The GALEN CORE Model for representation of the Common Reference Model for Procedures contains the building blocks for defining procedures - the anatomy, surgical deeds, diseases, and their modifiers used in the definitions of surgical procedures. The GALEN Common Reference Model is the model of medical concepts (or clinical terminology) being built in GRAIL. This model forms the underlying structural foundation for the services provided by a GALEN Terminology Server.

The GALEN Common Reference Model is available from the OpenGALEN Foundation which has been set up as a not-for-profit Dutch Foundation by the universities of Manchester and Nijmegen to make the results of the GALEN projects available to the world.

The ontology for the GALEN CORE model is designed to be re-usable and application independent. It is intended to serve not only for the classification of surgical procedures but also for a wide variety of other applications - electronic healthcare records (EHCRs), clinical user interfaces, decision support systems, knowledge access systems, and natural language processing. The ontology is constructed according to carefully selected principles so that the reasons for classification are always explicit within the model and therefore available for processing and analysis by each application. This leads to an ontology in which most information lies in the descriptions and definitions. The hierarchies are built bottom-up automatically based on these definitions.

Note that the word *ontology* has acquired a range of meanings in various communities. Following the usage of Guarino [Guarino and Giaretta 1995], it is used here with a lower case *o*
or in the plural to indicate the set of primitive, high level categories in a knowledge representation scheme together with any taxonomy which structures those categories.

Quality assurance of the model is an ongoing process. The most important quality assurance of the building blocks comes from the checks on the correct classification things built with them - the model of procedures and the other models for subspecialties being built in collaboration with other projects. Preliminary results from such checks are extremely promising.

The structure of the model is now believed to be complete, but there remain many details of anatomy and diseases to complete for each subspecialty area. Future development of the

model is governed by the requirements of the applications and the needs of the centres who are using it to develop classifications of procedures. The next areas to be addressed will be based on the needs of vascular, ENT, orthopaedic, and gynaecological surgery to meet the requirements and priorities of those centres.

The GALEN Common Reference Model is designed to be a re-usable application-independent and language-independent model of medical concepts. The GALEN Common Reference Model is the central feature of the GALEN Terminology Services which is a key enabling technology for:

- Electronic Healthcare Records
  providing the content and mediating between terminology in different EHCRs and EHCRs and decision support systems.
- Clinical User Interfaces
  Making EHCRs and decision support quick and easy to use.
- Classification and Coding Systems
  making it possible to build more systematic, more richly interconnected, and more complete coding and classification systems.
- Decision Support System
  helping people author compatible families of decision support, hypermedia, and EHCR systems from re-usable components
- Knowledge Management Systems
  organising and indexing information efficiently and flexibly for decision support, hypermedia, and bibliographic resources - reducing the inference required in decision support systems - providing an indexed repository of key facts.
- Natural Language Processing
  making structured information available as clinical users expect it; accepting natural language input to structured information systems.

The GALEN Common Reference model is what Rossi Mori refers to as a *third generation* terminology system [Rossi Mori, Consorti et al. 1997]. The key feature of the GALEN approach is that it provides a model - a set of building blocks and constraints - from which concepts can be composed. By contrast, most
traditional
classification systems such as ICD9/10, ICPC, or the earlier versions of the Read Codes attempt to provide fully enumerated lists of all of the concepts which might ever be needed. In GALEN, classification of composite concepts is automatic and based on formal logical criteria. In traditional systems, classifications must be performed by hand explicitly for each concept. Traditional systems are usually tuned for use in one primary task, and using them for alternative tasks is difficult. GALEN separates the concept model from the model of use. Where the formal logical criteria in the concept model do not correspond to the model of use in clinical

practice, an additional pragmatic is added separately to transform the conceptual model to fit the clinicians requirements. In this way, the underlying integrity of the logical model and its ability to support automatic manipulation by software is not compromised.

For further information about **GALEN**, please visit their website .