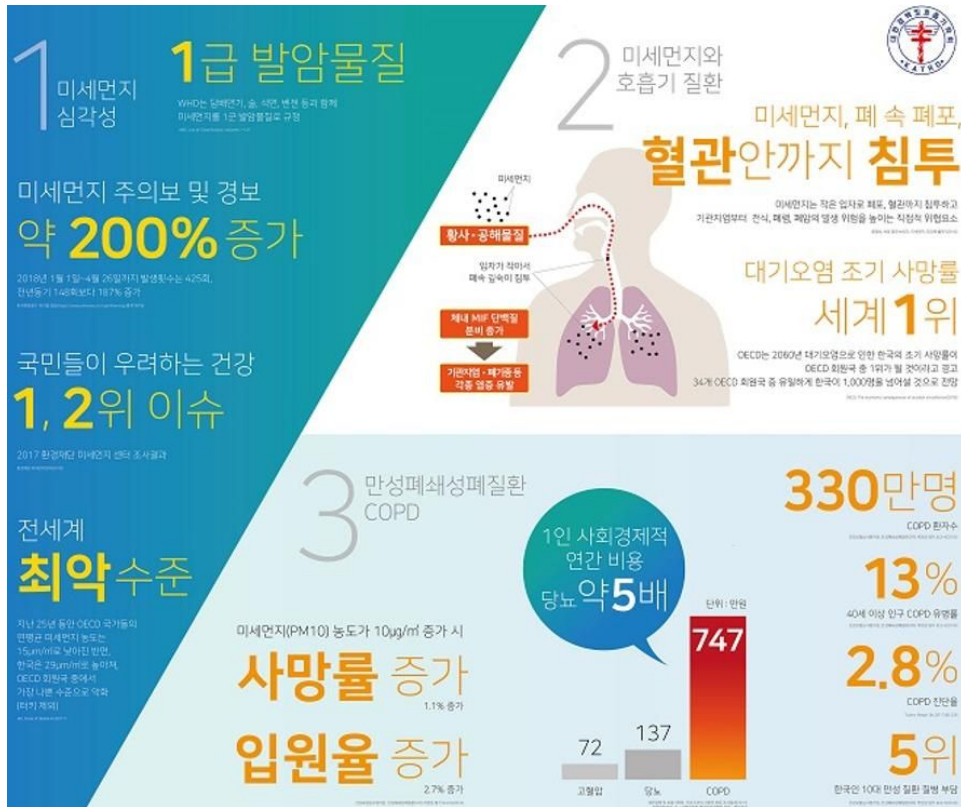


미세먼지(PM10) $10\mu\text{g}/\text{m}^3$ 증가 시 월평균 입원환자 및 외래환자 증가율 (단위: %)

입원환자

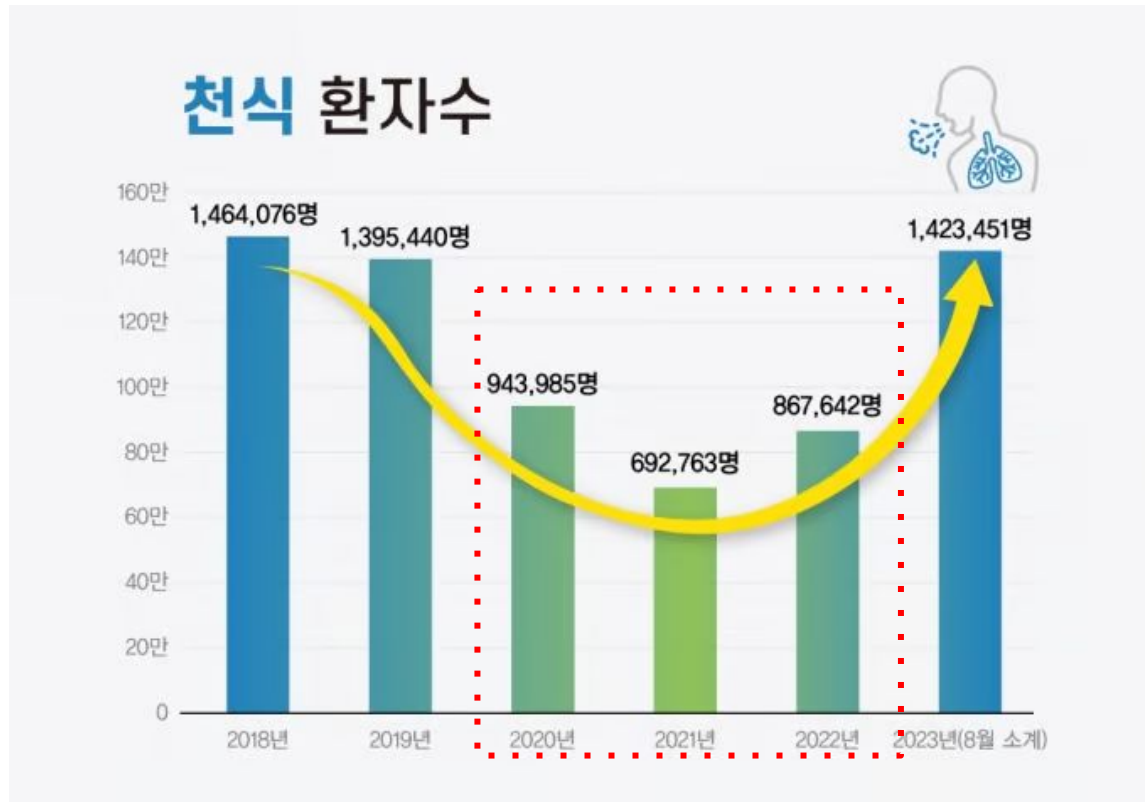


외래환자



2020년 미세 먼지로 인한 호흡기 질환 환자 추이 / 사진=건강보험심사평가원

개발 요구 사항

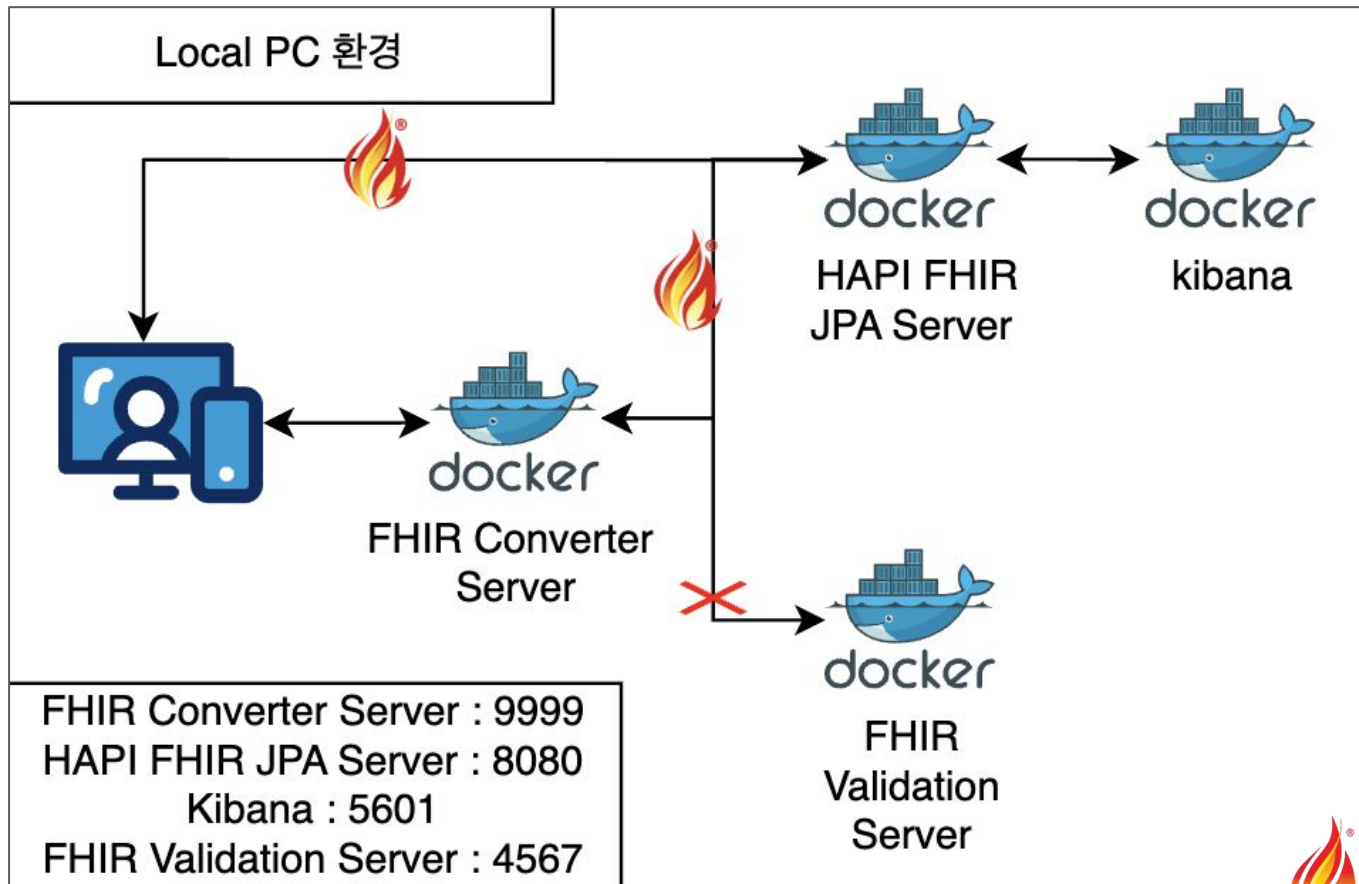


2018~2023년 천식 환자 수./사진=건강보험심사평가원,
강동경희대병원

FHIR Back-end Application DEV

- 어떤것을 사용할 것인가?
 - HAPI FHIR?
 - SMART on FHIR?
 - KR Core?
 - 뭐가 더 좋은지 난해하였지만 기관에서 공유해주신 자료를 바탕으로 진행하였을경우 도움을 받기 더 수월하다는 생각에 **HAPI FHIR**로 진행하였다.
- HAPI FHIR....
 - Plain / JPA Server ?

시스템 개요 구성



● FHIR Data Processing(1)

FHIR Data Service

Create Patient and Observations

Username:

HoBae

Birth Date (yyyy-mm-dd):

1998-04-07

Address:

49, Segwon-ro 316beon-gil, Gwonseon-gu, Suwon-si, Gyeonggi-do, Republic of Korea

Marital Status:

Single

FVC:

4.5

FEV1/FVC:

0.71

Create Patient

source Validator

Validated the uploaded resource against the <http://hl7.org/fhir/StructureDefinition/Bundle> StructureDefinition

No validation error issues found

Validation warnings:

1. Bundle.entry[0].resource/*Patient/1709c511-0be4-499a-9cb3-44a8a67abc7c*/maritalStatus: No code provided, and a code should be provided from the value set 'MaritalStatus' (<http://hl7.org/fhir/ValueSet/marital-status/4.0.1>) on line 1. [Jump to error.](#)
2. Bundle.entry[1].resource/*Observation/3dca5cd3-7552-4b8d-9be2-ed5823cf241e*): Best Practice Recommendation: In general, all observations should have a performer on line 1. [Jump to error.](#)
3. Bundle.entry[2].resource/*Observation/3be6b03-ed6c-4d58-946b-78a92f36c11f*): Best Practice Recommendation: In general, all observations should have a performer on line 1. [Jump to error.](#)
5. Bundle.entry[1].resource: Best Practice Recommendation: In general, all observations should have a performer on line 1. [Jump to error.](#)
6. Bundle.entry[2].resource: Best Practice Recommendation: In general, all observations should have a performer on line 1. [Jump to error.](#)
6. Bundle.entry[0].resource/*Patient/1709c511-0be4-499a-9cb3-44a8a67abc7c*): Constraint failed: dom-6: 'A resource should have narrative for robust management' (defined in <http://hl7.org/fhir/StructureDefinition/DomainResource>) (Best Practice Recommendation) on line 1. [Jump to error.](#)
7. Bundle.entry[1].resource/*Observation/3dca5cd3-7552-4b8d-9be2-ed5823cf241e*): Constraint failed: dom-6: 'A resource should have narrative for robust management' (defined in <http://hl7.org/fhir/StructureDefinition/DomainResource>) (Best Practice Recommendation) on line 1. [Jump to error.](#)
8. Bundle.entry[2].resource/*Observation/3be6b03-ed6c-4d58-946b-78a92f36c11f*): Constraint failed: dom-6: 'A resource should have narrative for robust management' (defined in <http://hl7.org/fhir/StructureDefinition/DomainResource>) (Best Practice Recommendation) on line 1. [Jump to error.](#)

No validation information issues found

```
1 { "resourceType": "Bundle", "type": "transaction", "entry": [{"fullUrl": "urn:uuid:1709c511-0be4-499a-9cb3-44a8a67abc7c", "resource":
```

Issues

VI

Create Patient

```
{
  "resourceType": "Bundle",
  "id": "b9c0a1ff-114b-4718-b334-994203d6f88f",
  "type": "transaction-response",
  "link": [
    {
      "relation": "self",
      "url": "http://localhost:8080/fhir"
    }
  ],
  "entry": [
    {
      "response": {
        "status": "201 Created",
        "location": "Patient/142/_history/1",
        "etag": "1",
        "lastModified": "2024-07-12T05:03:58.819+00:00",
        "outcome": {
          "resourceType": "OperationOutcome",
          "issue": [
            {
              "severity": "information",
              "code": "informational",
              "details": {
                "coding": [
                  {
                    "system": "https://hl7fhir.io/fhir/CodeSystem/hapi-fhir-storage-response-code",
                    "code": "SUCCESSFUL_CREATE",
                    "display": "Create succeeded."
                  }
                ]
              }
            }
          ],
          "diagnostics": "Successfully created resource \"Patient/142/_history/1\". Took 13"
        }
      }
    }
  ]
},
{
  "response": {
    "status": "201 Created",
    "location": "Device/143/_history/1",
    "etag": "1",
    "lastModified": "2024-07-12T05:03:58.819+00:00",
    "outcome": {
      "resourceType": "OperationOutcome",
      "issue": [
        {
          "severity": "information",
```

FHIR Data 생성

FHIR Data Validation

FHIR Data 저장



- **FHIR Data Processing(2)**

Get Patient Data

Patient ID:

142

Get Data

환자 아이디로 조회

Create Patient

```

    "resourceType": "Bundle",
    "id": "b9c8a1ff-114b-4718-b334-994203d6f08f",
    "type": "transaction-response",
    "link": [
      {
        "relation": "self",
        "url": "http://localhost:8080/fhir"
      }
    ],
    "entry": [
      {
        "response": {
          "status": "201 Created",
          "location": "Patient/142_history/1",
          "etag": "1",
          "lastModified": "2024-07-12T05:03:58.819+00:00",
          "outcome": {
            "resourceType": "OperationOutcome",
            "issue": [
              {
                "severity": "information",
                "code": "informational",
                "details": {
                  "coding": [
                    {
                      "system": "https://hapifhir.io/fhir/CodeSystem/hapi-fhir-storage-response-c",
                      "code": "SUCCESSFUL_CREATE",
                      "display": "Create succeeded."
                    }
                  ]
                }
              }
            ],
            "diagnostics": "Successfully created resource \"Patient/142_history/1\". Took 13"
          }
        }
      }
    ],
    "response": {
      "status": "201 Created",
      "location": "Device/143_history/1",
    }
  }
}

```

source Validator

Validated the uploaded resource against the <http://hl7.org/fhir/StructureDefinition/Bundle> StructureDefinition

No validation error issues found

Validation warnings:

1. [Bund1e.entry\[0\].resource/\"Patient/1709c511-0be4-499a-9ecb3-44a8a67abc7c\";maritalStatus](#): No code provided, and the value should be provided from the value set [\"MaritalStatus\" \(http://hl7.org/fhir/ValueSet/maritalStatus.4.0.1\)](#) on line 1. [Jump to error](#).
2. [Bund1e.entry\[1\].resource/\"Observation/33dc5cd3-7552-4b8d-9be2-ed5823c1241e\"](#): Best Practice Recommendation: In general, all observations should have a performer on line 1. [Jump to error](#).
3. [Bund1e.entry\[2\].resource/\"Observation/43be03bc-cde6-4d58-946b-78a92f36c1f1\"](#): Best Practice Recommendation: In general, all observations should have a performer on line 1. [Jump to error](#).
4. [Bund1e.entry\[1\].resource](#): Best Practice Recommendation: In general, all observations should have a performer on line 1. [Jump to error](#).
5. [Bund1e.entry\[2\].resource](#): Best Practice Recommendation: In general, all observations should have a performer on line 1. [Jump to error](#).
6. [Bund1e.entry\[0\].resource/\"Patient/1709c511-0be4-499a-9ecb3-44a8a67abc7c\"](#): Constraint failed: dom-6: 'A resource should have narrative for 'robust management' (defined in [http://hl7.org/fhir/StructureDefinition/DomainResource](#)) (Best Practice Recommendation) on line 1. [Jump to error](#).
7. [Bund1e.entry\[1\].resource/\"Observation/33dc5cd3-7552-4b8d-9be2-ed5823c1241e\"](#): Constraint failed: dom-6: 'A resource should have narrative for 'robust management' (defined in [http://hl7.org/fhir/StructureDefinition/DomainResource](#)) (Best Practice Recommendation) on line 1. [Jump to error](#).
8. [Bund1e.entry\[2\].resource/\"Observation/43be03bc-cde6-4d58-946b-78a92f36c1f1\"](#): Constraint failed: dom-6: 'A resource should have narrative for 'robust management' (defined in [http://hl7.org/fhir/StructureDefinition/DomainResource](#)) (Best Practice Recommendation) on line 1. [Jump to error](#).

No validation information issues found

```
1 {"resourceType": "Bundle", "type": "transaction", "entry": [{"fullUrl": "urn:uuid:1709c511-0be4-499a-9cb3-44a8a67abc7c", "resource":
```

Issue:

FHIR Data Validation

```

{
  "device": {
    "reference": "Device/143"
  },
  "search": {
    "mode": "match"
  }
}

fullUrl": "http://localhost:8080/fhir/Device/143",
resource": {
  "resourceType": "Device",
  "id": "143",
  "lastUpdated": "2024-07-12T05:03:58.819+00:00",
  "source": "WuM2320yldYVXxj",
  "versionID": "1",
  "activationPeriod": "2024-07-12T05:03:58.819+00:00",
  "manufacturer": "Example Manufacturer",
  "deviceName": [
    {
      "name": "Model XYZ",
      "type": "model-name"
    }
  ],
  "type": {
    "coding": [
      {
        "system": "http://snomed.info/sct",
        "code": "122783803",
        "display": "Spirometry"
      }
    ]
  }
},
search": {
  "mode": "match"
}

```

FHIR Data Export

Microsoft Excel 2016 interface showing a spreadsheet with patient data. The ribbon is set to '데이터' (Data). The spreadsheet has columns A through F. Row 1 contains headers: A1 'Resource/Type', B1 'ID', C1 'Name/Status', D1 'BirthDate/Category', E1 'Address/Code', and F1 'MaritalStatus/Display'. Rows 2-5 contain data for Patient, Observation, Observation, and Device respectively. The 'Patient' row (row 2) has a value of 42 in column B, 'HoBae' in column C, '1998-04-07' in column D, '49, Segwon-ro 316beon-gil, Gwo Single' in column E, and '49, Segwon-ro 316beon-gil, Gwo Single' in column F. The 'Observation' row (row 3) has a value of 44 in column B, 'final' in column C, 'Vital Signs' in column D, '1986-9' in column E, and '1986-9' in column F. The 'Observation' row (row 4) has a value of 45 in column B, 'final' in column C, 'Vital Signs' in column D, '1992-5' in column E, and '1992-5' in column F. The 'Device' row (row 5) has a value of 43 in column B, 'Example Manufactu' in column C, 'Model XYZ' in column D, 'Spirometry' in column E, and 'Spirometry' in column F.



EOD