



## *White Paper*

# From Prescription to Administration: a Complete Environment for Chemotherapy Management

### **Abstract**

*This document presents the development for chemotherapy' management made by Nice Computing for the University Hospitals in Geneva, Switzerland. The goal of this project is to help clinicians to prescribe chemotherapies through standardized protocols, to electronically transfer the requests to the central pharmacy, to help the chemist to fill prescriptions and finally to allow correct administration of preparations to patients.*

### **Keywords:**

Hospital Information Systems (HIS), Chemotherapies, Traceability, Pharmacy, RFID



## 1. Introduction

The Hospital Information System (HIS) within the University Hospital of Geneva is a well-established and fully distributed system. It includes, state of the art applications and services such as Electronic Patient Record, Radiology Information System, HL-7v3 based ADT, etc. An order prescription application has also been developed and is widely used for order entries including drug prescriptions, physiotherapies and the like.

Since several years, the preparation of chemotherapies has been centralized at the pharmacy in order to guaranty a high level of quality of the preparation as well as the security of the people in charge of the preparations.

Until recently however, prescriptions were handwritten on paper, faxed to the pharmacy and processed thereafter. Such a procedure has several potential problems including mental calculation of doses, retranscription of doses, no automatic control of minimal/maximal dosages and no integration of the prescription into the HIS.

A project has therefore begun in order to offer all contributors involved tools for supporting their specific tasks during the entire process beginning from the prescription and ending with administration of drugs. The project has resulted in four main modules that are described in the next chapters:

- A prescription module for clinicians using standardized protocols;
- A module helping the chemists for the chemotherapy preparation at the pharmacy level;
- A pharmacy workflow management module;
- A module guiding nurses and clinicians during the administration of chemotherapies.

Interactions between these modules are presented in figure 1.

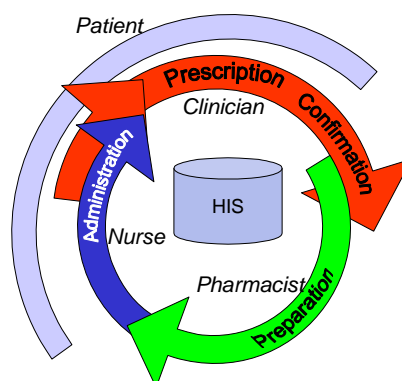


figure 1 Global Workflow



figure 2

## 2. Prescription

In order to standardize chemotherapy administration, the clinicians decide the mandatory usage of predefined protocols. A protocol is a composed set of drugs to be administered according to a certain time schedule. It is also a document for clinicians and nurses detailing administration planning. Presently, only the first part is fully computerized – an additional project is in progress for evaluating possibilities to support the administration planning.

In order to efficiently support the clinician during the prescription process, a full description of drugs to be administered has been produced (including minimum/maximum dosages that cannot be exceeded). Items are then defined which represent a drug administered a certain way at a certain dose. These items can then be associated to a time schedule to form a protocol that can be correctly adapted to a certain patient according to his/her age, weight, size and even taking into account specific laboratory results such as Creatinin levels .

During the adaptation phase of a specific protocol, the clinician has the possibility to reduce doses or to cancel some drugs (figure 3). He cannot however request doses higher than what was defined in the protocol. Controls are also performed to check if all of the patient parameters are compatible with the protocol (i.e. age, gender).

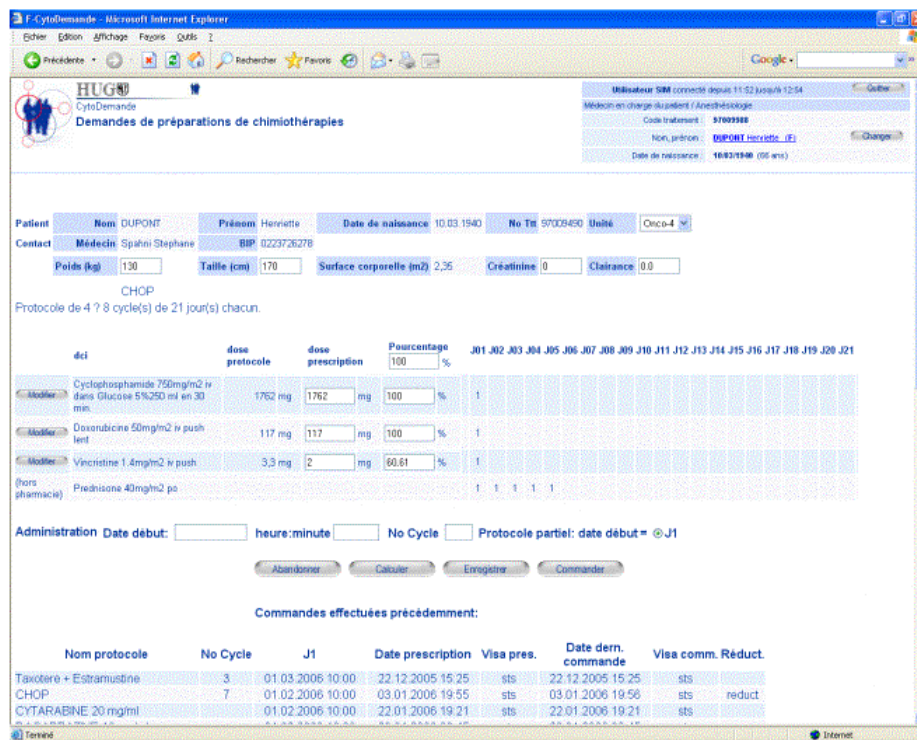


figure 3 Adaptation and Initiation of a protocol

After the adaptation phase, the clinician has to confirm, week per week, the orders (figure 4). Once confirmed, the orders are transferred to the pharmacy for preparation.

The screenshot shows the HUG CytoDemande web application. At the top, it displays the patient's name (DUPONT), sex (Henriette), date of birth (10.03.1940), and other identifiers. Below this, a table lists the chemotherapy protocol details, including drug names, doses, and administration schedules across four weeks. The table has columns for 'Semaine no 1' through 'Semaine no 4' and a 'Pourcentage' column. The drugs listed are Doxorubicine, Blomycine, Yerbactine, and Decarbazine. The interface also includes buttons for 'Administration', 'Commander', and 'Supprimer'.

| dc1  | dose protocole | dose prescription | Pourcentage | Semaine no 1<br>D? command? | Semaine no 2<br>D? command? | Semaine no 3<br>A commander | Semaine no 4<br>En attente de comman |
|--|----------------|-------------------|-------------|-----------------------------|-----------------------------|-----------------------------|--------------------------------------|
| Doxorubicine 25mg/m <sup>2</sup> iv dans NaCl 0,9% 50 ml en 10 min.  | 45 mg          | 45 mg             | 100 %       | 1                           |                             | 1                           |                                      |
| Blomycine 10mg/m <sup>2</sup> iv dans NaCl 0,9% 50 ml en 10 min.     | 18,1 mg        | 18,1 mg           | 100 %       | 1                           |                             | 1                           |                                      |
| Yerbactine 5mg/m <sup>2</sup> iv dans NaCl 0,9% 50 ml en 10 min.     | 10,9 mg        | 10,9 mg           | 100 %       | 1                           |                             | 1                           |                                      |
| Decarbazine 375mg/m <sup>2</sup> iv dans Glucose 5%250 ml en 30 min. | 679 mg         | 679 mg            | 100 %       | 1                           |                             | 1                           |                                      |

figure 4 Confirmation of administration (weekly)

At each stage, a summary of the prescription or the confirmation is produced and can be printed by the clinician. These summaries are also automatically placed into the electronic patient record.

### 3. Production of Preparations

The project described here is one component of the global computerization of the central pharmacy. Although already ISO 9001 certified, the pharmacy is continuously enhancing its infrastructure in order to guaranty the highest possible level of quality and security of its production. The electronic transmission of requests for chemotherapy preparations is thus participating in this process. Two extensions for the infrastructure of the pharmacy were therefore developed:

- Prescriptions for fabrication of cytotoxics are no longer hand-written from the received fax issued from the ward but automatically generated by an ad-hoc module developed in the framework of this project;
- A tool helping the chemist during the preparation of products has been integrated. The tool<sup>1</sup> enables the control of what is being prepared by guiding the chemist step by step and checking through an electronically connected precision balance that the right product has been used and particularly that the right quantity of substance has been used.

Of course these extensions have required a full description of the products being used at the pharmacy, the manner in which they have to be prepared, constraints on minimal and maximal doses, etc. This has resulted in a complete model describing all substances and

<sup>1</sup> CATO® software, by Hanke & Horner, Vienna, Austria.

materials used for the preparation of cytotoxics.

Once clinicians have validated prescriptions, they are made available to the pharmacy for production (figure 5). At this stage, the chemists can produce the recipe for each preparation (figure 6), potentially grouping several productions into a single preparation recipe such as the same product for several days. Each preparation is of course assigned its own id.

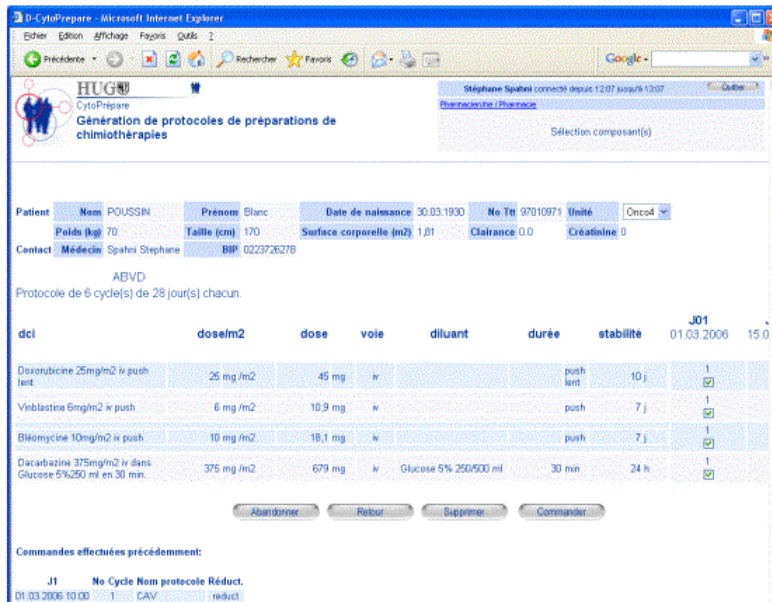


figure 5 Protocol Ready for Production

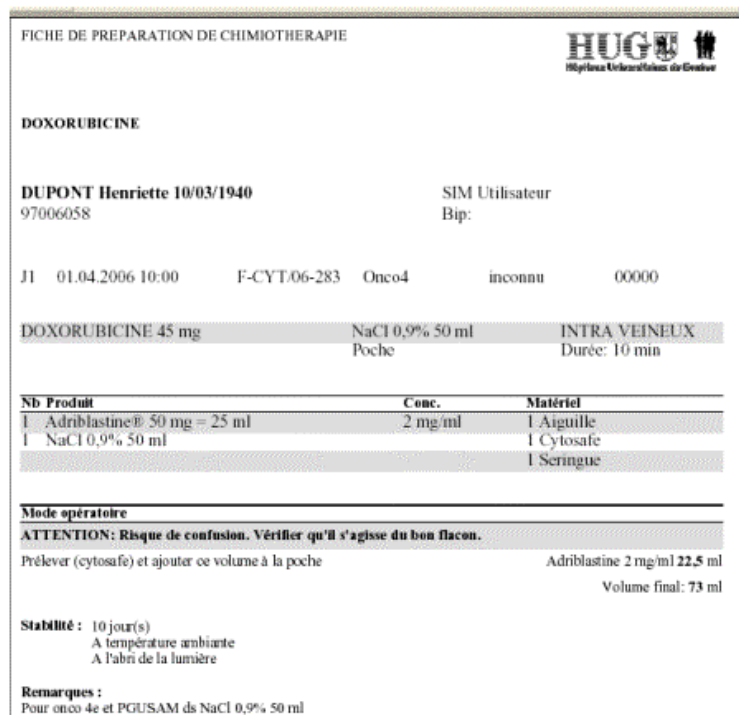


figure 6 Recipe

The pharmacy has also the possibility to view which protocols are waiting for approval,

enabling resource planning for the following days.

## 4. Workflow Management of Preparations

This module aims at supporting the state of the preparations as well as the traceability of the preparations made by the pharmacy. It presents general information for a specific preparation (figure 7) and offers various functions:

- Confirming the current status of a specific preparation (e.g. material prepared, preparation ended, etc.) (figure 8);

The screenshot shows the 'Préparation no D-cyt/06-111' page. It includes a patient profile with fields for name, date of birth, and medical history. Below this, there are sections for 'Produits utilisés' (Products used) and 'Visas' (Visas/Prescriptions). The 'Produits utilisés' section contains a table with columns for 'Dose', 'Nom', 'Type', 'No Dispense', and 'No Lot'. The 'Visas' section contains a table with columns for 'Date visa', 'Date opération', 'Type', 'Initiales', and 'Remarques'.

| Dose | Nom                               | Type                   | No Dispense | No Lot       |
|------|-----------------------------------|------------------------|-------------|--------------|
| 1    | Cisplatine Brevib 100 mg + 100 ml | solutionPreAEnglo      | 12938       | 00969-01-07  |
| 1    | NaCl 0,9% 500 ml                  | solutionPreAEngloQuart | 8333        | 0582205-0608 |

| Date visa           | Date opération   | Type   | Initiales | Remarques |
|---------------------|------------------|--|-----------|-----------|
| 03.03.2006 12:01    | 03.03.2006 12:00 | prescription Tacotène + Cisplatine + RTX oesophage | sts       |           |
| 03.03.2006 12:01    | 03.03.2006 12:01 | sortie matériel                                    | sts       |           |
| 14.03.2006 19:49:00 | 14.03.2006 19:49 | mat-mlq  | sts       |           |

figure 7 General Information for a Preparation

The screenshot shows the 'Préparation no D-cyt/06-111 préparée le 14.03.2006 à 08:00' page. It features a form for updating the preparation status. The 'Type de visa' section has radio buttons for 'Actualisation', 'Blocage de la préparation', 'Annulation de la préparation', and 'Information'. The 'Actualisation' option is selected, and the 'Durée administrée' is set to 50 minutes. There are buttons for 'Ajouter Visa' and 'Annuler'. Below the form is a 'Visas' table with columns for 'Date visa', 'Date opération', 'Type', 'Initiales', and 'Remarques'.

| Date visa           | Date opération   | Type   | Initiales | Remarques |
|---------------------|------------------|--|-----------|-----------|
| 03.03.2006 12:01    | 03.03.2006 12:00 | prescription Tacotène + Cisplatine + RTX oesophage | sts       |           |
| 03.03.2006 12:01    | 03.03.2006 12:01 | sortie matériel                                    | sts       |           |
| 14.03.2006 19:49:00 | 14.03.2006 19:49 | mat-mlq  | sts       |           |

figure 8 Status of a Preparation

- Printing Labels for Preparations (figure 9);



|  |   |
|--|---|
| Onco2: COLLOMBE Marie-Louise 16.02.1946                                  |   |
| CISPLATINE 32 mg   | INTRA VEINEUX <b>J15</b>  |
| Poche NaCl 0,9 % ad 532 ml   |   |
| <b>Conservation:</b><br>A température ambiante<br>A l'abri de la lumière | <b>Exp: 25.03.2006 à 08:00</b><br>Durée: h mn<br>Posé le: à h<br>Débit: ml/h<br>Préparé le: 22.03.2006 à 08.00<br>Lot: D-cyt/06-111 |
| <b>Remarques:</b>  |   |
| CHIMIOThERAPIE   |   |

figure 9 Labels

- Confirmation of Raw Materials and Batch Numbers (figure 10);

The screenshot shows a web browser window displaying a software interface. The browser address bar shows 'http://scotty.hug.ch: D-CytoTrace - Microsoft Internet Explorer'. The page title is 'HUG Chimio Trace, 2004'. The user is identified as 'Stéphane Spätor connecté depuis 13.02.2006 à 14:05'. The main content area is titled 'Préparation no D-cyt/06-111' and contains a table of 'Produits utilisés:'. The table has columns for 'Qté', 'Nom', 'Type', 'No Diagène', 'Actif', 'No Lot (numéro MREA)', and 'Action'. The table lists several items: Cisplatine Clivine® 100 mg + 100 ml, NaCl 0,9% 500 ml, Cytosate, and Seringue. The 'Actif' column contains checkboxes, and the 'No Lot' column contains input fields for lot numbers and dates.

figure 10 Update of Raw Materials Used

- Assigning complementary information to preparations in order to support the administration module (blocking a preparation due to a failed quality control; extending use-by: date; etc.);
- Linking the specific pharmacy applications with the CATO® software (i.e. sending orders, getting preparation status back);
- Support for traceability of the cytotoxics.

## 5. Administration of Preparations

Once a preparation is ready, it is sent to the patient's ward unit. As the goal of the whole project is to ensure a global quality, a tool for guiding the administration process has also been developed. This tool supports the nurses or the clinicians in the validation process by checking items such as correct preparation for the right patient and that the preparation is still usable (i.e. not outdated, not blocked after distribution by the pharmacy, etc.). It also provides valuable information including exact flow for bags or pumps, current status of the delivery, etc.

This application required the patient identity and preparation number. This is realized by using three RFID (Radio Frequency Identification) chips with one on each of the following: nurse's identity badge, label of the preparation and patient's bracelet. References stored on RFID chips are international UCC/EAN-128 codes uniquely describing the patient, the nurse or the clinician and the prescription preparations. Before the administration starts, or during the administration when a control is wished, RFID codes are scanned and sent to HIS for validation.

As shown in figure 11, the terminal used by the nurse for making these controls is a simple PDA (Portable Digital Assistant) equipped with a RFID reader which communicates through the WiFi (Wireless Fidelity) network linked with the central servers.



*figure 11 PDA used during the administration phase*

This application enables not only the validation that it is the right preparation for the right patient but also informs the HIS when a specific preparation has been administered. Nurses have also the possibility through the same interface to suspend, restart, end or cancel an administration. Thus valuable information can then be included in the electronic patient record.

## 6. Conclusion

With this set of applications, a complete solution for management of chemotherapy is available. Easy to configure, it can be accustomed to local procedures such as the production of preparations. The strong involvement of oncologists, chemists as well as nurses makes it truly adaptable to the needs of the users. Initial feedback suggests high satisfaction with the tools they have available now for supporting their work.

## 7. Acknowledgements

This project has been accomplished with close collaboration between the Radiology and Medical Informatics Department (Prof. Antoine Geissbühler, Prof. Christian Lovis), the Central Pharmacy (Mrs Monique Ackermann, Dr. Pascal Bonnabry), and the Department of Oncology (Dr. Nicolas Mach., Mrs Lucienne Bigler, Mrs Sophie Ledu) in the University Hospitals of Geneva, Switzerland.