

KAT: A FLEXIBLE XML-BASED KNOWLEDGE AUTHORIZING ENVIRONMENT

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BACKGROUND

1. The knowledge content should be created by clinicians whenever possible, without requiring the continuous assistance of knowledge engineers.
2. The content should be structured enough to be computable, yet readable enough to be easily understandable by clinicians.
3. The content generation process should enable open collaboration between clinicians with different areas of expertise, representing multiple facilities and services across the enterprise.

REQUIREMENTS

Table 1 ■ Needs, Features, and Requirements for the Knowledge Authoring Tool

Needs	Features	Requirements
Supports simple authoring process	Accessible throughout enterprise	Available at terminals throughout the enterprise, regardless of location or computer type
	Easy to use	Adopt LDAP authentication already used in enterprise applications for both security and user convenience
	Straightforward process to submit content for review	Users are able to use the tool quickly and effectively with minimal training
	Quick access for content to be edited	Tool must be integrated with application designed for open review and feedback Users must be able to manage and organize their authoring tasks within the tool Users may quickly search, sort, and filter through content to identify material for editing
Provides distributed, collaborative authoring	Content stored in a central repository	Must be developed on a set of core services that read from, write to, and search a central knowledge repository
	Reuse of existing content (supports modularity)	Must have the ability to search for content in the knowledge repository and link results to knowledge content currently being authored or edited
	Robust document versioning strategy	Must provide the ability to create from existing content as a template ("copy as") Must support and enforce a robust version control strategy for documents in the repository
Flexible, generic tool	Operates independently of the content that it produces	Information necessary for authoring, processing, and transforming content must be stored outside the application
	Able to author multiple, potentially very different types of content	Must be able to support the authoring of documents from any valid content model
Creates readable, computable content	Output must be structured and coded	Content must be created from well-defined models
	Application must be able to present content in an understandable, relevant format to user	Must support use of coded elements directly selected from a terminology server Must be able to transform content from the underlying content model to an understandable format for the user

FRAMEWORK

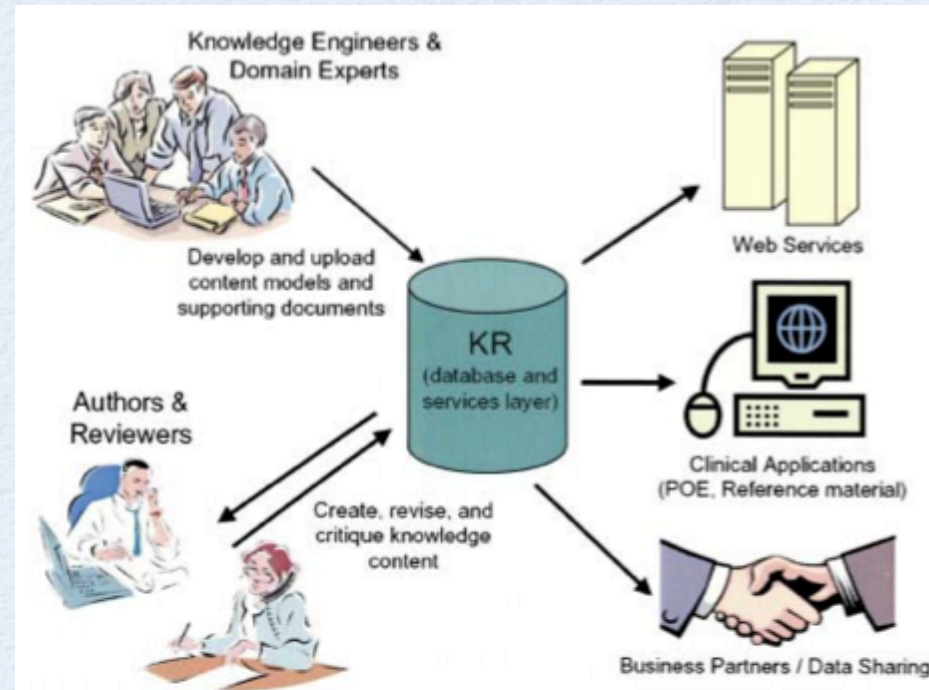
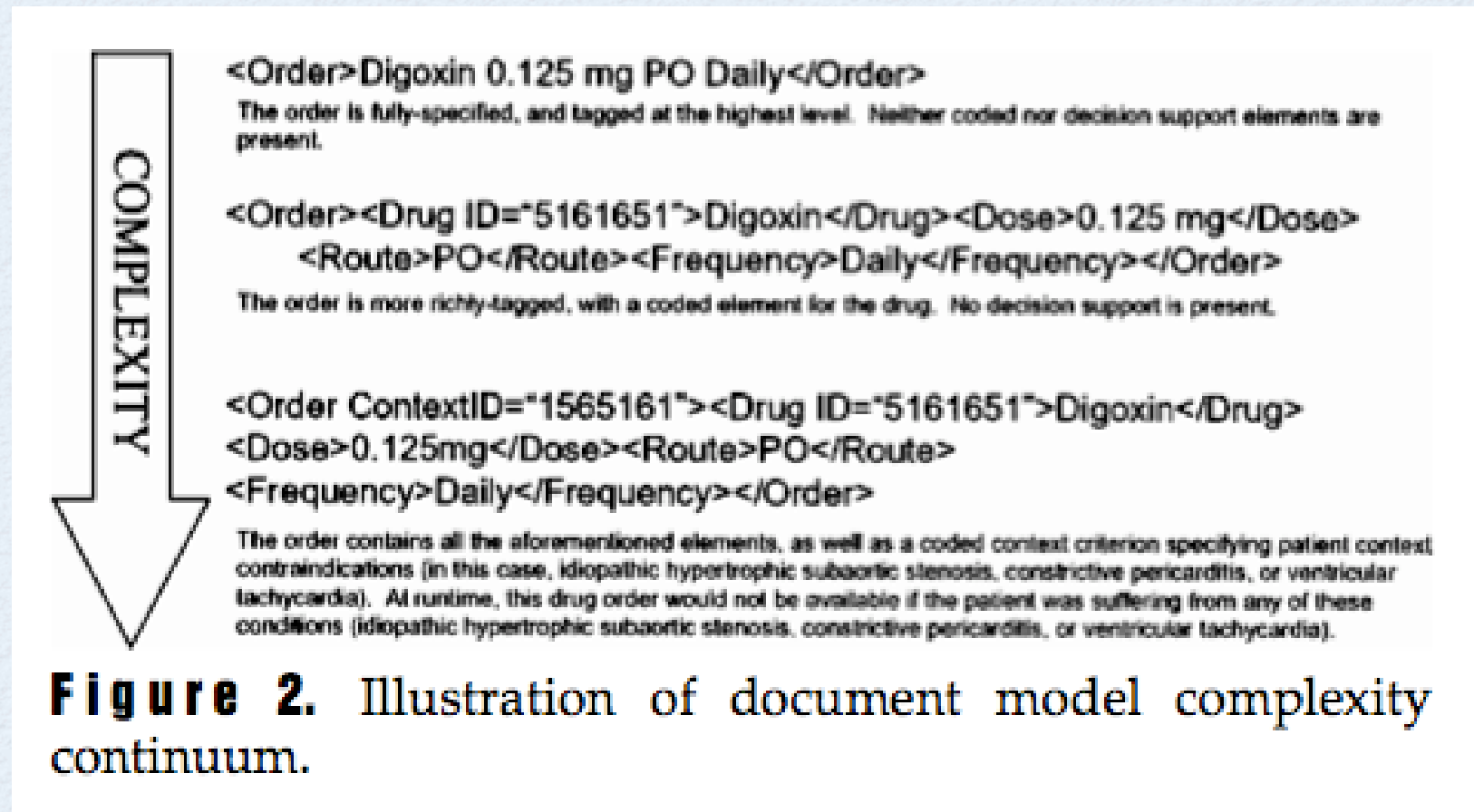


Figure 1. Document framework used by the knowledge authoring tool (KAT): Knowledge engineers work directly with domain experts to create the XML schema data models and their supporting documents for authoring (XML template, Web form, eXtensible Stylesheet Language Transformations). Once these are uploaded to the knowledge repository (KR), authors can create and update knowledge content using these models. Reviewers analyze the content and provide feedback to the authors. The KR services allow for standardized access to data from the central repository. Web services, clinical applications, and business partners can access the XML data through standardized protocols. KR content can then be transformed and used in a variety of applications or potentially shared with other institutions.

DOCUMENT COMPLEXITY



KAT: EXAMPLE

KAT: IHC's Knowledge Authoring Tool - Microsoft Internet Explorer

Knowledge Authoring Tool

Compose My Documents Search My Profile Logout

Document Header Document Body

Medications ☐ Mutually exclusive

Group Instruction: [add Group Instruction](#)

Order Name	Selection	Instruction	Eligibility	Info button link
Erythromycin ophthalmic ointment to eyes following birth, per guidelines	Pre-selected	add instruction	add Eligibility	add Info button link
Hepatitis B vaccine per guidelines	Pre-selected	add instruction	add Eligibility	add Info button link
NICU flush solutions per guidelines	Pre-selected	add instruction	add Eligibility	add Info button link

[add Nested Order Set](#)

Calculated Order Identifier	Selection	Instruction	Eligibility	Info button link
51072208 Aquamephyton 0.25 mg/kg	Pre-selected	add instruction	add Eligibility	add Info button link
51072209 Ampicillin 100 mg/kg/dose	Unselected	add instruction	add Eligibility	add Info button link
51072210 Gentamicin mg/kg/dose	Unselected	add instruction	add Eligibility	add Info button link

Subgroup heading: ☐ Mutually exclusive

[add Group Instruction](#)

Order Name	Selection	Instruction	Eligibility	Info button link
Pain scale monitoring	Pre-selected	add instruction	add Eligibility	add Info button link
Sucrose for anticipated painful procedures, per guidelines	Pre-selected	add instruction	add Eligibility	add Info button link

Done Local intranet

Start 12:35 PM

KAT: EXAMPLE

Welcome to KAT, BMC's Knowledge Authoring Tool - Microsoft Internet Explorer

Knowledge Authoring Tool

Compose My Documents Search My Profile Logout

Welcome, Terry.

My Work In Progress (18 documents ... 6 shown) ☒ Enable Filters

Title: ICU Type: * Dates: Reset

Document Title	Type	Last Edited	Edit	Save As	Preview	Publish	Delete
AO - CRANIOTOMY POST-OP ICU ADMIT ORDER SET	Order Set	Jul 12, 2004 06:49 PM					
AO - LIVER TRANSPLANT POST-OP ICU ORDER SET	Order Set	Jul 12, 2004 06:19 PM					
AO - MASTER ICU ORDER SET	Order Set	Jul 08, 2004 04:34 PM					
AO - PNEUMONIA (SEVERE) ICU ADMIT ORDER SET	Order Set	Jul 14, 2004 05:06 PM					
AO - SEPSIS (SEVERE) ICU ADMIT ORDER SET	Order Set	Jul 14, 2004 05:01 PM					
AO - STROKE ICU ADMIT ORDER SET	Order Set	Jul 12, 2004 06:36 PM					

My Published Documents (178 documents ... 12 shown) ☒ Enable Filters

Title: ADMIT Type: Order Set Date: Status: Active Reset

Document Title	Type	Last Published	Document ID	Status	Ownership	Edit	Save As	Preview	Info
AO - GENERIC MSICU ADMIT ORDER SET	Order Set	Jul 13, 2004 03:45 PM	51052107	Active					
AO - TRAUMA ADMIT ICU ORDER SET	Order Set	Jul 13, 2004 03:45 PM	51052259	Active					
AO - DIABETIC KETOACIDOSIS ICU ADMIT ORDER SET	Order Set	Jul 13, 2004 03:44 PM	51051952	Active					
AO - GENERIC STRICU ADMIT ORDER SET	Order Set	Jul 13, 2004 03:44 PM	51052108	Active					
AO - GI BLEEDING ADMIT ICU ORDER SET	Order Set	Jul 13, 2004 03:44 PM	51052153	Active					
AO - SEPSIS (SEVERE) ICU ADMIT ORDER SET	Order Set	Jul 10, 2004 11:00 AM	51052276	Active					
AO - PNEUMONIA (SEVERE) ICU ADMIT ORDER SET	Order Set	May 06, 2004 03:46 PM	51052369	Active					
AO - DVT / PE ICU ADMIT ORDER SET	Order Set	May 06, 2004 03:31 PM	51052662	Active					
AO - STROKE ICU ADMIT ORDER SET	Order Set	May 06, 2004 08:47 AM	51052658	Active					
AO - CRANIOTOMY POST-OP ICU ADMIT ORDER SET	Order Set	May 01, 2004 01:15 PM	51052809	Active					
AO - RESP. FAILURE (HYPOXIC) ICU ADMIT ORDER SET	Order Set	Feb 05, 2004 12:20 PM	51052181	Active					
AO - RESP. ACIDOSIS (HIGH pCO2) ADMIT ICU ORDER SET	Order Set	Feb 05, 2004 12:06 PM	51052201	Active					

Done Local intranet

KAT USAGE

Table 3 ■ Total XML Knowledge Base Content Distribution (Original Content and All Subsequent Revisions Thereof)

Document Category	Q2 2003	Q3 2003	Q4 2003	Q1 2004	Q2 2004	Q3 2004	Q4 2004	Total	Avg. No. of Versions per Original Document
Interdisciplinary nested order set	42	50	432	44	2	0	0	570	2.63
Nested order set	93	309	262	197	118	111	25	1115	4.01
Order set	17	98	257	422	298	228	94	1414	5.42
Assessment		154	13	1	172	12	233	585	4.83
Index page		5	0	3	58	5	18	89	2.36
Lab diagnostic findings		1	274	0	57	17	78	427	5.24
Risk factors causes		1	351	0	94	13	3	462	2.19
Symptoms		4	610	0	168	17	6	805	1.58
Antibiotic monograph			12	9	89	4	39	153	4.18
Care plan module			344	36	0	0	0	380	1.40
Miscellaneous footnote			8	9	473	46	36	572	2.68
Literature citation				1354	120	62	25	1561	1.81
Procedure				111	330	92	17	550	5.39
Tables and tools				479	1161	178	55	1873	3.43
Calculated order					40	30	4	74	4.17
Calculation					23	27	1	51	4.88
Clinician reference					16	8	1	25	1.53
E-resources page					2	42	24	68	4.02
Glossary					1	1	2	4	4.62
Index					156	3	3	162	4.24
Interdisciplinary protocol					768	79	82	932	1.77
Patient education					67	3	5	75	13.60
Practice guideline					145	31	17	193	4.00
Problem					999	104	112	1215	1.03
Risk for problems					439	40	64	543	2.22
WorkMed examination					20	12	21	53	2.31
E-resources profile						70	14	84	14.00
Quarterly content total	152	622	2563	2665	5816	1235	979	14035	2.97
Total no. of categories in KR	3	8	11	14	26	27	27		

KAT USAGE

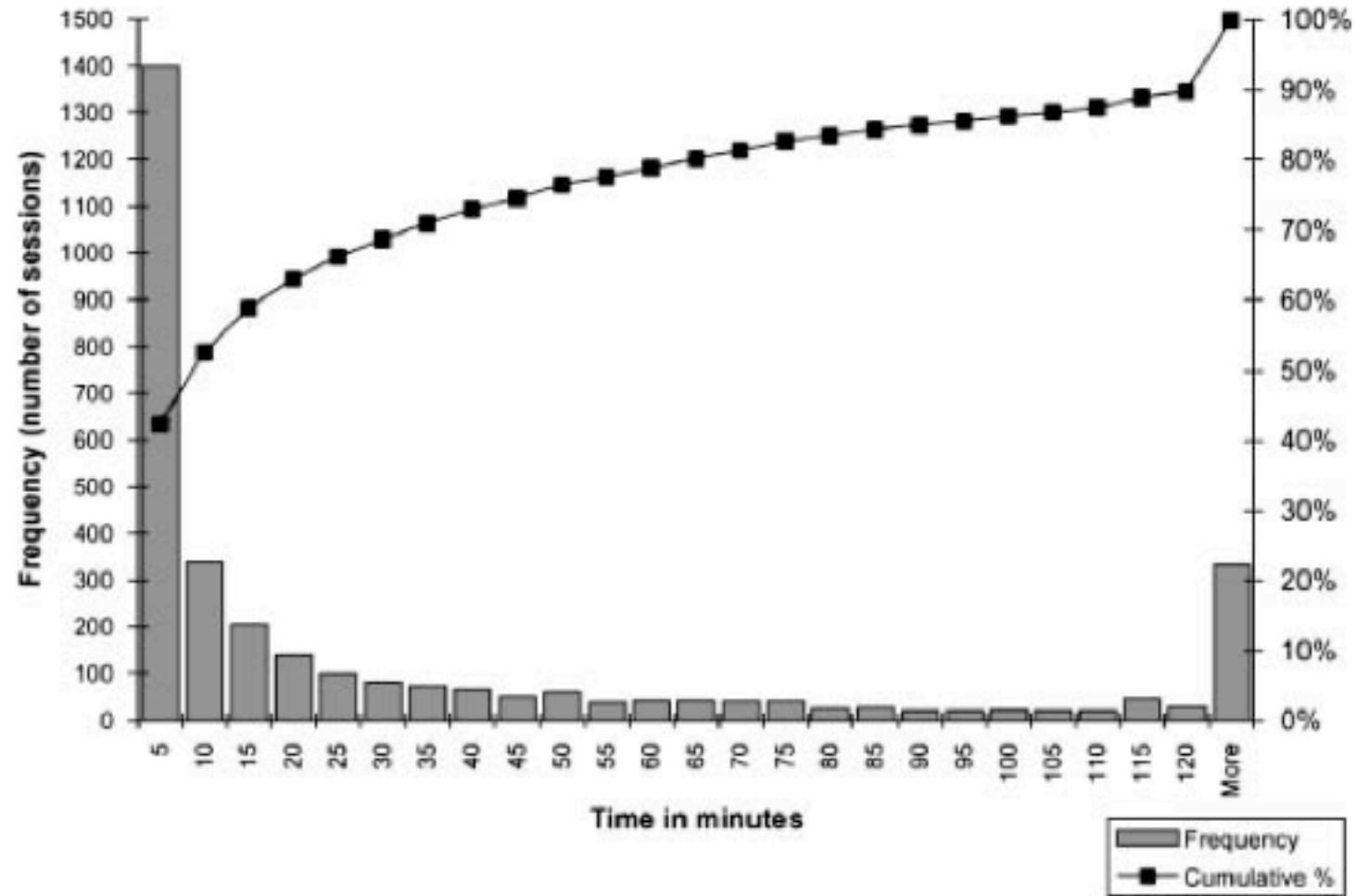


Figure 5. Authoring session length distribution.

FLOW OF INFORMATION

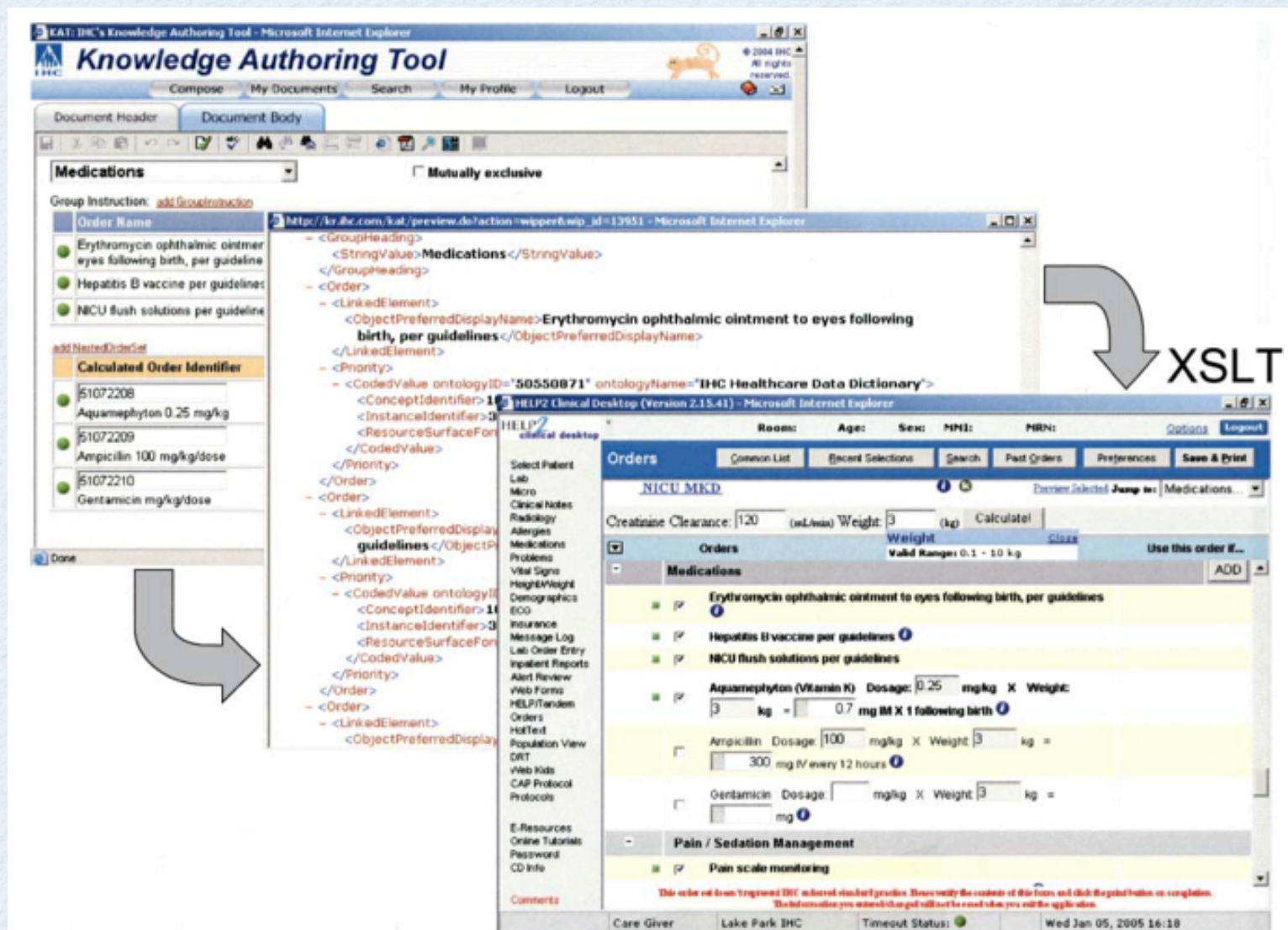


Figure 6. The flow of information from the authoring environment to clinical applications is illustrated here. A knowledge authoring tool generates and stores XML-based order sets into the knowledge repository. These data are subsequently retrieved and transformed via eXtensible Stylesheet Language Transformations (XSLT) for use in the provider order entry application.