Oracle Healthcare Foundation

ORACLE®
Health Sciences

Oracle Healthcare Foundation (OHF) is a unified healthcare analytics platform. It is a data integration/warehousing solution providing clinical, financial, administrative, and omics modules. Building upon OHF, healthcare organizations can deploy pre-built business intelligence, analytic, data mining, and performance management solutions from Oracle and its partners. These organizations can also leverage OHF's out-of–the-box self-service analytics tools to build self-service analytics solutions.

KEY BUSINESS BENEFITS

- Provides comprehensive data warehousing and analytics platform for secondary use of healthcare data.
- Allows faster deployment and lower risk for implementation of healthcare provider data warehousing and analytics applications.
- Enables healthcare organizations to integrate data from hundreds of disparate source systems into a single source of truth.
- Provides integrated view of healthcare data silos, including vast volumes of clinical, administrative, financial, and omics data.
- Offers a fit-for-purpose analytics platform for data acquisition, validation, integration, warehousing, and analytics solutions for healthcare.
- Supplies self-service analytics enabling business analysts and developers to develop Business Intelligence (BI) applications quickly
- Enables significant time reduction (from hours to minutes) for creating BI applications to explore and visualize Key Performance Indicators (KPIs)
- Offers Omics module for unprecedented power and agility in analyzing large molecular data sets from internal and external sources to identify biomarkers.

Healthcare Analytics - From Aggregation to Action

In light of rising demands to reduce costs, enhance patient outcomes and improve financial results, healthcare organizations require analytics to support financial and clinical decision making for internal, as well as external, reporting. These analytics can help to lower costs, optimize treatment plans, enhance service delivery, advance performance indicators, and streamline operational processes. OHF offers a fit-for-purpose, analytics platform provides a data acquisition, data integration, data warehousing, and data analytics solution to evaluate your organization's information and turn data-driven insight into action.

OHF eliminates the silo analytics of the past by integrating data from disparate source systems and aggregating the clinical, financial, administrative, and omics data from all care settings into a single source of truth for decision making at all organizational levels, from departmental to enterprise. OHF accelerates the ability to visualize integrated data through its Self-Service Analytics module. These analytics assist caregivers and administrators in making informed decisions that can improve patient outcomes and reduce cost of care for both financial and total resource demands.
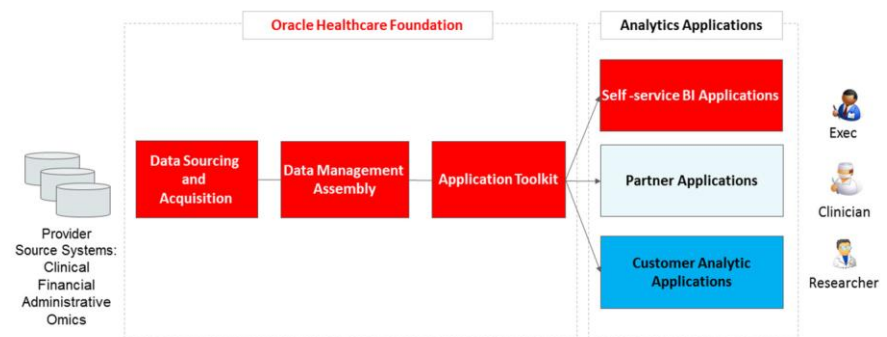
The following diagram illustrates the OHF solution:

Figure 1: Illustration of Oracle Healthcare Foundation

ORACLE®

Data Sourcing and Acquisition

OHF provides data sourcing and supports data acquisition by establishing inbound touch points for data from disparate sources. This process maintains the raw data until it is integrated into OHF's data warehouse and data mart.

OHF's Data Sourcing and Acquisition module includes:

Interface Tables.–These tables, based on a pattern based data model, provide a staging area designed to ease data acquisition from disparate source systems. The Interface Tables serve as a standard and integration bridge between multiple source systems and the normalized data warehouse (Healthcare Data Warehouse).

Terminology Loaders - These loaders extract, transform, and load (ETL) flat file terminology content into interface terminology tables for custom or standard data acquisition, such as International Classification of Diseases (ICD), Systematized Nomenclature of Medicine (SNOMED), Current Procedural Terminology (CPT), Logical Observation Identifiers Names and Codes (LOINC), RxNorm, and various other, controlled, medical vocabularies.

Omics Module - This module provides a storage and querying data model for genomic data including: genes, proteins, pathways, variants, and expressions. The Omics loader supports loading reference and results data to the Omics data model. The Omics loader service provides APIs that collect data from a variety of formats. The Omics service also supports uploading reference data from public sources (Ensembl, SwissProt, HUGO, COSMIC, Pathway Commons, 1000 Genomic, TCGA, etc.), and data from licensed sources, like Genome Trax.

Data Management Assembly

OHF's Data Management Assembly provides metadata-driven ETLs that integrate data into pattern-driven, data models of Healthcare Data Warehouse, Healthcare Common Data Mart, and Cohort Data Mart.

Data Management Assembly includes:

Healthcare Data Warehouse - This is a central repository of integrated data from disparate sources in healthcare organizations. Clinical, financial, and administrative data, as well as DICOM imaging metadata, are all represented by this comprehensive model. OHF's Healthcare Data Warehouse enables clinical and business insights by serving as a single repository for a holistic, enterprise view of all provider data.

Warehouse Integration Loaders – These loaders, with advanced data management and master data management features, offer an ETL infrastructure for data processing from the multitude of sources in the healthcare enterprise to the Healthcare Data Warehouse.

Advanced data management - This capability includes configurable business rules and late-arriving data rules, bi-temporal versioning, and exception management.

Master Data Management – This feature supports easier management of healthcare master data, specifically terminologies/codes, units of measure, and master seed data. Terminology Management supports the standardization of terminology data for

- The advanced data management capability supports configurable business rules and late-arriving data rules, and foundation rules applied to every record and exception management.
- Satisfying various criteria, Cohort Data Mart is designed for fast, real-time querying for patient cohorts.

Application Toolkit:

- Provides a set of pre-built fact and dimension tables designed that meet healthcare analytics demands.
- Offers Healthcare Common Data Mart, a star schema with clinical and finance subject areas including facts, dimensions, and hierarchies.
- Provides Application Toolkit Loaders to extract data from Healthcare Data Warehouse and load the Healthcare Common Data Mart.

Self-service Analytics:

- Enables business analysts and developers to create BI applications rapidly with self-service analytics tools
- Enables the exploration and visualization of KPIs and integrated healthcare data in a few minutes via self-service analytics.
- Leverages Oracle Business Intelligence (OBI) as the user interface to analyze data in a self-service manner.

consistent concepts. Each coded attribute in Healthcare Data Warehouse can be populated with codes that belong to one, specified, standard terminology.

Cohort Data Mart – This data mart consists of patient and research-subject-relevant dimensions, as well as associated measures, designed to optimize patient-centric and research subject-centric queries. ETLs extract data from the warehouse and load it into Cohort Data Mart for consumption of the data in downstream analytical applications.

Self-Service Analytics

Self-Service Analytics (SSA) is a fast, easy, and efficient feature that creates analytical application reports and dashboards within minutes of loading data into OHF's Healthcare Common Data Mart for clinical, financial and administrative domains.

Healthcare Common Data Mart -This capability accelerates data visualization, exploration of KPIs, and data discovery, as well as helps caregivers and administrators make more effective, patient-related decisions.

The following are few example reports that can be created easily and quickly using SSA:
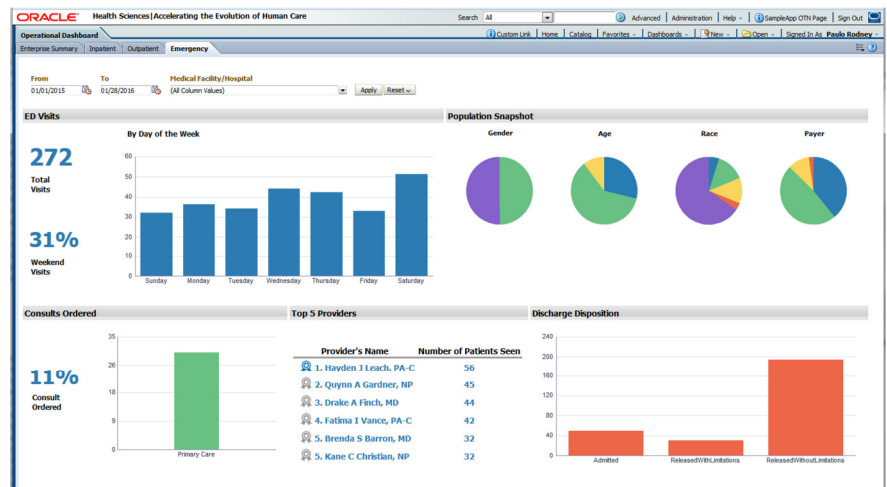

Figure 2: Example of self-service BI reports

Figure 3: Example of self-service BI reports

Oracle Healthcare Foundation provides clinical, financial, administrative and omics modules.

Oracle offers a complete platform (all modules) and an option to choose one or more modules, along with the OHF Core module.

THE OHF Core module has common subject areas referenced in the other modules and included with any/modules.

THE OHF Core module is comprised of the subject areas below:

• Party

• Patient

• Service Provider

• Insurer

• Concern

• Consent & Advance Directive

• Device

• Encounter

• Facility

• Value Based Care

• Derived Measure

• Referral

• Code Repository

• Graph (Hierarchies)

• Master Catalog

THE OHF Clinical module supports the subject areas:

• Case

• History

• Incident

• Intervention

• Observation

• Order

• Pharmacy

• Specimen

• Study

THE OHF Financial module supports subject areas:

• Accounting and Financial Reporting

• Billing

Application Toolkit

The application Toolkit is a quick, easy, and efficient way to build downstream applications. It provides the OHF Healthcare Common Data Mart, containing clinical, financial and administrative domain facts/dimensions that are common to many applications built for healthcare analytics. These capabilities facilitate a rapid, extendable means of moving healthcare analytics data from the Healthcare Data Warehouse model.

Application Toolkit quickly enables business analysts and BI application developers to generate BI applications, integrate data across silo analytics, compare reports, enable cross-application filters, enforce data governance, and extend/reuse the data mart and ETLs in multiple applications.

Application Toolkit provides OHF's Self-Service Analytics tool which can generate the Oracle Business Intelligence (OBI) Repository Design (RPD) in a few minutes, without the need of investing months in RPD analytical application development.

The following diagram illustrates how Self-Service Analytics help to accelerate taking "data to the glass" during the analytical application development phase by leveraging Oracle Business Intelligence Enterprise Edition (OBIEE).
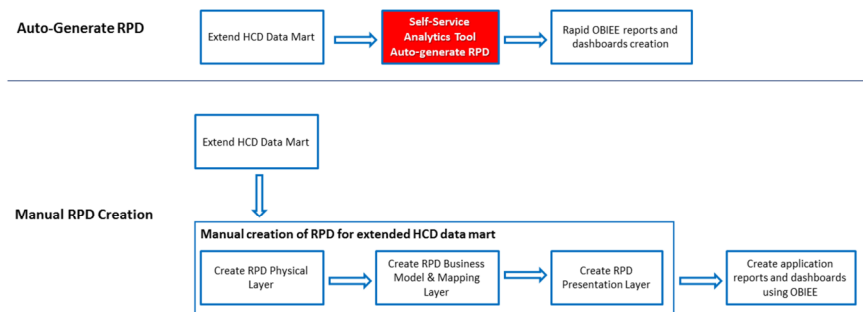

Figure 4: Illustration of Self-service Analytics tool

This solution scales to generate the RPD for the data mart that is created by extending Healthcare Common Data Mart for the analytical applications developed.

Unified Installer and Simplified Deployment

A single, unified installer supports the installation of all data models, data management assembly, and data pipeline services. Simplified deployments of pattern-driven data models (staging area, data warehouse, data marts, and metadata-driven loaders) enable the integration of data into data warehouse and data marts.

Administration Console

Administration Console supports managing routine administration tasks through web applications for all components of OHF and provides the following features:

• Load summary - Allows the user to monitor load details

- Charge Master
- Claims
- Cost Allocation
- Patient Financial Services
- Accounts Payable

The OHF Administrative module supports the subject areas:

- Human Resources (HR) and Payroll
- Inventory
- Purchasing
- Scheduling
- Survey

Omics Module

- Provides data model for genomic data storage and querying including: genes, proteins, pathways, variants, and expressions.
- Offers Omics Loaders for loading reference and result data to Omics data model.
- Provides APIs to collect data from a variety of formats.
- Supports the upload of result data in four popular formats including: Variant Call Format (VCF and gVCF), Mutation Annotation Format (MAF), Complete Genomics (CGI) masterVar format, gene expression tab-separated values, RNA-seq, and Copy Number Variation data (SEG and VCF formats).
- Supports uploading reference data from public sources including: Ensembl, SwissProt, HUGO, COSMIC, Pathway Commons, 1000 Genomic, and TCGA.

- Exception Log - Allows the user to analyze exceptions logged during data load to Healthcare Data Warehouse
- Profiler - Allows the user to identify the data quality of coded and reference attributes of Interface Tables through built-in profiling queries.

Modular Solution for Analytics Roadmap

The OHF solution addresses a healthcare organization's need for a modular approach to its analytics adoption roadmap alignment with its deployment and use of relevant subject areas. The modular approach allows an organization to prioritize and emphasize its preferred areas of need in the initial deployment.

Customers can license the entire platform or start with one or more modules. The Core OHF module has common subject areas referenced in the other modules and included with any/all modules.

The other modules are:

- Oracle Healthcare Foundation - Administrative Module
- Oracle Healthcare Foundation - Clinical Module
- Oracle Healthcare Foundation - Financial Module
- Oracle Healthcare Foundation - Omics Module

The below descriptions are to be used as a guide to determine which modules might be needed to support a solution.

Core

Core module supports following subject areas:

- **Party** - contains information related to an individual and an organization.
- **Patient** - includes data for an individual who received medical care, attention, or treatment from a service provider.
- **Service Provider** - includes data relevant to a hospital, non-hospital facility, doctor, or other provider.
- **Insurer** - contains information related to the party that issues an insurance policy that will compensate the policy holder, if specified events occur.
- **Concern** - contains any data pertaining to a patient that may require a service provider's attention, such as: diagnosis, illness, condition, chief complaint, problem, injury, mental condition, disorder, etc.
- **Consent and Advance Directive** - contains information related to an authorization for specified medical care and legal agreements that convey decisions about end-of-life care.
- **Device** - contains information related to durable devices in the organization, specifically those devices that require maintenance or those that provide workloads important in business analytics.
- **Encounter** - includes data that are relevant to the occurrence between a patient and healthcare participant(s) for providing patient service(s) or assessing the patient's health status.
- **Facility** - contains information related to a brick and mortar, licensed, certified, and/or accredited facility which provides inpatient, outpatient, or ancillary services.
- **Value Based Care** - contains information about member centric view of the adjudicated claims, member eligibility along with Primary Care Provider or

attributed provider data, risk score indicating high-cost high-risk patients, and data essential for population health programs or value-based care programs.

- **Derived Measure -** contains information either in an aggregated form or as a pre-calculated value from systems and sources external to OHF. These derived values and measures enable third party benchmark data and data from host organization data marts external to OHF to be consumed, compared, and analyzed with data sourced through OHF. This optimized analysis can include the data host organization, as contracted, or obtained from Premier, Vizient, CDC, HospitalCompare.gov, and Leapfrog, etc. Internal data can include budget and organizational goals for ALOS, CMI, Payer Mix, and FTEs, etc**.**

- **Referral** - contains information related to external-inbound, external-outbound, and internal referrals and data essential for analysis of referral trends, referral patterns, referral volume, top referral sources, and referral time to appointment.

- **Code Repository** – contains master data information in terminology tables.

- **Graph** - contains hierarchy or graph data.

- **Master Catalog** - contains information related to a catalog of items and services at the enterprise level.

Clinical

The OHF Clinical module supports following subject areas:

- **Case** - represents data that are a logical sequence of interrelated interventions and pre and post intervention activities performed in a contiguous manner by (a) service provider(s). A single Case usually consists of one or more significant surgical procedures, supplemented by a variety of other interventions, such as anesthesia, substance administrations, and non-surgical procedures.

- **History** - stores data related to any past and current information that is collected, documented, witnessed, or obtained about a patient. Information can be gathered from a variety of sources, including the patient and caregivers, as well as members of the health care team. Examples include: allergy history, substance history, immunization history, family history, social history, etc.

- **Incident** - includes data that capture an atypical, near-miss, or unplanned occurrence(s) to a patient, visitor, or employee that may, or may not, result in a negative outcome.

- **Intervention** - includes data that are relevant to actions taken to alter or achieve a patient's outcome by interfering or interceding. It contains data specific to all types of interventions, from the most complex procedure and groups of procedures, to simple bedside interventions. Examples include: patient education, substance administration, procedure, test, anesthesia, surgical procedure, image series, image study, etc.

- **Observation** - includes data that represent clinical subjective and objective information about a patient obtained from an informant directly or indirectly involved with the patient. Examples include: assessments, discharge summary, reports, results, image instance, etc.

- **Order** - includes data that are relevant to the instruction originated from an authorized party for initiation of actions directly or indirectly related to provision of care to patients. It includes the data relevant to the entire lifecycle of the Order. Examples include: ADT order, diet order, lab order, nursing order, substance administration order, therapy order, etc.

- **Pharmacy** - stores data regarding the life cycle of prescriptions. This includes the written order for preparing, packaging, and administrating substances

and/or other treatments to a patient or human subject. It includes pharmacy processes such as: prescription substance order, prescription review/fill/dispense, drug preparation and review, medication error and resolution, as well as pharmacy and inventory.

- **Specimen** - includes data that represent a sample of a patient's tissue, fluid, or other material used for laboratory analysis to assist differential diagnosis or staging of a disease process.
- **Study** – contains information related to clinical research studies.

Administrative

The OHF Administrative module supports the following subject areas:

- **Human Resources (HR) and Payroll** - contains information related to personnel management, including payroll, benefits, time and labor, positions, compliance with employment law, training, and certifications.
- **Inventory** - contains information related to the organization's management of its complete list and location of disposable products and consumables including: purchase order, purchase contract, requisition, receipt, delivered location, and early request, etc.
- **Purchasing** - contains information related to the process of agreements between an organization and a supplier to buy specific products or services.
- **Scheduling** - contains information related to appointments and a pre- defined or planned time slot for a resource, such as a service provider, equipment, or a care site.
- **Survey -** contains information related to the collection methods for qualitative and quantitative information on products and services received by individuals or by groups of individuals.

Financial

The OHF Financial module supports following subject areas:

- **Accounting and Financial Reporting**- contains information about the organization's operational billing and financial life cycle.
- **Billing** - contains information related to the summary of charges for a medical care episode of one or more bill line items.
- **Charge Master** - contains information related to price lists for a service provider organization, including all services, procedures, and supplies.
- **Claims** - contains information related to request for payment for patient care services, from an organization or service provider, to an insurer.
- **Cost Allocation** - contains information about direct, indirect costs, fixed, and variable costs by procedure, DRG, and cost center.
- **Patient Financial Services** - contains information related to the patient's account, hospital bill, charges, billing compliance, and health plan.
- **Accounts Payable** - contains information related to the process and agreements made between a buyer and a seller of products, goods, and services.

Omics

The OHF Omics model provides unprecedented power and agility in analyzing large molecular data sets from internal and external sources in the pursuit of biomarkers.

The Omics module provides a data model for storing and querying genomic data including: genes, proteins, pathways, variants, and expressions. It also provides loaders

for adding reference and results data to the omics data model.

The OHF Omics loader service provides APIs to collect data from a variety of formats. It also supports the upload of results data in four popular formats including: Variant Call Format (VCF and gVCF), Mutation Annotation Format (MAF), Complete Genomics (CGI) masterVar format, gene expression tab-separated values, RNA-seq, and Copy Number Variation data (SEG and VCF formats). In addition, the modules can upload reference data from public sources for the OHF Omics data model.

The OHF Omics model, designed according to the central knowledge of molecular biology, leverages Oracle's knowledgeable, in-house, bioinformatics team, its pedigree in data management/integration, and its renowned development best practices. The result is a system that meets the specific requirements of today's researchers. By centralizing and integrating clinical and omics data, Oracle gives researchers tremendous cross-platform querying power that saves time, lowers resource requirements, and helps lead to novel biomarker discovery.
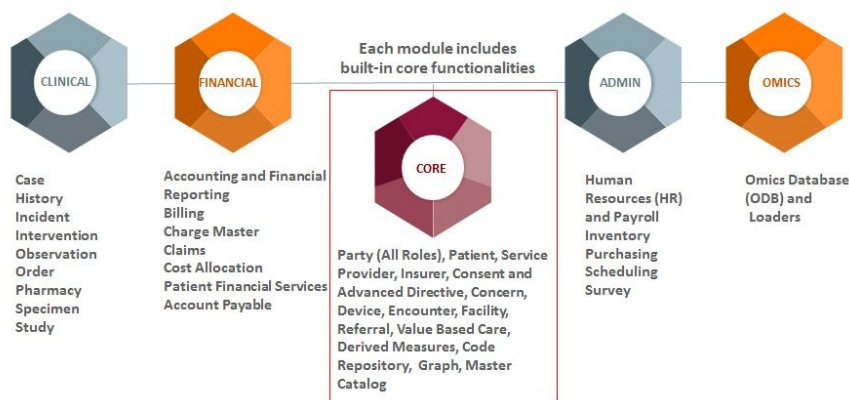

Figure 5: Oracle Healthcare Foundation modules

Robust, Scalable, and Reliable Healthcare Foundation

Oracle's solution provides better, data-driven support that improves outcomes at reduced cost and resources across the continuum of care (administrative, clinical, financial, and omics).It includes more than 35 subject areas that transform disparate data into actionable insight.

Built specifically for the healthcare industry by health care professionals, OHF is a secure, reliable, scalable, and robust data warehousing and analytics solution.

OHF capabilities include:

- **Foundation for healthcare analytics** with a fit-for-purpose, data warehouse and advanced, speedy, scalable data management capabilities
- **Scalability** to process large data volumes and address the needs of providers of any size, from national healthcare delivery, to academic medical centers, to emerging IDNs and ACOs, to community providers**.**
- **Better decision-making** across the continuum of care by integrating data from disparate sources and empowering providers with insight to optimize resources and cost, quality, and outcomes at the individual patient and population group levels.
- **Business agility** with OHF Self-Service Analytics accelerates data visualization and data discovery for the integrated data from clinical, financial, and administrative

domains within minutes of loading the data**.**

- **A productized solution** and the Oracle Partner Network enabling successful business intelligence project implementation, while accelerating time-to-value to achieve excellence within the healthcare organization.
- **Functionality across Oracle solutions-**with native functionality shared and supported between Oracle Healthcare Foundation, Oracle Healthcare Precision Medicine, Oracle Translational Research Center, and Oracle Healthcare Self-Service Analytics using Oracle Business Intelligence 12c for Data Visualization, supporting the entire data ecosystem of patient care; from the bench to the bedside.

Improved Clinical and Business Insights for Better Outcomes

The benefits from an integrated view of healthcare data are substantial in today's world. They can provide great assistance to caregivers and administrators by making available all information that aids:

- Actionable insights
- Decision support across domains
- Improved patient outcomes
- Reduced costs and resources across the continuum of care

The OHF solution provides the analytical insights that drive rapid organizational response for healthcare transformation. This leads to measured evidence-based care and improved patient outcomes.

Faster Deployment, Lower Risk and Total Cost of Ownership

Oracle, with decades of experience working with many of the world's largest enterprise data warehouses, has built clinical data repositories holding vast amounts of patient records. This experience, combined with the domain expertise of physicians, nurses, and healthcare data analysts, has enabled Oracle to create the Oracle Healthcare Foundation solution. OHF reduces the risks associated with implementing data warehousing and analytics and provides the shortest path to full value realization for analytics.

CONTACT US

For more information about Oracle Healthcare Foundation, visit oracle.com or call +1.800.633.0643 to speak to an Oracle representative.

ORACLE®

CONNECT WITH US

oracle.com/healthsciences

healthsciences_ww_grp@oracle.com

youtube.com/user/oraclehealthsciences

facebook.com/oraclehealthsciences

twitter.com/oraclehealthsci

Integrated Cloud Applications & Platform Services

Oracle is committed to developing practices and products that help protect the environment