

UNIVERSAL DATA MODELS FOR Health Care

By Len Silverston

Managing health care information is challenging. There are many ways that health care organizations process information and various interpretations of terms. For instance, who is the customer in health care? Is it the patient, the insured, the insurance provider that pays claims, the financially responsible party, the third-party administrator, or the employer that buys the insurance? Who is the provider of services? Is it the individual health care practitioner, the health care network, the institution or medical office, or a combination of these? Parties within health care may act in different capacities; for example, an HMO may provide its own doctors or may subcontract its personnel and facilities from other providers, labs or health care facilities. Employers may self-insure, administer their own programs or hire third-party administrators. Additionally, maintaining information on health care service deliveries and the corresponding claims is very difficult due to the many business rules that apply to different situations.

Thus, flexible models are needed to handle the many different scenarios that can occur in health care. Furthermore, data models are needed to truly understand the nature of the data within health care and build systems that can effectively handle current and future needs. Universal data models are template or generic models that offer insights and patterns to aid in understanding and designing effective systems.

This article will provide a sample of some of the universal data models



available for health care applications and is based upon *The Data Model Resource Book, Revised Edition, Volume 2* which contains a much more comprehensive set of universal data models for health care as well as data models for other industries. While it is appropriate to analyze the specific needs of organizations, much time and money can be gained by reusing standard health care data constructs to take advantage of concepts and techniques that have been proven to be effective.

Universal Models Clarify and Offer Alternatives

Why would one use generic or template data models to define health care information requirements rather than base the model on industry-specific knowledge and/or information-gathering meetings? In addition to being able to save time and effort by providing proven reusable data constructs, universal data models provide additional perspectives that may not be apparent during information requirements gathering. For instance, universal models can provide

concepts such as storing information about people and organizations independent of roles that are being played. Universal data models can illustrate the nature of data needed for any type of business cycle, which may help clarify what is needed for health care delivery and subsequent claim items. Another benefit of using universal data models is that they offer broader perspectives that very often can more easily accommodate future needs of the enterprise.

Health Care Parties

In health care, the same people and organizations often act in many different roles at the same time and can very often change over time. For instance, an organization may be the payer, the administrator and the employer all at the same time, or these roles may be played by different organizations. The same person may be a dependent, an insured, a patient or even an employee or contractor of the health care organization.

Figure 1 shows some of the key roles involved in health care. Because parties may play any number of roles, the “party” model shown in Figure 1 is an extremely effective structure for consistently maintaining a person or organization’s information in a single place while showing the many roles that apply to each person or organization.¹ Thus, each subtype of PARTY ROLE may be related to a health care activity, and each person or organization’s information (such as name, social security number, federal tax ID, demographics or background information) can be maintained consistently within the PARTY entity.

Health Care Service Delivery and Claims

A central need within most health care organizations is effective management of information on patient services performed and the associated claims for reimbursement of those services. Many hospitals, physicians, dentists, chiropractors, other health care organizations as well as insurance providers and administrators spend considerable time and effort modeling this information in order to properly define their information requirements.

Are health care deliveries and claims a unique information requirement associated exclusively with health care or are there “universal” data principles and models that apply to modeling health care delivery and claims information?

The basic nature of business is to deliver goods and/or services and receive payment in return. In health care, a patient receives health care treatments; and, in return, the health care provider receives compensation either from the insurance company, the patient or a financially responsible party. Therefore, the health care model needs to include a mechanism to capture health care “deliveries” and their associated claims.

A health care claim is actually a request for reimbursement of health care deliveries. When a person receives treatment for health care, the claim is a mechanism to ask for reimbursement from the insurance provider, the patient or another financially responsible party.

In health care, something is delivered (i.e., a procedure, a drug dosage, an examination, etc.), and a request for reimbursement follows the delivery. Could there be similarities to other industries where goods and services are delivered and then a request for reimbursement is made? In many other industries, the delivery is usually called a shipment. The request for reimbursement is usually referred to as an invoice.

A “Universal” Delivery and Invoicing Model

Consider the data model in Figure 2. You may be thinking, “What does this have to do with health care?” However, there are similarities that can be very

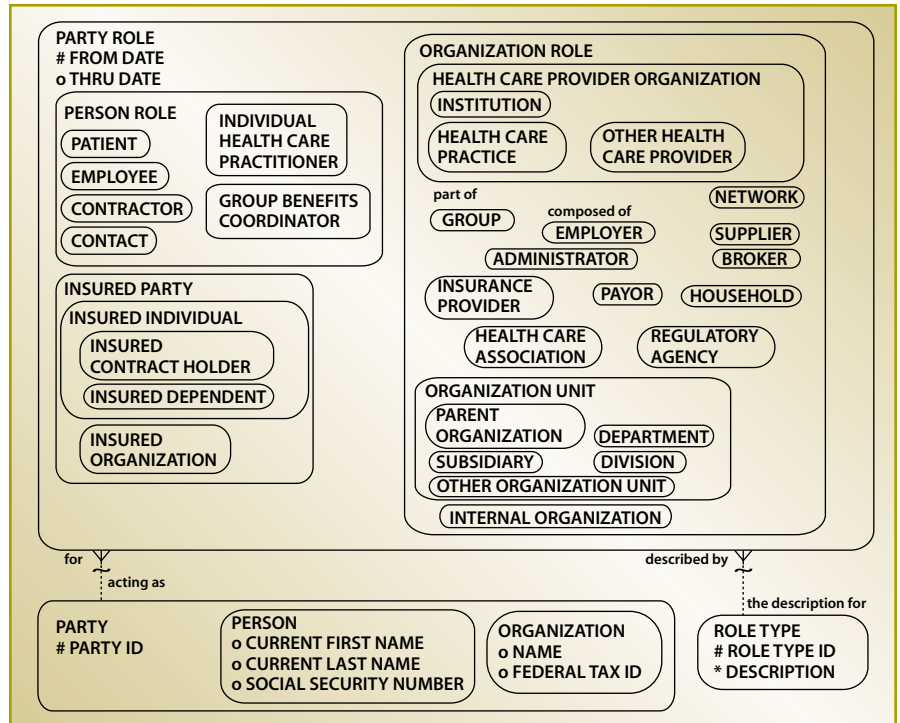


Figure 1: Health Care Parties

useful. By evaluating if some of the same concepts apply to claims as in traditional invoice processing, the data modeler can help ensure the accuracy and completeness of the health care claims data model.

In many organizations, there are shipments or “deliveries” of products and subsequent invoicing. A SHIPMENT is a delivery of goods and is often composed of many SHIPMENT ITEMS, each of which is related to a particular GOOD that was shipped. SHIPMENT ITEMS have a many-to-many relationship to INVOICE ITEMS, which are the line items for each of the products on a specific INVOICE. This many-to-many relationship exists because shipment items may be combined and invoiced as a single invoice item; alternatively, there could be multiple partial invoices for the same shipment (or invoice items may be reissued for a single shipment item). INVOICES may be resubmitted using the INVOICE RESUBMISSION entity, and the status of invoices is tracked through the INVOICE STATUS entity. Finally, INVOICE ITEMS may be settled by PAYMENTS. Again, a PAYMENT may apply to several INVOICE ITEMS and an INVOICE ITEM may have several payments (for instance, if partial payments are applied).

Data Modeling Notation:

- A crow’s foot (three prongs at the end of the relationship line) indicates that there are many occurrences of the entity near the crow’s foot for each entity that is not near the crow’s foot. For example, each PARTY may be acting in one or more PARTY ROLES (entity names are shown in caps in this article).
- The dotted line indicates optionality (as opposed to mandatory) for each side of the relationship. Each ROLE TYPE may be (because this is a dotted part of the line) the description for one or more PARTY ROLES. Read the other way, each PARTY ROLE must be described by one and only one ROLE TYPE.
- A ‘#’ in front of an attribute indicates that this attribute is a key. A ‘*’ indicates that the attribute is a mandatory attribute. A ‘o’ before an attribute indicates that the attribute is optional.
- Boxes within boxes indicate subtypes or subtentities.

Health Care Delivery and Claims Model

In health care, there are also “deliveries” that occur and subsequent requests to be reimbursed. The “deliveries” are in the form of health care services being performed, and the requests to be reimbursed are known as claims.

Figure 3 illustrates a data model to manage delivery and claims information within a health care organization. Whereas a SHIPMENT is made up of SHIPMENT ITEMS, each corresponding to a particular GOOD, the health care process usually begins with a HEALTH CARE VISIT from a PATIENT that is made up of several HEALTH CARE DELIVERIES, each corresponding to a HEALTH CARE OFFERING. For instance, a health care visit may consist of three deliveries: an exam, a specific procedure and a particular drug.

As in the previous shipment and invoice model, there is a need in health care to be reimbursed for delivery of health care services. A request for payment in health care may take two main forms: it may be an invoice for uninsured services where the patient did not pay at the time of visit, or it may take the form of a claim for services that are reimbursed by insurance providers and or government reimbursements such as Medicaid.

INVOICES from health care providers can be modeled using the data structures from Figure 2 and replacing the SHIPMENT ITEM BILLING associative entity with a HEALTH CARE DELIVERY BILLING associative entity in order to relate each HEALTH CARE DELIVERY with one or more INVOICE ITEMS and vice versa.

In the second case of processing insurance claims, there are similar properties to an invoice because an invoice also represents a request for payment. Just as an invoice may be resubmitted if there was a mistake or if it was not paid, a CLAIM may also be resubmitted through the CLAIM RESUBMISSION entity (for instance, if the first claim was denied or lost). This entity relates one CLAIM to another CLAIM, revealing if a claim was resubmitted in place of another claim.

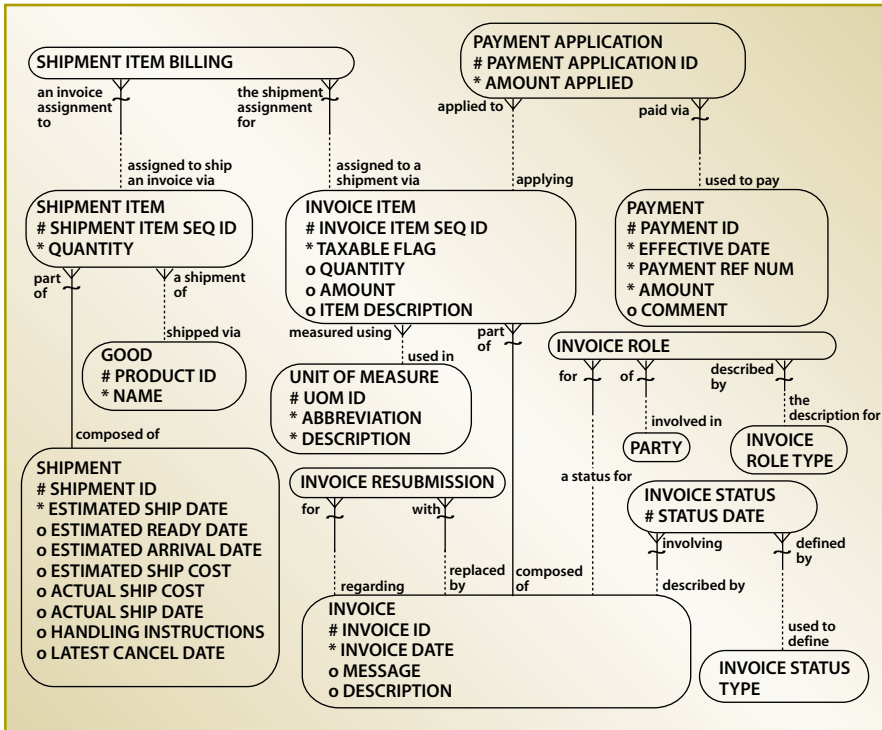


Figure 2: Shipment and Invoicing Data Model

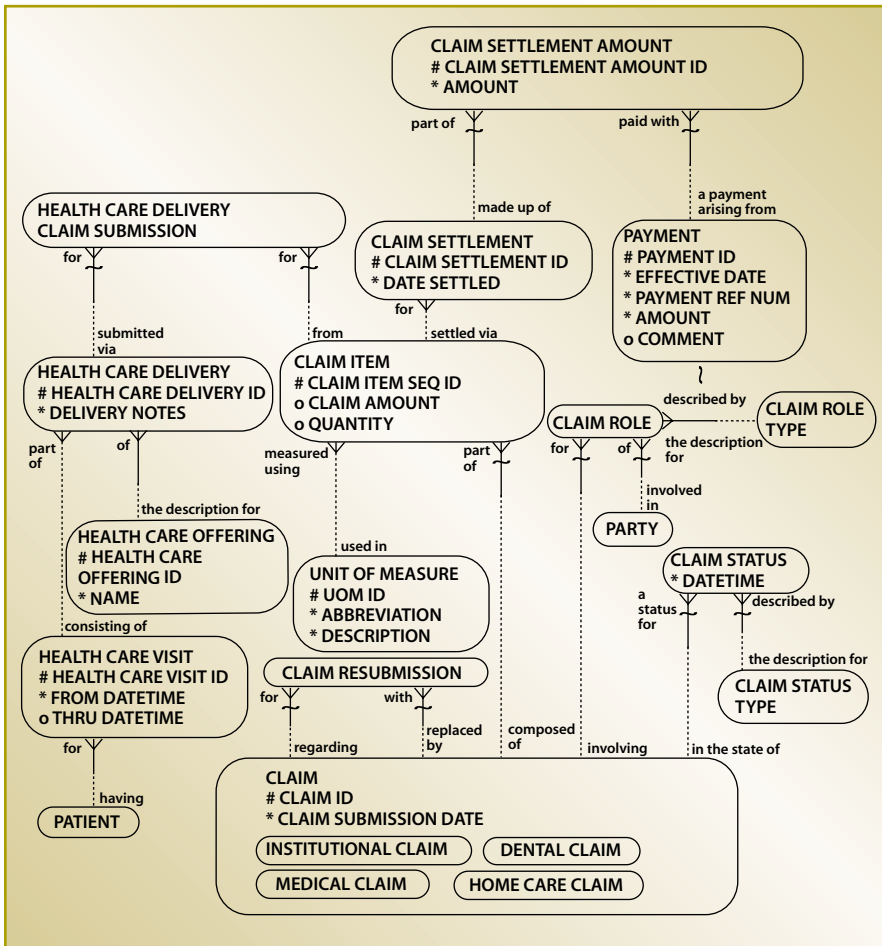


Figure 3: Health Care Deliveries and Claims

The status of the CLAIM is maintained through the CLAIM STATUS entity, which allows many CLAIM STATUS TYPES (received, being reviewed, partially paid or closed) to be recorded over time. The people and organizations involved in the claim are handled through the flexible structure of relating a CLAIM to multiple CLAIM ROLES, each of which may be of a PARTY acting within a particular ROLE TYPE (i.e., patient, insured, party sending claim, party receiving claim, administrator, reviewer, manager, etc.).

The payment of claims has some similarities to the universal shipments and invoice model in Figure 2, although there are some differences. PAYMENTS may be grouped to provide reimbursement for several claim items; likewise, each claim item may have several payments (for example, when partial payments occur over time for a claim).

One major difference in payments for health care claims is that they go through an additional process known as the adjudication process, evaluating the validity of the claim and how much of the claim to pay based upon the policy as well as a plethora of business rules defined by the insurance provider. Therefore, the CLAIM SETTLEMENT entity is related to both the payment and the CLAIM ITEM. Similar to shipments and invoices, there is a many-to-many relationship from each HEALTH CARE DELIVERY to each CLAIM ITEM.

Service Delivery Versus Claims

Many health care professionals view the claim item the same as the delivery of health care services. If the claim item is for a particular procedure corresponding to a CPT code, then many would argue that the claim item serves as the medical record for the patient. Very often there is a one-to-one relationship between the claim item and the delivery of service. However, as previously stated, there are many cases where claim items are related to many health care deliveries or there are many claim items for the same health care delivery.

A CLAIM ITEM may be related to many HEALTH CARE DELIVERIES

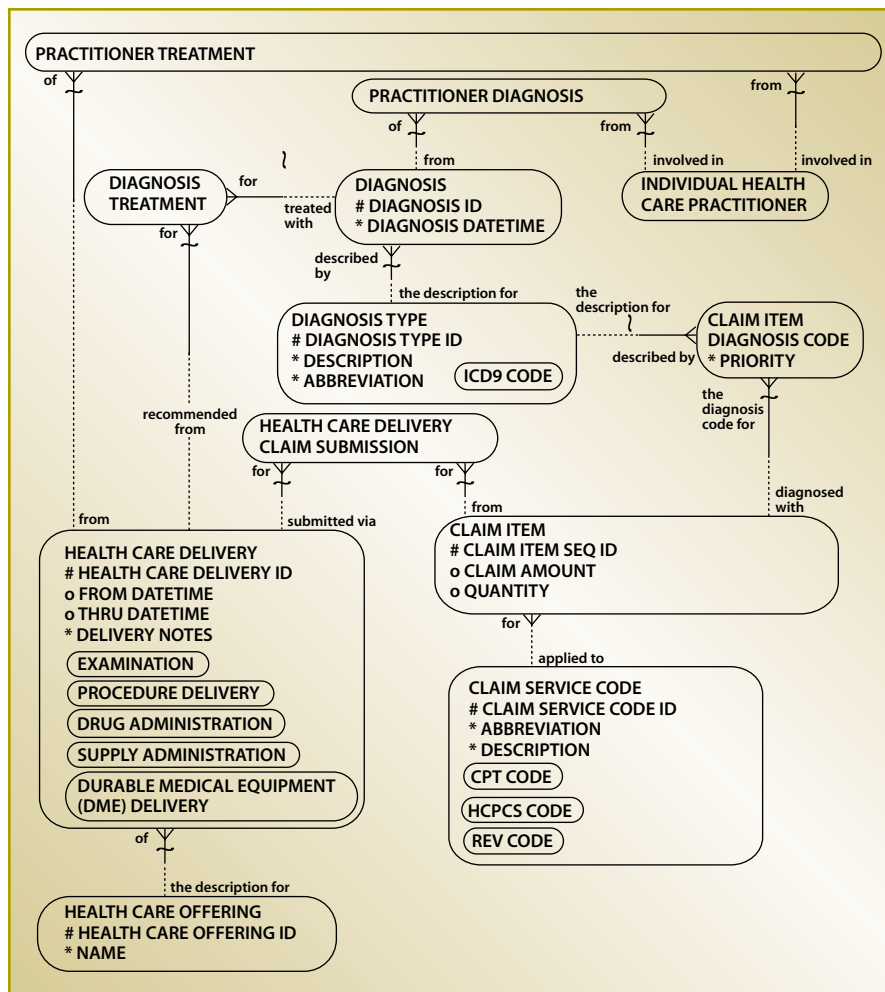


Figure 4: Diagnosis and Claim Service Codes

because one may elect to group two deliveries on a single claim item (for example, two administrations of the same drug). Additionally, hospitals often group services from multiple health care providers into a single claim before it is submitted to the insurance provider (for example, multiple physical therapy sessions from different therapists).

Conversely, a HEALTH CARE DELIVERY may be related to more than one CLAIM ITEM due to numerous reasons. For instance, the same delivery may be covered by more than one policy. In this situation, insurance providers apply coordination of benefits rules. A HEALTH CARE DELIVERY may also have several CLAIM ITEMS when more than one claim is submitted (for instance, if the first settlement was not satisfactory).

Another case is when a medical procedure is performed by several

health care practitioners (for instance, an anesthesiologist anesthetizing the patient for surgery, the surgeon conducting the operation and a pathologist performing lab tests on the patient's tissue as part of the operation). Each doctor may submit his/her own bill for the same medical operation. This results in the need for separate claims for each part of the same health care delivery.

By understanding the generic model illustrating that deliveries and the subsequent invoices for them can be quite different, the data modeler has another perspective on what is "delivered" in health care and the corresponding request(s) for payment.

The benefits of maintaining the service delivery separately from the claim item are great. By distinguishing the claim item from the health care service delivery, a complete medical record is available for what actually

happened to each patient from the associated charges that were claimed (or invoiced). For instance, if several drug treatments or physical therapy sessions were combined into a single claim item, each of these should still be maintained and accessible in order to properly track the patient's medical record.

Procedures and Diagnoses

Figure 4 further demonstrates the distinction between the actual services rendered versus claims in terms of procedures and diagnosis. The model shows that a HEALTH CARE DELIVERY is related to a HEALTH CARE OFFERING, meaning that the health care delivery may be for an examination, procedure delivery, drugs or any other offering that has been rendered by the provider. The CLAIM ITEM is for a CLAIM SERVICE CODE, typically a current procedure terminology (CPT) code that is a scheme designated for insurance reimbursement.

HEALTH CARE DELIVERIES have much more detail about exactly what happened. The CLAIM ITEM will only record what is necessary for billing purposes. For instance, the PRACTITIONER TREATMENT entity records all the INDIVIDUAL HEALTH CARE PRACTITIONERS involved in the HEALTH CARE DELIVERY, which HEALTH CARE PRACTITIONERS

were involved in which DIAGNOSIS, and which DIAGNOSIS involved which TREATMENTS. In comparison, the only diagnosis information needed for the CLAIM ITEM is the DIAGNOSIS TYPE(S).


What was delivered (the HEALTH CARE DELIVERY) may not always directly correspond to what was billed (the CLAIM ITEM). For instance, a doctor may treat a patient for a torn earlobe from earrings being pulled, and different doctors may correlate that to different claims codes. One doctor may relate it to a tear in the earlobe, another may relate it to removing a lesion from the back of the ear and some doctors may relate it to both.

There are often other differences between the delivery and claim. For example, a patient may go in for a chin implant and also has a wart removed, the physician may or may not submit a claim on the wart removal to the insurance provider. The medical record for the patient may, therefore, be different than the claims record. Some health care deliveries may not even be billed because they were not covered under insurance or they were financially insignificant and not worth billing.

The bottom line is that flexible data structures are needed for maintaining information on the various parties involved, health care deliveries, associated

claims information and especially managing the relationships between these types of information.

Flexible Data Structures

With the vast number of ways that health care may be delivered and the need to provide very adaptable data structures to effectively handle health care requirements, universal data models offer possibilities for health care data structures, allowing ultimate flexibility and maintainability. These universal data models also enable an understanding of the basic nature of the data within health care in order to build systems to improve health care management and effectiveness. 

References:

1. Please refer to "A Universal Data Model for Relationship Development" in *DM Review's* March 2002 issue or *The Data Model Resource Book, Volume 1* (Wiley 2001) for more detailed explanations of the "party" model shown in Figure 1.

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