# Web*THAL*

## Web-based clinical records program for thalassaemia patients

Medical Board: **Brindisi, Cagliari, Genova, Milano, Torino**
Educational grant: **Novartis**
Development & support: **M.O.S.T. srl**

Dott. Lorenzo Nazario

# WebTHAL

- The project
- Core functions
- Project status
- Future developments

MOST

# The project

- Origins
- Mission
- Implementation

# WebThal: project history

- **Get rid of the drawbacks of the old Camputhal program:**
  - **Not Year 2000 compliant**
  - **>20 year old!**
  - **Not internet ready**
  - **Shared use of clinical data among users (> 20 hospitals, both in Italy and abroad)**

# Project goals

- **Common core:**
  - **Clinical records**
  - **Computer code**
- **Ad hoc enhancements for specific needs**
- **Capitalize on  the internet advantages**

# Project goals

- **A tool both flexible and extendable (custom sections, i.e. cardiological,..)**
- **Deploy a network of thalassaemia competence centers:**
  - **Epidemiological data**
  - **Therapy**
  - **Studies**
  - **National registry**

# Implementation

- Take advantage of an existing product, in order to minimize startup delays
- Intranet / internet web solution
- Handling of records and attachments
- Data export for statistical analysis

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# Implementation

- Standard based solution
- No scalability limits
- Native web support
- Local and Remote access

# Implementation

- No software installation on the user workstation
- Remote maintenance and updates

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# Core

- Features
- Strengths
- Clinical core
- Application survey

# Features

- **Off the shelf product that handles both data base and archive interactions:**

- **Both data and documents archiving (echography, radiography, spettrographical analisys, …)**

- **Web based**

# Features

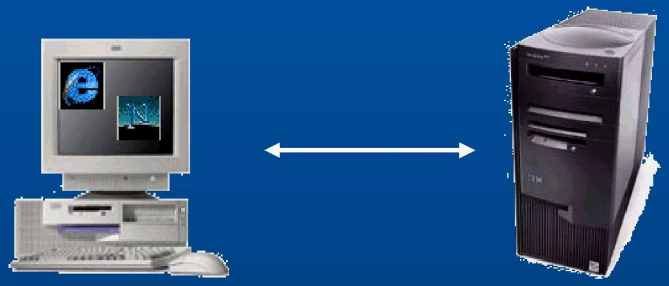
- **Standards based**
  - Web Interface (HTML+Java+Javascript)
  - SQL database
  - Secure protocol for data transmission over public lines: Secure Socket Layer (SSL)
- **Easy scalability**
  - Already used for millions of documents
  - Available on Unix platforms, both Intel (Linux) and SUN (Solaris) based

# Features

- **Easy customization:**
  - **Common core, ad hoc developments**
  - **Ad hoc developments will be shared among remaining centers (prenatal analisys, computer interface with test laboratories)**

# Features

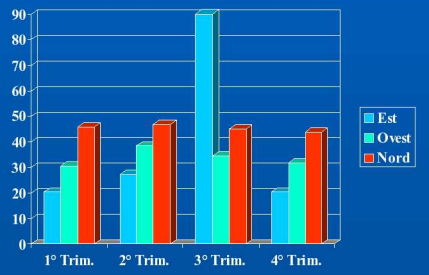
- Model based on Web servers and Browser client



- Client workstation do not need special software

# Features

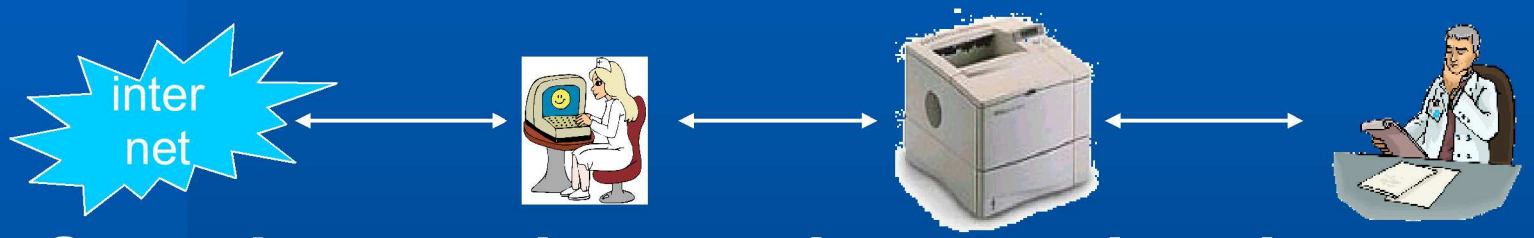
- Data export for statistical programs




- Remote software update

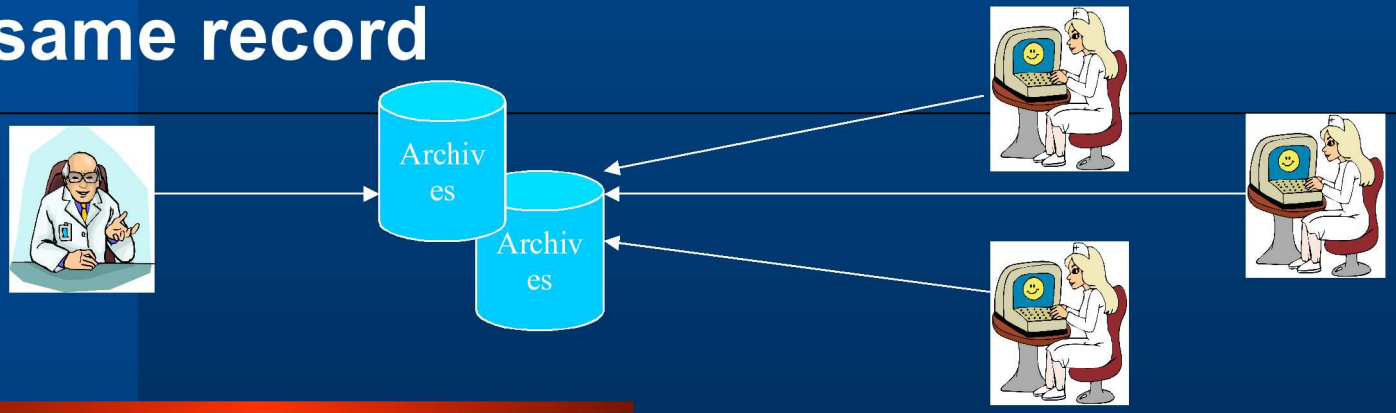
# Features

- **Paper print** of the clinical records




- Complex queries can be saved and retrieved later

- Handling of a **simultaneous** change of the same record



# Strengths

- Local and remote access
- Easy data sharing and data aggregation on the main server
- Easy customization
- Web based from project design
- Everybody knows how to use a web browser: fast learning curve

# Q&A

- Is the network mandatory?
  - No, in case of a missing network, the server can be installed stand alone
- Who is in charge of the server handling?
  - Remotely controlled
  - A National server is available ( www.talassemia.it), it can be used by small centers, maintaining all the features of a local installation (clinical records print from the browser)

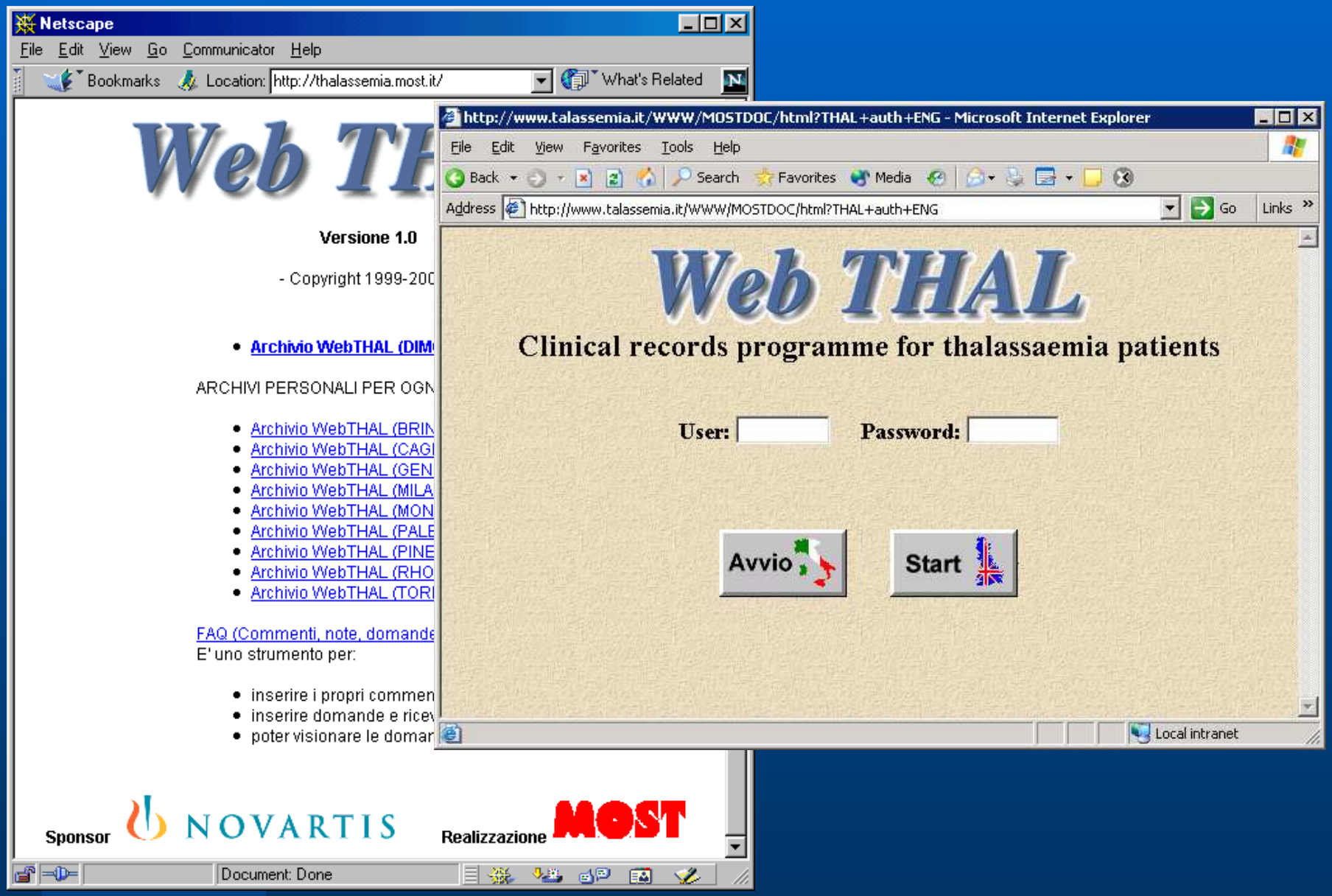
# Medical core

1. Private data
2. Family tree
3-10. DAY HOSPITAL
    3. Treatment
    4. Blood transfusion
    5. Iron chelation
    6. Chelation follow up
    7. Therapy 1
    8. Therapy 2 (diet)
    9-10. Blood test (1-2)
11. New Iron chelator FOLLOW UP
12. TESTS.
13. Cardiological data.
14. Urinary Iron Excretion
15. Intensive Chelation
16. Annual Summary chart
17. SCHEDA COMPLICANZE
18. Clinical diary

*** Specialistic Charts ***

19-22. Cardiological chart
    19. Heart assessment
    20. Echocardiocraphy
    21. HOLTER
    22. ERGOSPIROMETRY
23. Prenatal diagnosis
24. Test Laboratories interface

XX. ENDOCRINOLOGIC chart


Netscape
File Edit View Go Communicator Help
Bookmarks Location: http://thalassemia.most.it/ What's Related
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Versione 1.0
- Copyright 1999-200
Archivio WebTHAL (DIM
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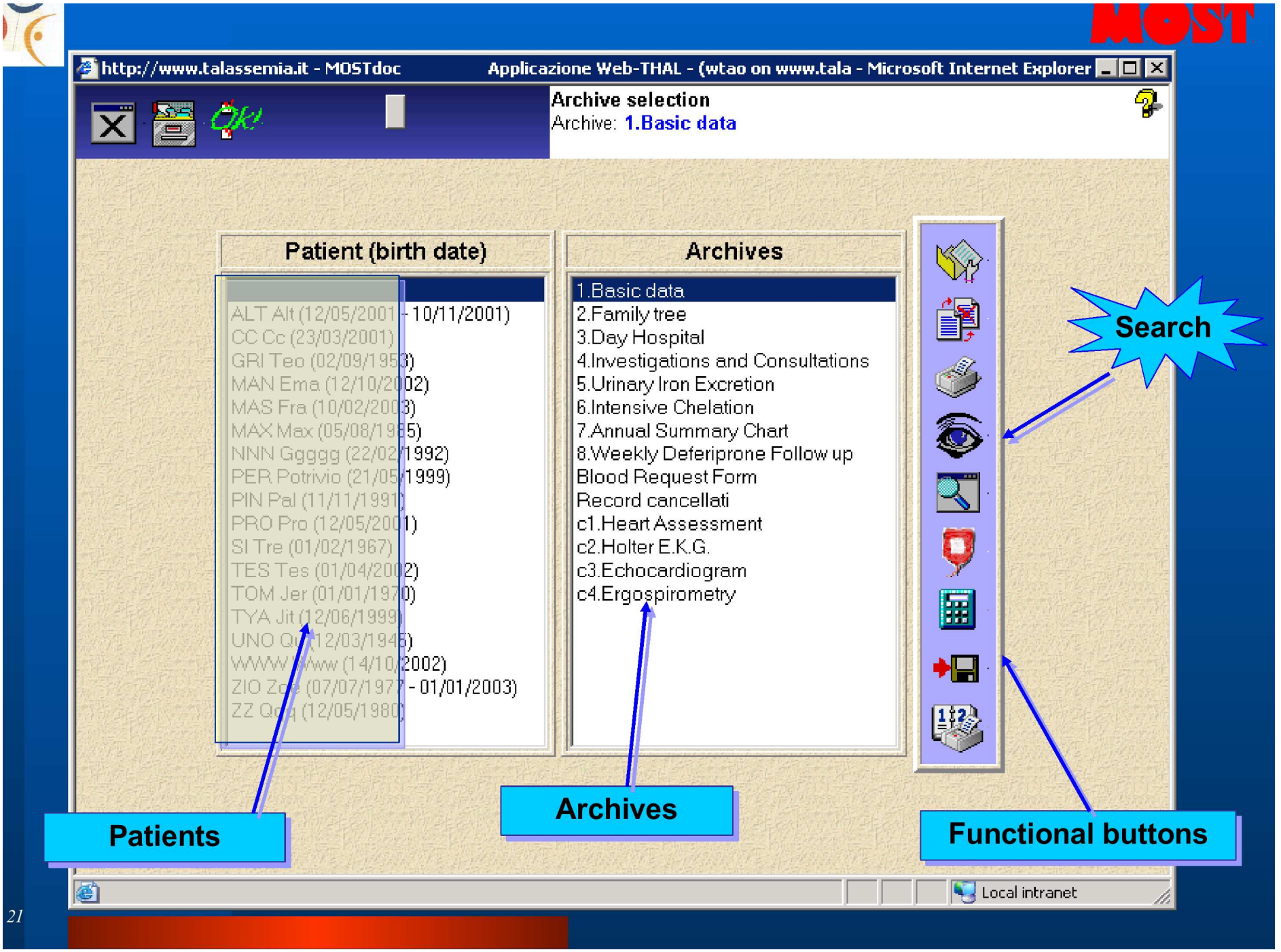
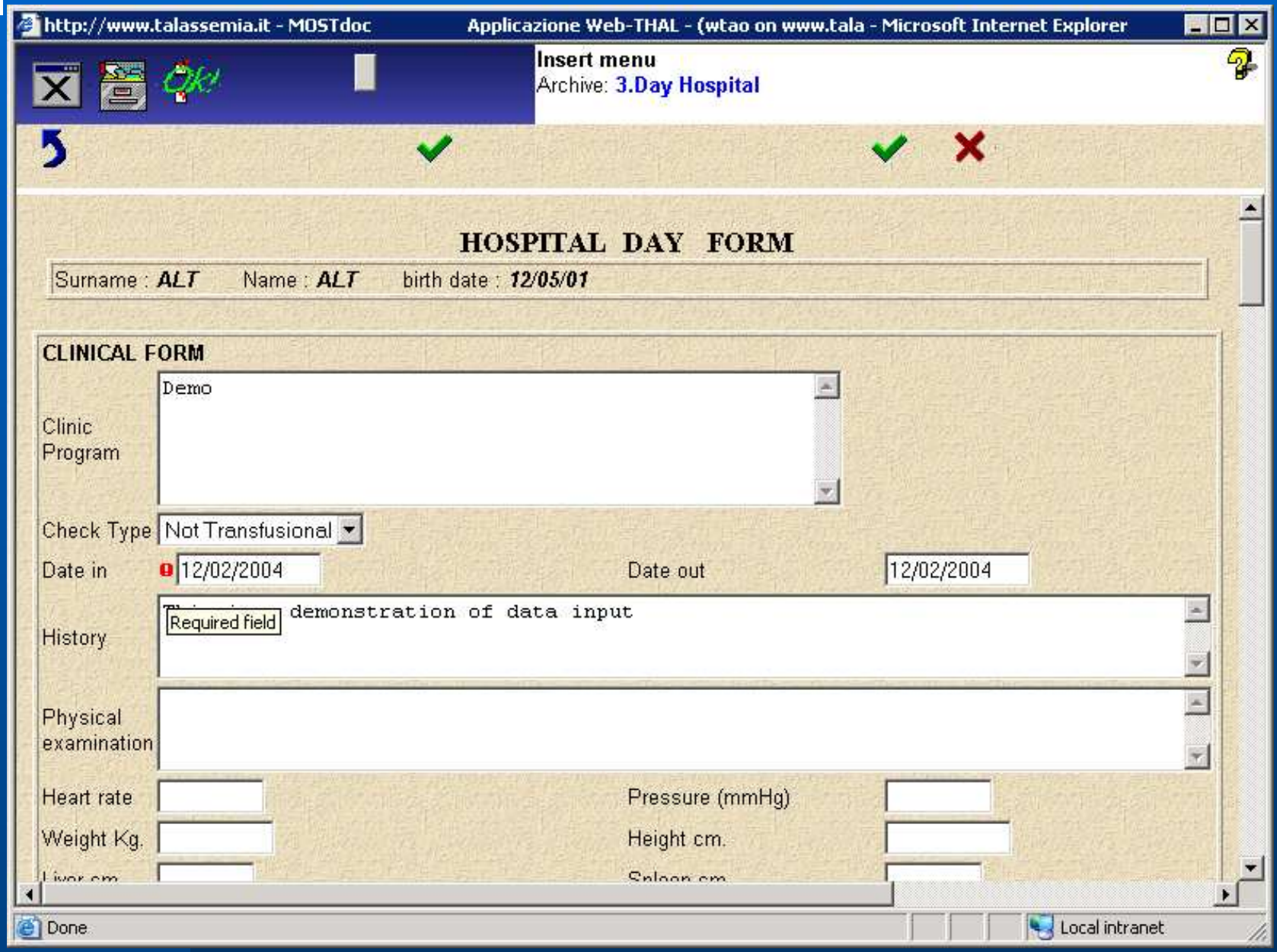
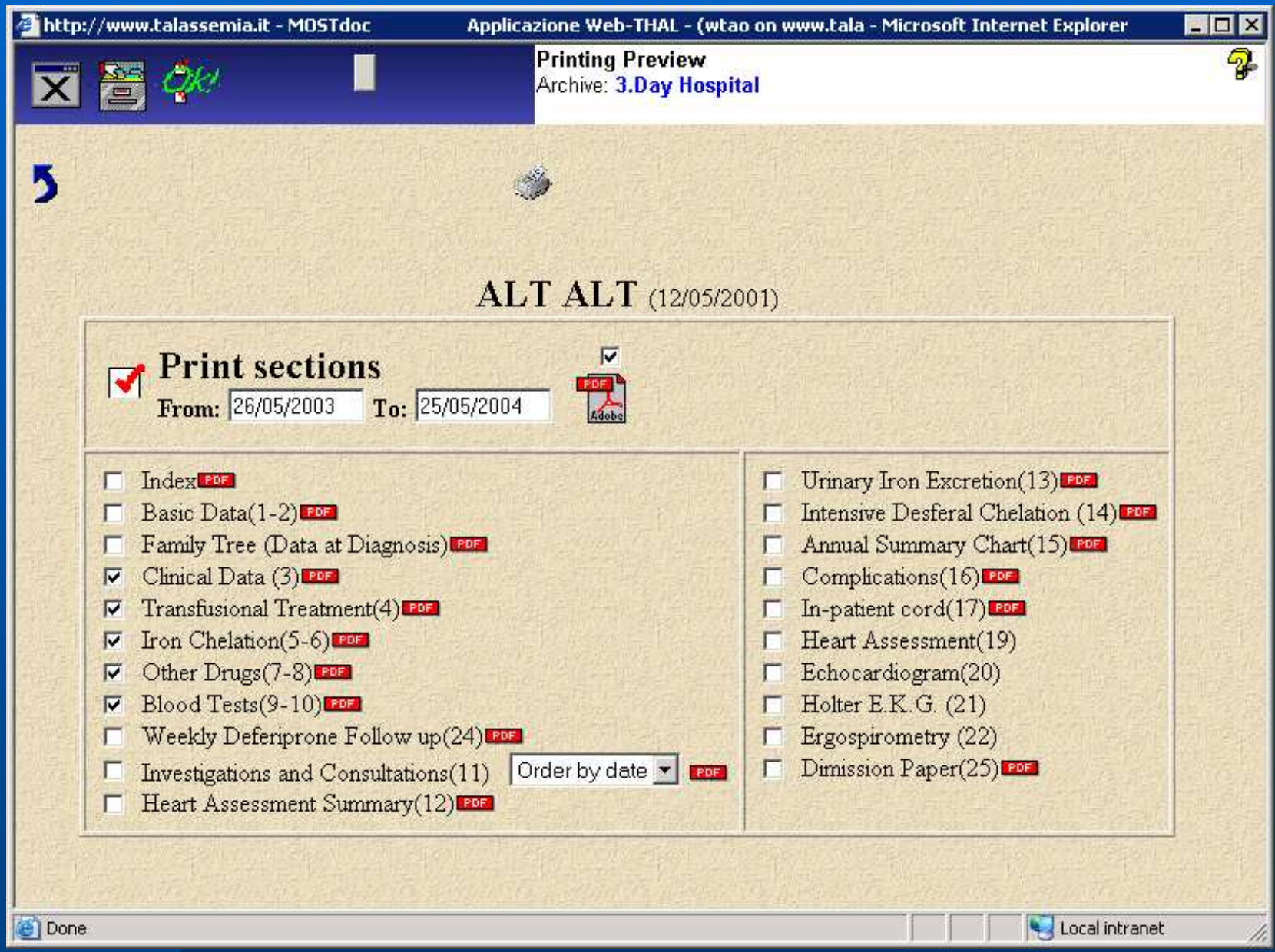
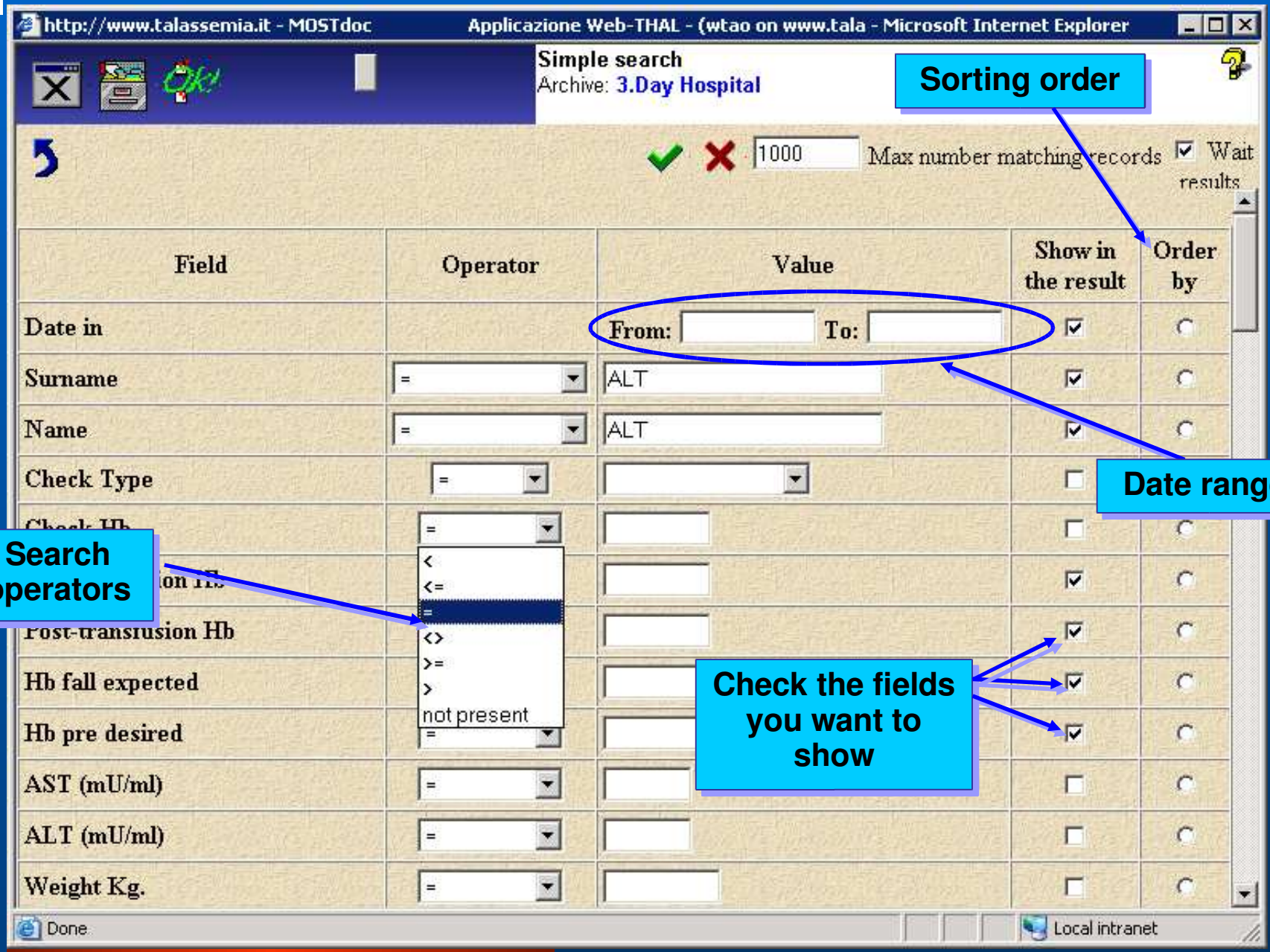
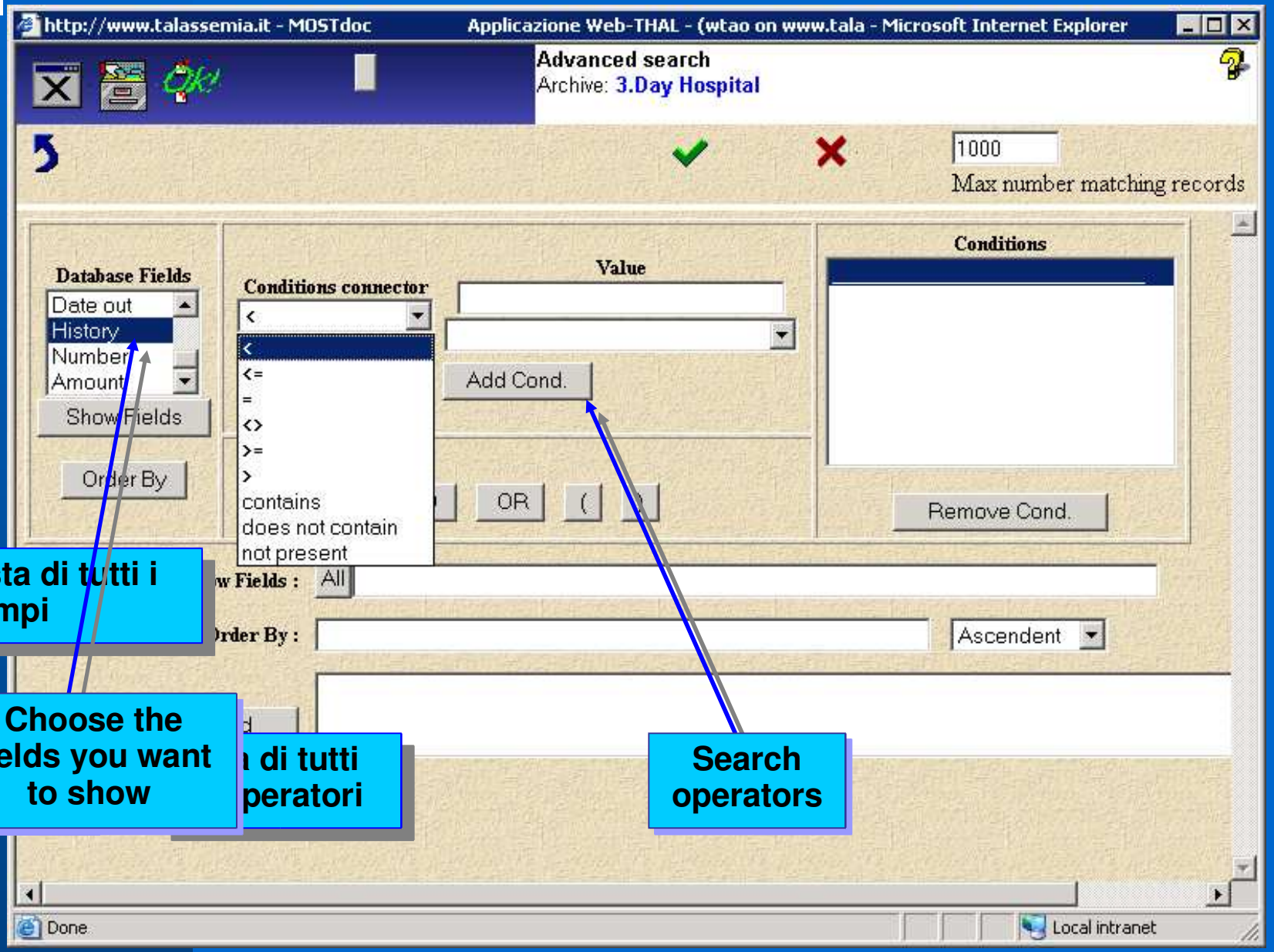
Archivio WebTHAL (PINE
Archivio WebTHAL (RHO
Archivio WebTHAL (TORI
FAQ (Commenti, note, domande
E' uno strumento per:
inserire i propri commen
inserire domande e ricev
poter visionare le domar
Sponsor NOVARTIS
Realizzazione MOST
Document: Done
http://www.talassemia.it/WWW/MOSTDOC/html?THAL+auth+ENG - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www.talassemia.it/WWW/MOSTDOC/html?THAL+auth+ENG
Go Links
Web THAL
Clinical records programme for thalassaemia patients
User:
Password:
Avvio
Start
Local intranet


http://www.talassemia.it - MOSTdoc
Applicazione Web-THAL - (wtao on www.tala - Microsoft Internet Explorer
Archive selection
Archive: 1.Basic data
Patient (birth date)
ALT Alt (12/05/2001 - 10/11/2001)
CC Cc (23/03/2001)
GRI Teo (02/09/1953)
MAN Ema (12/10/2002)
MAS Fra (10/02/2003)
MAX Max (05/08/1985)
NNN Ggggg (22/02/1992)
PER Potrivio (21/05/1999)
PIN Pal (11/11/1991)
PRO Pro (12/05/2001)
SI Tre (01/02/1967)
TES Tes (01/04/2002)
TOM Jer (01/01/1970)
TYA Jit (12/06/1999)
UNO Qui (12/03/1945)
WWW Www (14/10/2002)
ZIO Zio (07/07/1977 - 01/01/2003)
ZZ Qua (12/05/1980)
Archives
1.Basic data
2.Family tree
3.Day Hospital
4.Investigations and Consultations
5.Urinary Iron Excretion
6.Intensive Chelation
7.Annual Summary Chart
8.Weekly Deferiprone Follow up
Blood Request Form
Record cancellati
c1.Heart Assessment
c2.Holter E.K.G.
c3.Echocardiogram
c4.Ergospirometry
Search
Patients
Archives
Functional buttons
Local intranet


http://www.talassemia.it - MOSTdoc
Applicazione Web-THAL - (wtao on www.tala - Microsoft Internet Explorer
Insert menu
Archive: 3.Day Hospital
HOSPITAL DAY FORM
Surname : ALT Name : ALT birth date : 12/05/01
CLINICAL FORM
Clinic Program
Demo
Check Type
Not Transfusional
Date in
12/02/2004
Date out
12/02/2004
History
Required field
demonstration of data input
Physical examination
Heart rate
Pressure (mmHg)
Weight Kg.
Height cm.
Done
Local intranet


http://www.talassemia.it - MOSTdoc
Applicazione Web-THAL - (wtao on www.tala - Microsoft Internet Explorer
Printing Preview
Archive: 3.Day Hospital
5
ALT ALT (12/05/2001)
Print sections
From: 26/05/2003
To: 25/05/2004
Index
Basic Data(1-2)
Family Tree (Data at Diagnosis)
Clinical Data (3)
Transfusional Treatment(4)
Iron Chelation(5-6)
Other Drugs(7-8)
Blood Tests(9-10)
Weekly Deferiprone Follow up(24)
Investigations and Consultations(11)
Order by date
Heart Assessment Summary(12)
Urinary Iron Excretion(13)
Intensive Desferal Chelation (14)
Annual Summary Chart(15)
Complications(16)
In-patient cord(17)
Heart Assessment(19)
Echocardiogram(20)
Holter E.K.G. (21)
Ergospirometry (22)
Dimission Paper(25)
Done
Local intranet

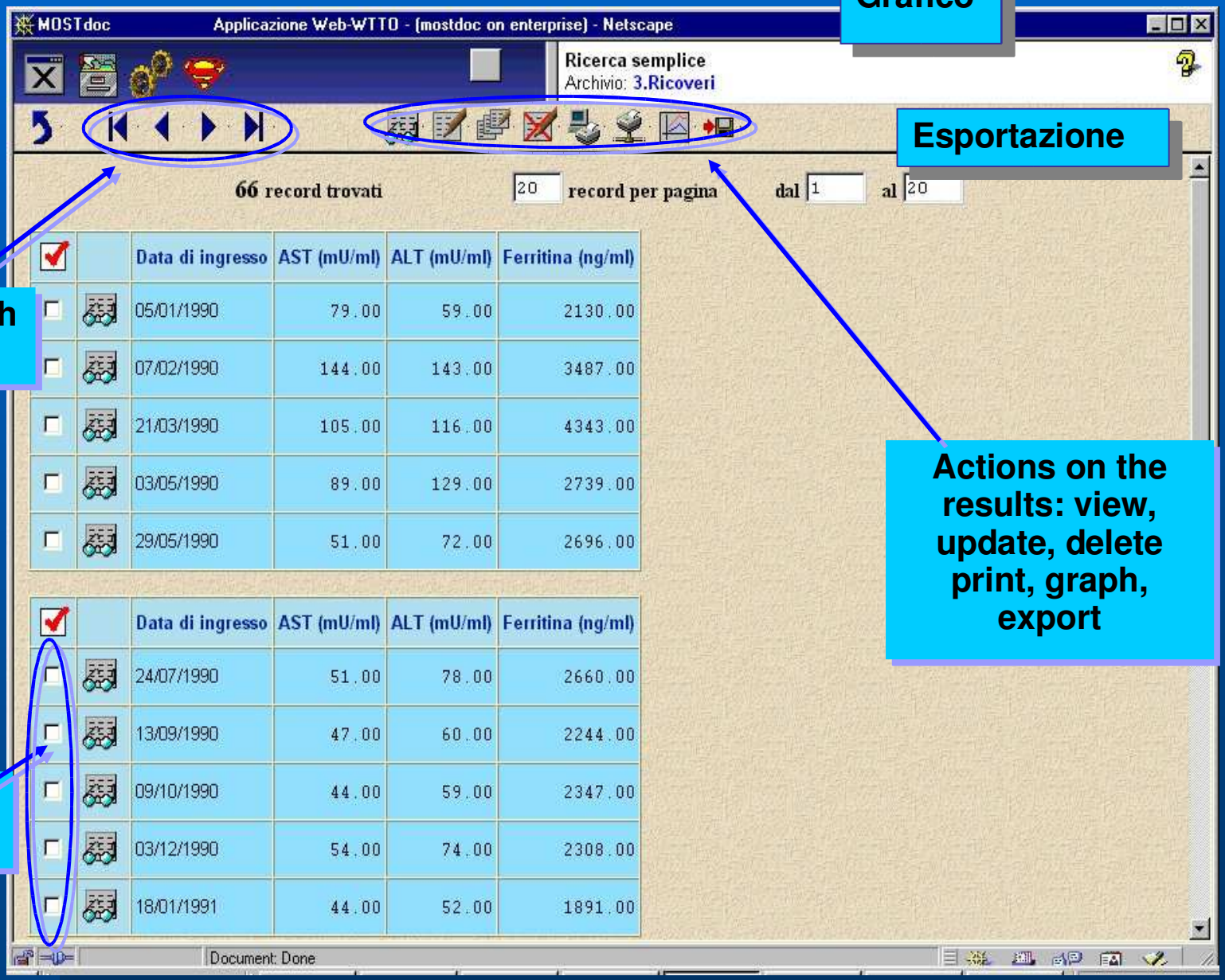

http://www.talassemia.it - MOSTdoc
Applicazione Web-THAL - (wtao on www.tala - Microsoft Internet Explorer
Simple search
Archive: 3.Day Hospital
Sorting order
1000
Max number matching records
Wait results
Field
Operator
Value
Show in the result
Order by
Date in
From:
To:
Surname
ALT
Name
ALT
Check Type
Post-transfusion Hb
Hb fall expected
Hb pre desired
AST (mU/ml)
ALT (mU/ml)
Weight Kg.
<
<=
=
<>
>=
>
not present
Date range
Search operators
Check the fields you want to show
Done
Local intranet




**Lista di tutti i campi**

**Choose the fields you want to show**

**Search operators**




Grafico

Esportazione

Move through the results

Actions on the results: view, update, delete print, graph, export

Record selection

MOSTdoc Applicazione Web-WTTO - ( on 130.192.110.4) - Netscape

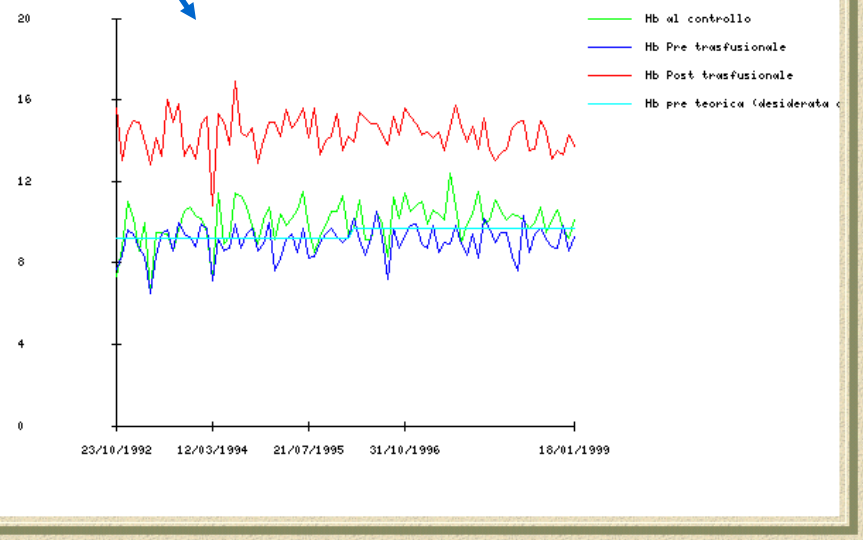
Ricerca semplice
Archivio: 3.Ricoveri

82 record trovati | 20 record per pagina | dal 1 al 20

| | | Data di ingresso | Hb al controllo | Hb Pre trasfusionale | Hb Post trasfusionale | Hb pre teorica (desiderata al prossimo controllo) |
|---|---|---|---|---|---|---|
| ☐ | | 23/10/1992 | 7.30 | 7.70 | 15.60 | 9.20 |
| ☐ | | 25/11/1992 | 8.70 | 8.40 | 13.00 | 9.20 |
| ☐ | | 23/12/1992 | 11.00 | 9.60 | 14.50 | 9.20 |
| ☐ | | 28/01/1993 | 10.20 | 9.40 | 15.00 | 9.20 |
| ☐ | | 11/03/1993 | 8.60 | 8.70 | 14.90 | 9.20 |

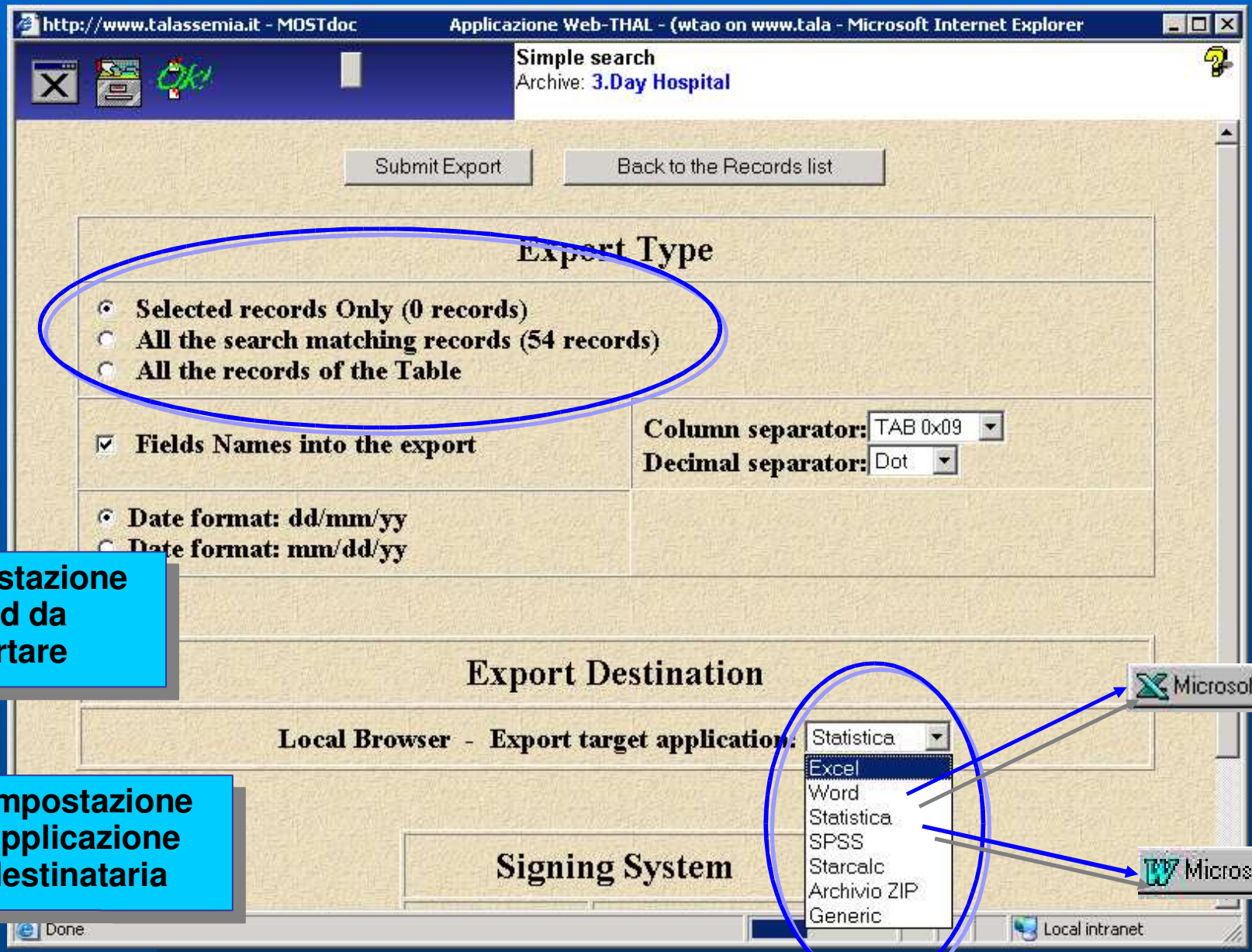
| | | Data di ingresso | Hb al controllo | Hb Pre trasfusionale | Hb Post trasfusionale | Hb pre teorica (desiderata al prossimo controllo) |
|---|---|---|---|---|---|---|

Document: Done



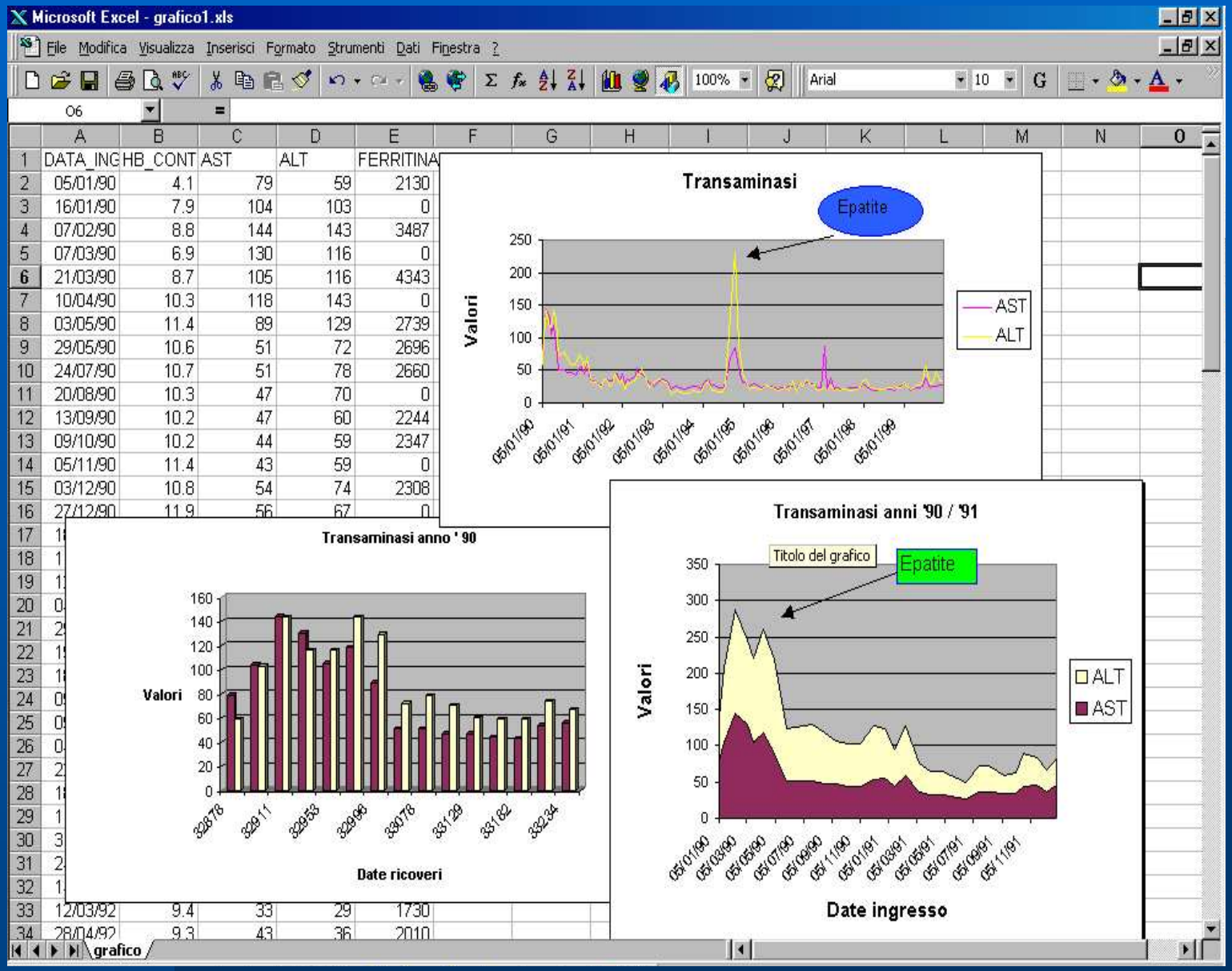



WebTHAL




**Impostazione record da esportare**

**Impostazione applicazione destinataria**


Microsoft Excel - grafico1.xls
File Modifica Visualizza Inserisci Formato Strumenti Dati Finestra ?
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DATA_ING HB_CONT AST ALT FERRITINA
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16/01/90 7.9 104 103 0
07/02/90 8.8 144 143 3487
07/03/90 6.9 130 116 0
21/03/90 8.7 105 116 4343
10/04/90 10.3 118 143 0
03/05/90 11.4 89 129 2739
29/05/90 10.6 51 72 2696
24/07/90 10.7 51 78 2660
20/08/90 10.3 47 70 0
13/09/90 10.2 47 60 2244
09/10/90 10.2 44 59 2347
05/11/90 11.4 43 59 0
03/12/90 10.8 54 74 2308
12/03/92 9.4 33 29 1730
28/04/92 9.3 43 36 2010
grafico
Transaminasi
Epatite
Valori
AST
ALT
Transaminasi anno ' 90
Valori
Date ricoveri
Transaminasi anni '90 / '91
Titolo del grafico
Epatite
Valori
ALT
AST
Date ingresso

# Hardware requirements

- **WebTHAL servers**
  - Pentium III or higher, Hard disk > 20Gbyte, Ethernet and remote connection
  - Main center is based on a 64 bit Ultra sparc
- **WebThal clients**
  - Any graphical workstation (Windows 3.11, 95, 98, NT, W2000, XP Macintosh o Unix) with a browser (Netscape 3.1 or higher,  Explorer 4.0 or higher)

# Software requirements

- **WebTHAL Servers**
  - Intel: Linux, with security updates (at least monthly)
  - MOST*doc archiving system*
  - Webthal enhancements to MOSTdoc
- **WebTHAL clients**
  - Netscape 3.1 or higher, Explorer 4.0 or higher

# Project status

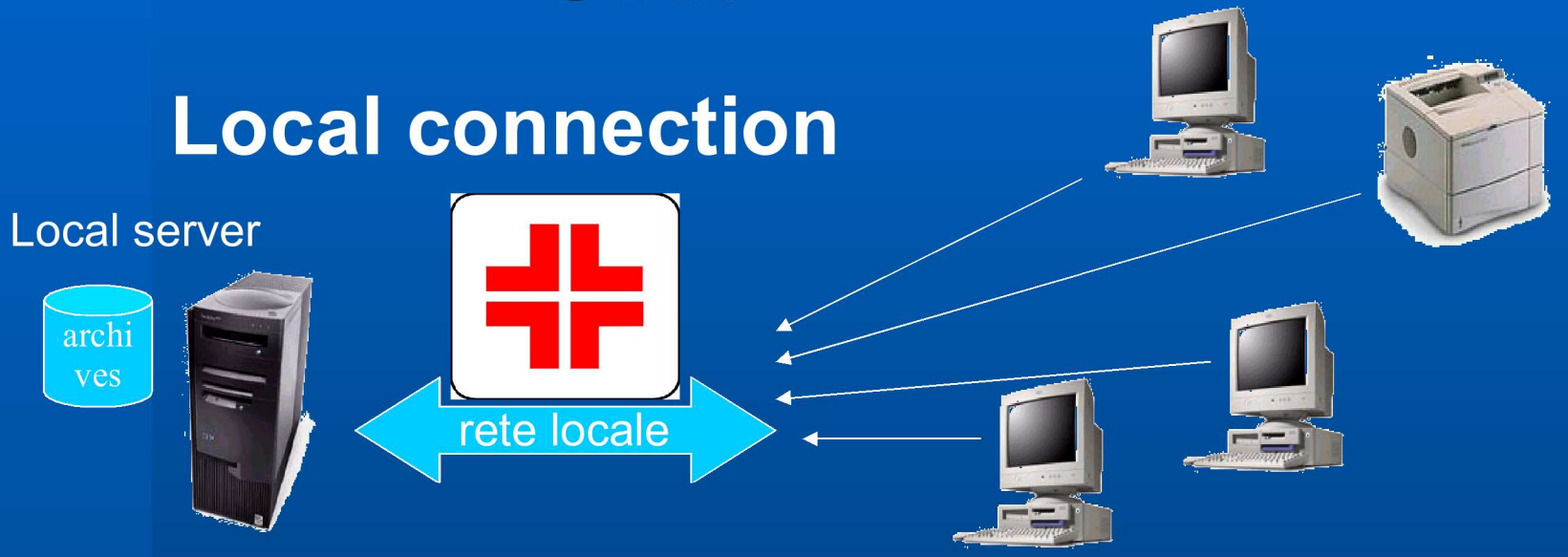
- Possible use
- Core extensions
- Multicenter studies
- Security
- Support
- Logistic / administration

# Utilization patterns

- **International Master Server**
  - Data Collection, backup and post processing of the peripheral records
  - Handling of *remote access* centers
- **Independent local access server**
  - High level centers, able to customize the software installation, that share data with the main server
- **Local access server**
  - In house server with remote support
- **Remote access**
  - Web browser only, with internet access (and a printer)

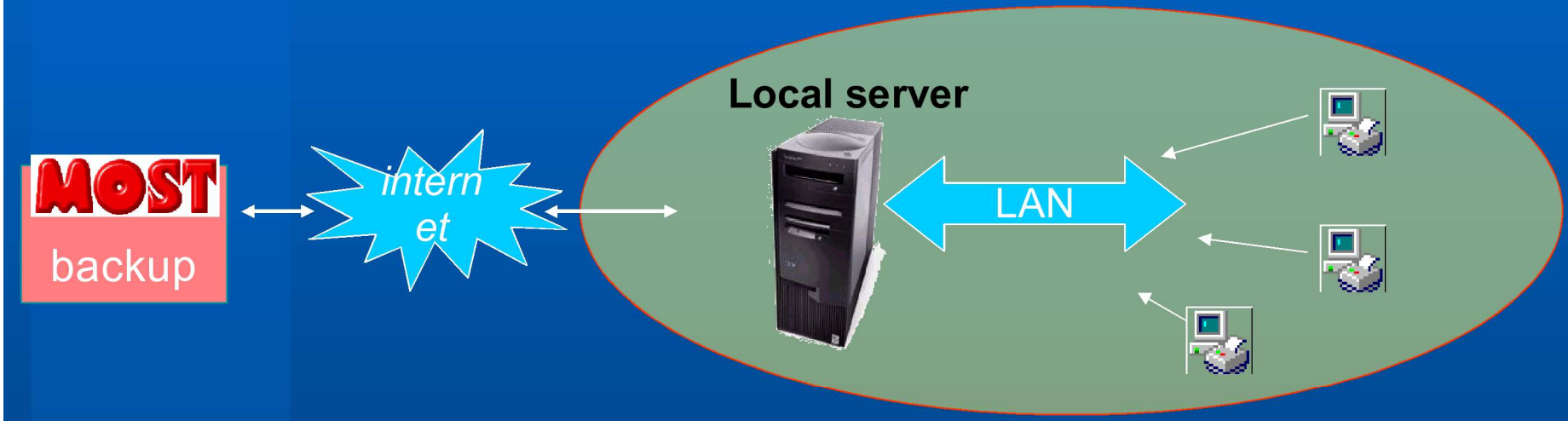
# Uses

## Local connection



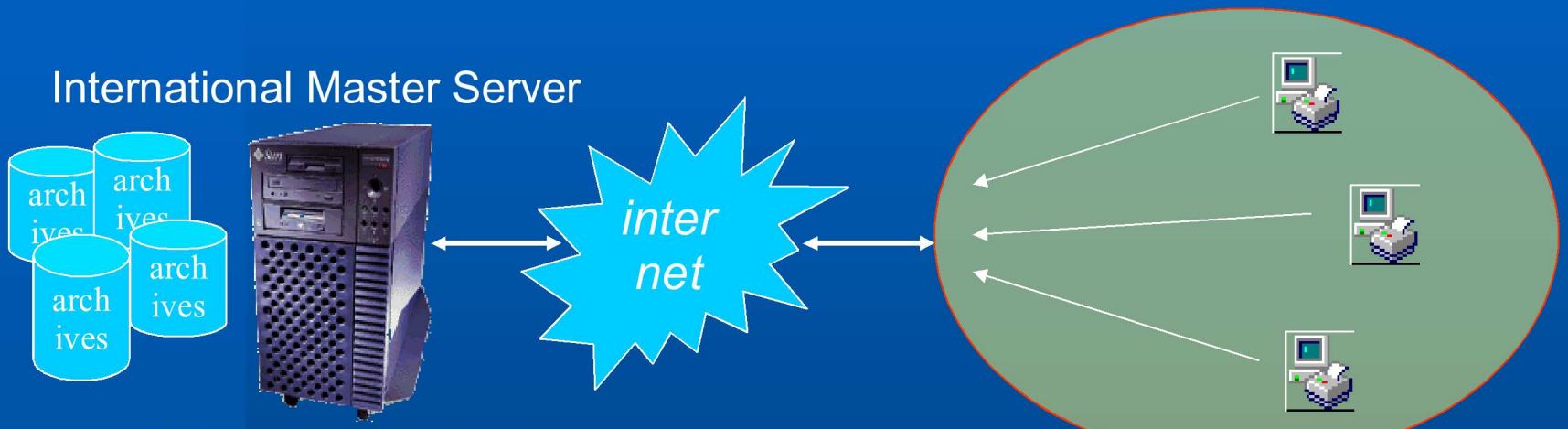

## Remote connection

# Local access server



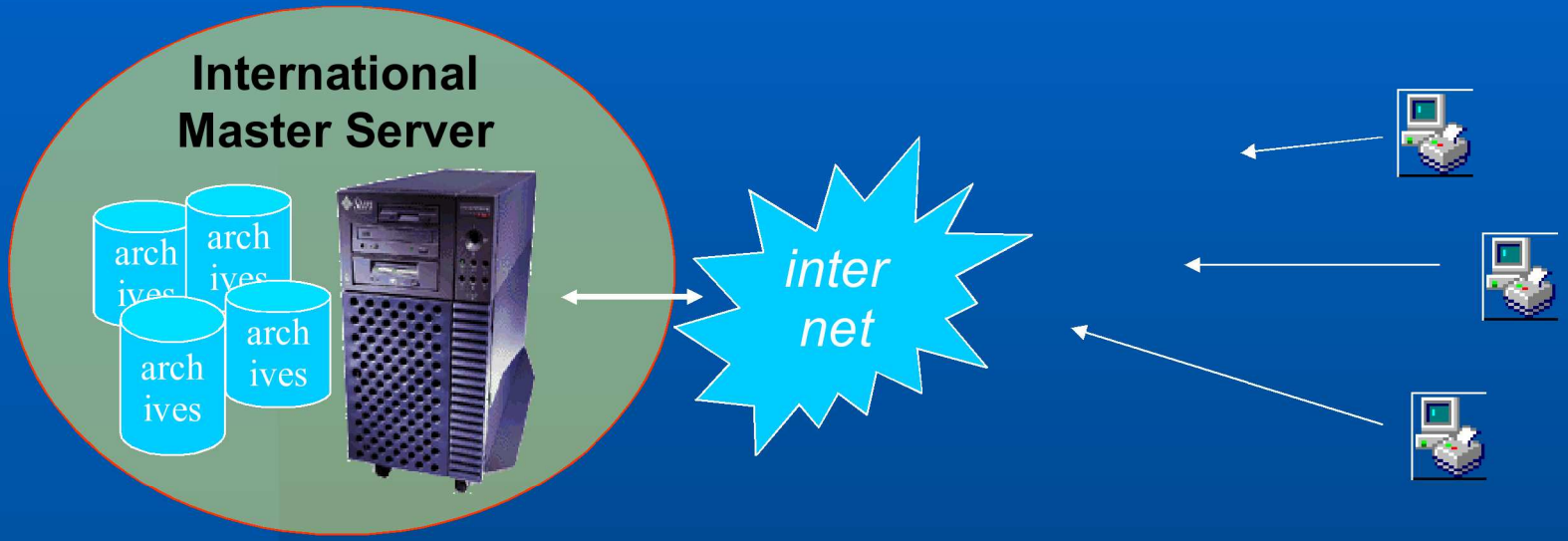

- WebTHAL server, seen as a black box
- The server has a graphical interface, allowing a direct operation on it, or, having a Local Area Network, client workstation can be used (if enabled)
- The server, if enabled, allows remote handling and backup
- Program updatates, security patches etc , are performed remotely

# Remote access centers




- **NO WebTHAL local server**
- **One or more PC connected to the national server using internet**
- **They connect to the national server for day by day use of the clinical records and for shared studies**
- **Clinical records are printed on local printers**
- **Data privacy is strongly enforced, cryptography is applied on every data transmission**
- **Explicit agreement is mandatory for a shared use of the collected data**

# International Master Server

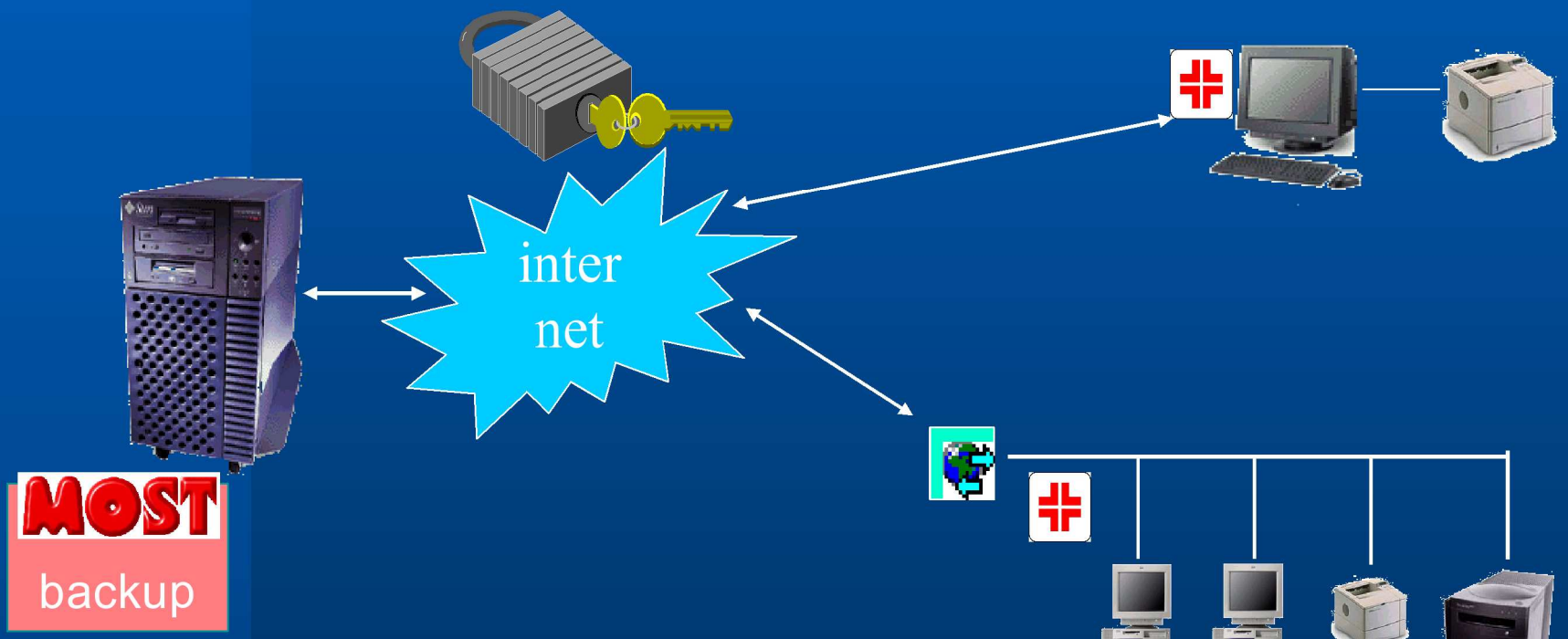



- High availability connection (10 MB/s Fiber optic and 2 Mb/s HDSL)
- Holds:
  - clinical records of the remote access centers
  - Backup copy of the clinical records of the local access servers
  - Talassemia.it Site
  - Anonymous data for shared studies

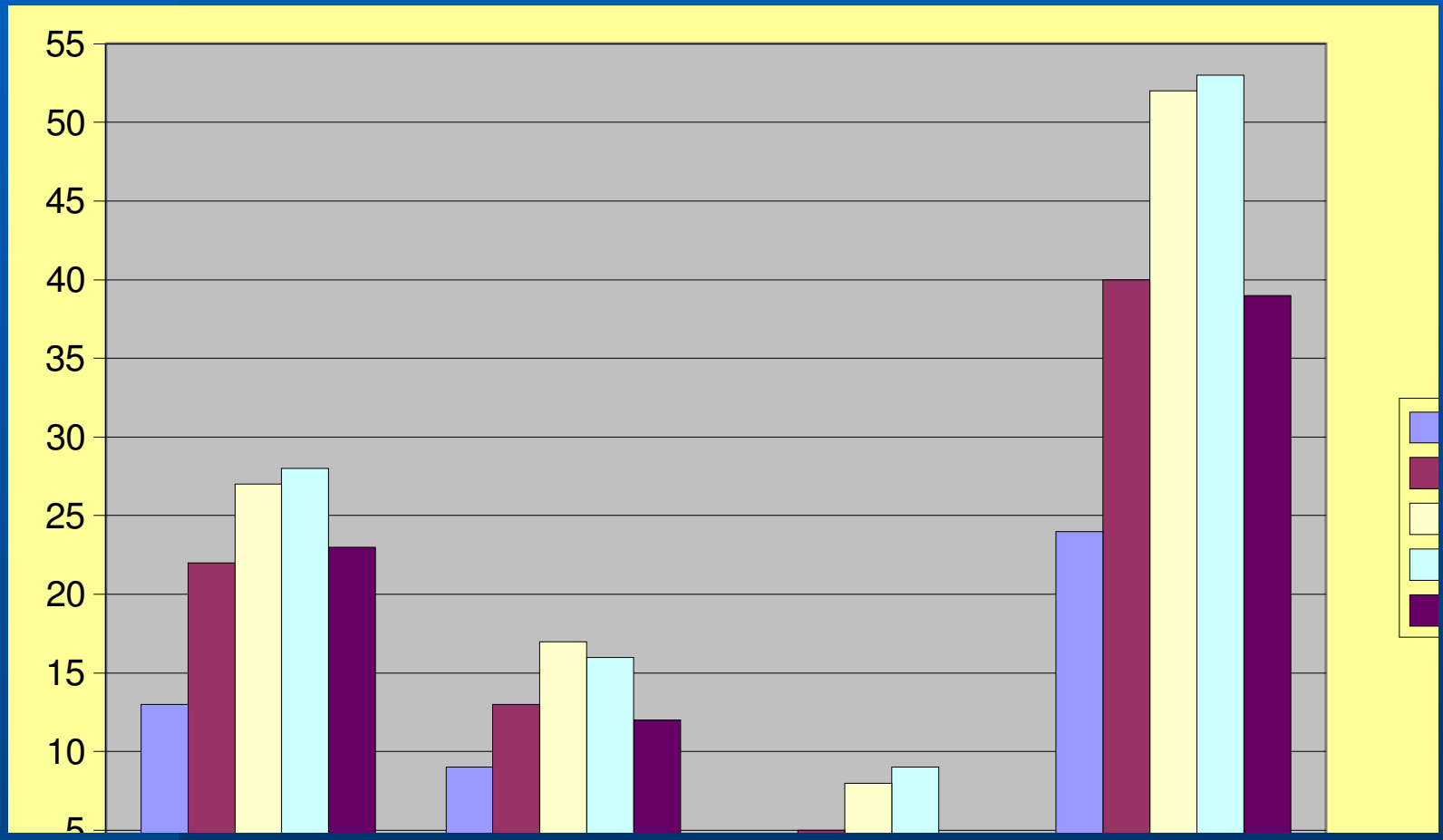
# International Master Server

- ***Internet site: www.talassemia.it***
  - **Project presentation**
  - **Newsletter**
  - **Meeting schedule**
  - **WebTHAL, working demo version**
  - **Shared studies results**
  - **Center list**
  - **Clinical examples**

# Overall picture



# Overall picture



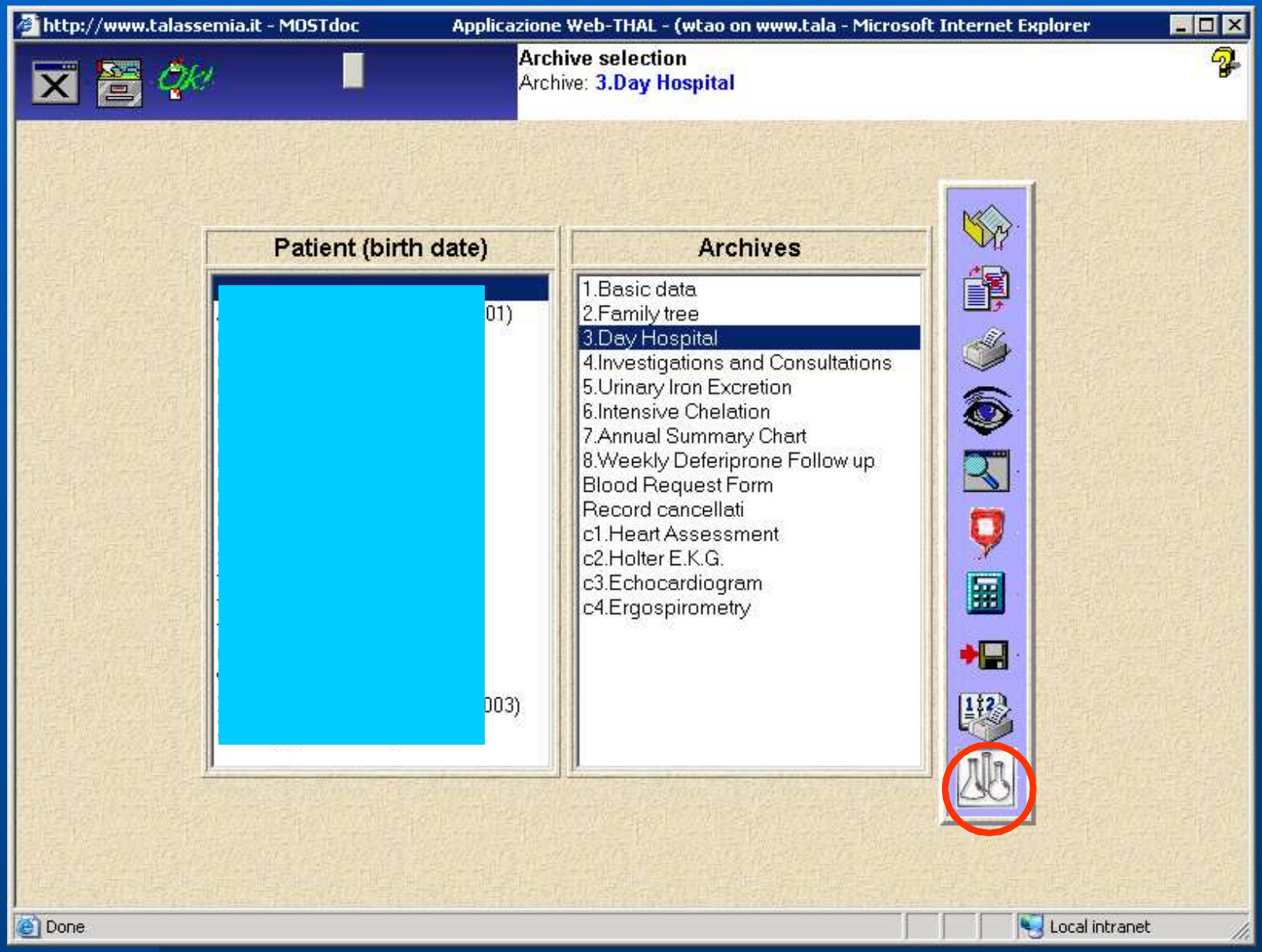
# “CORE” extensions

- **Cardiological section** (2001)
- **Prenatal diagnosis** (2002-2003)
- **Laboratories interface** (2002-2003)
- **Endocrinological section** (2004-2005)

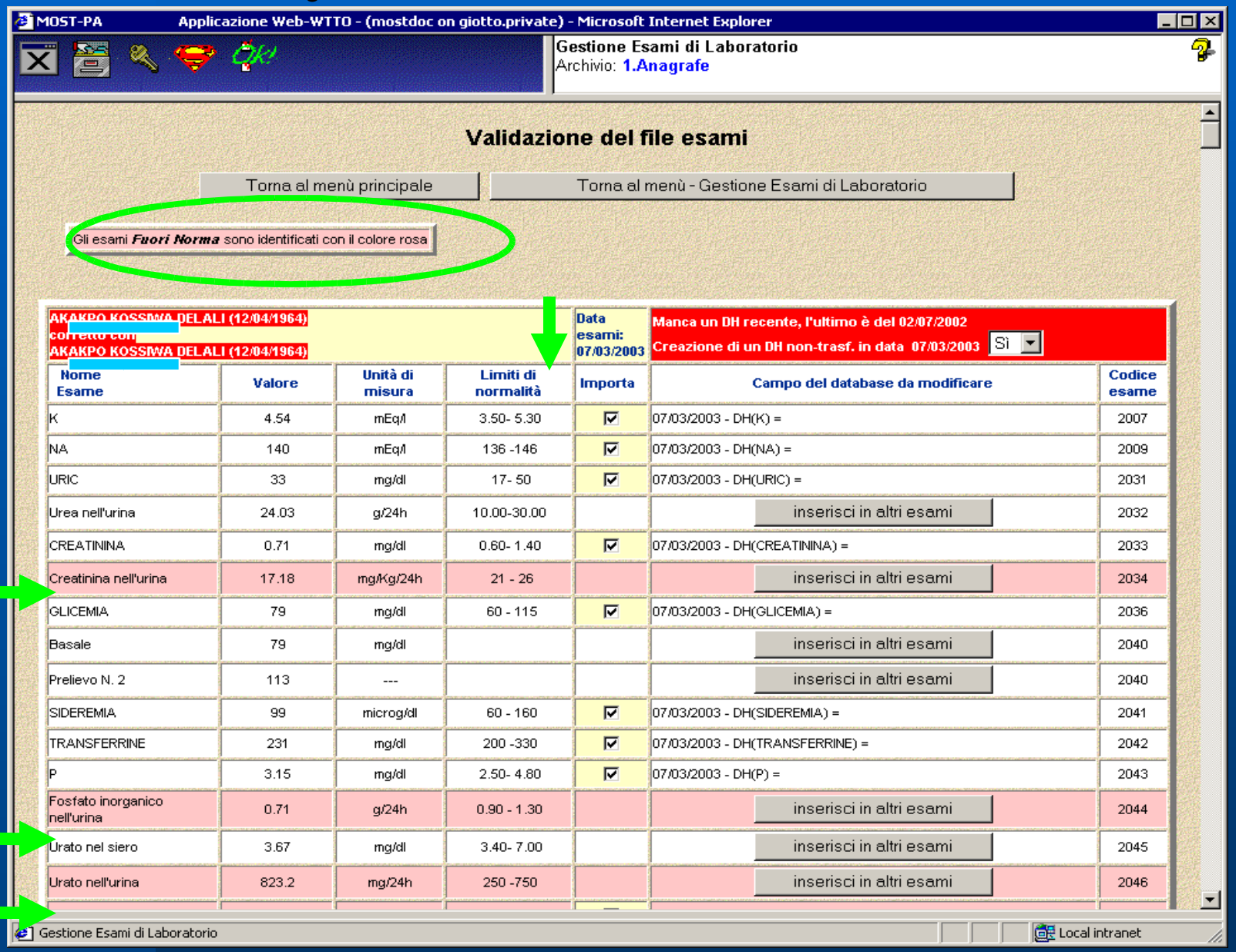
# Laboratories interface

- Exams record in XML format, common to all centers
- Custom plug-in for data conversion from the laboratories of the 3 pilot centers (Torino, Genova e Cagliari)
- Digital signature of imported data

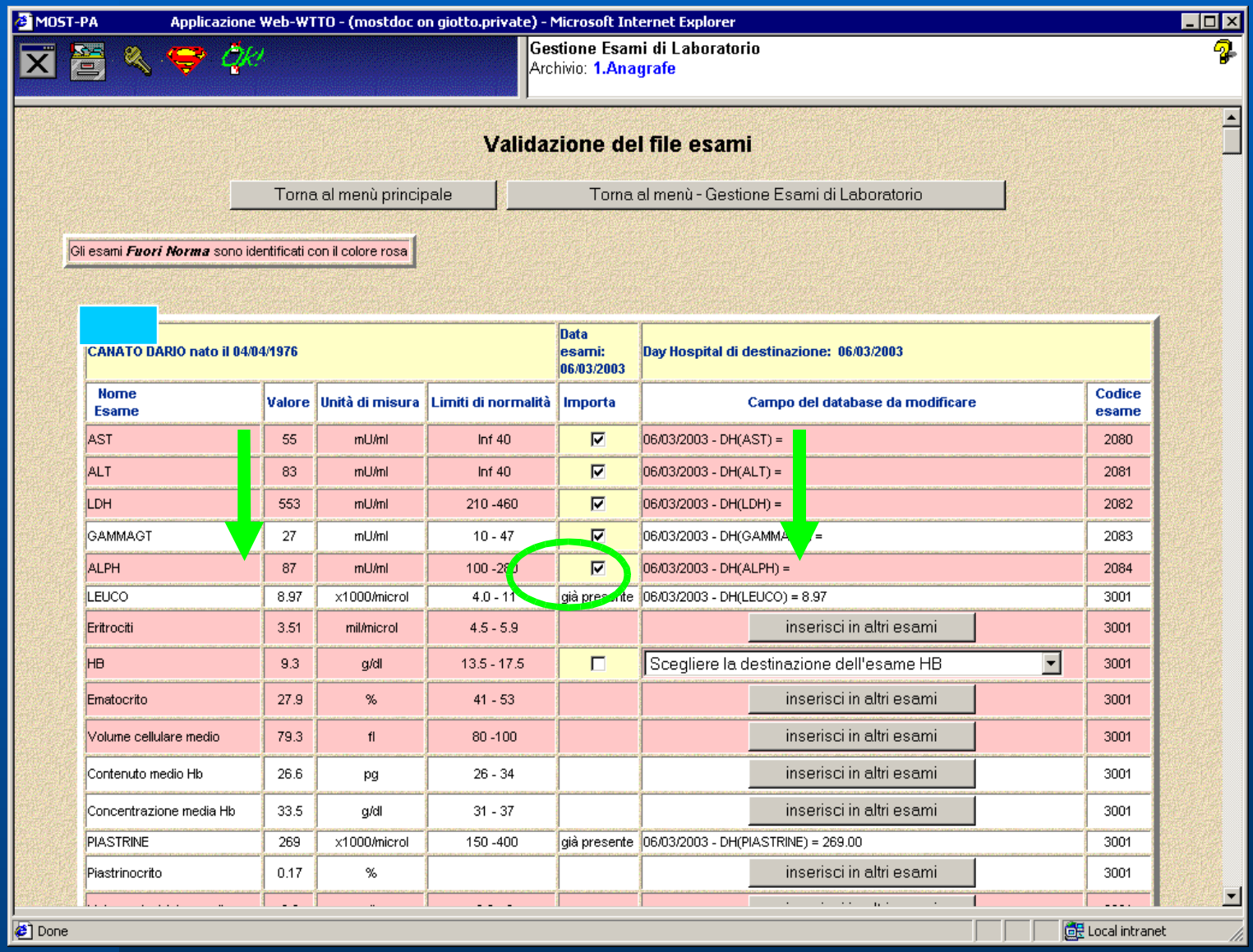
# Laboratories section



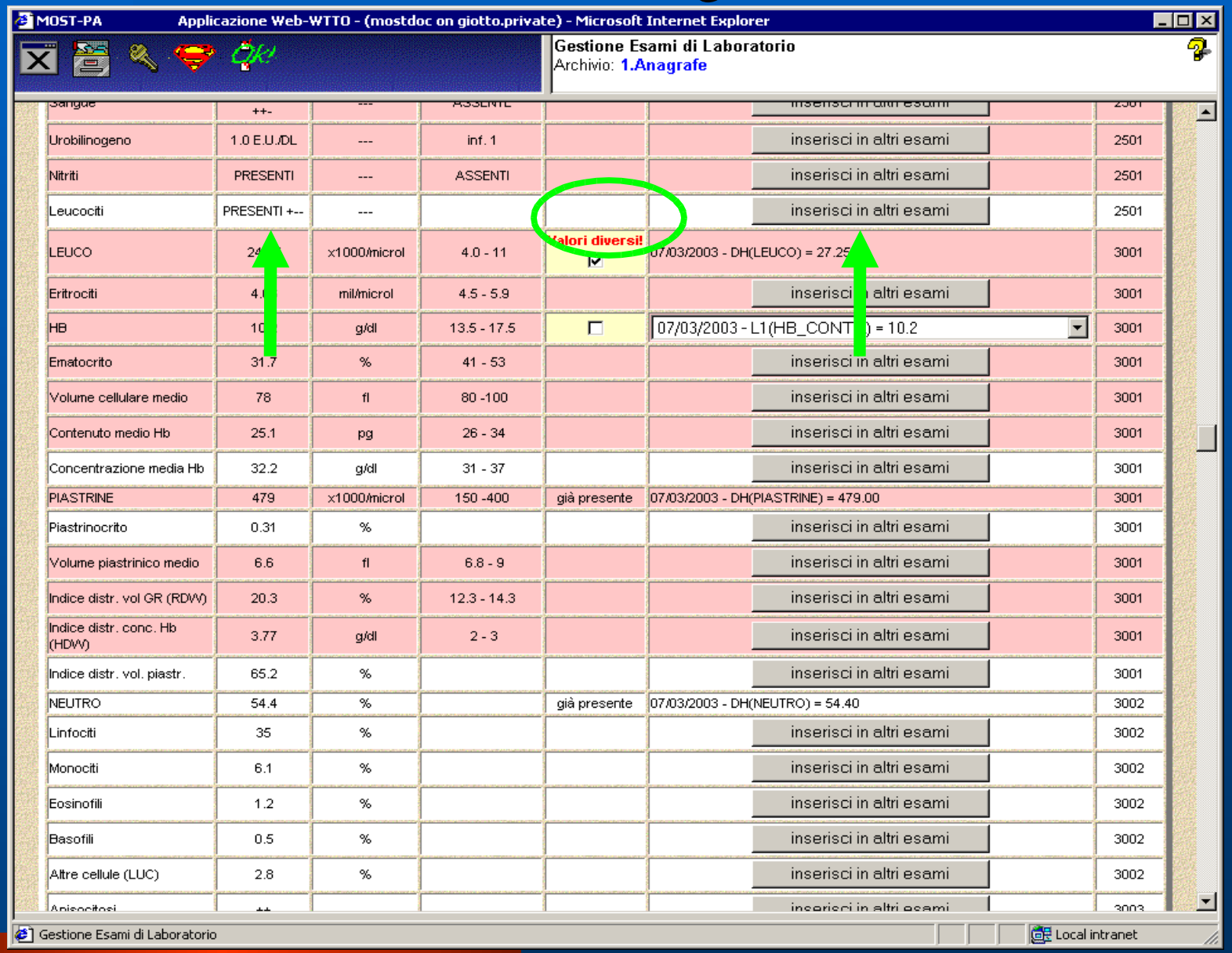
# Laboratory Data Preview & Validation



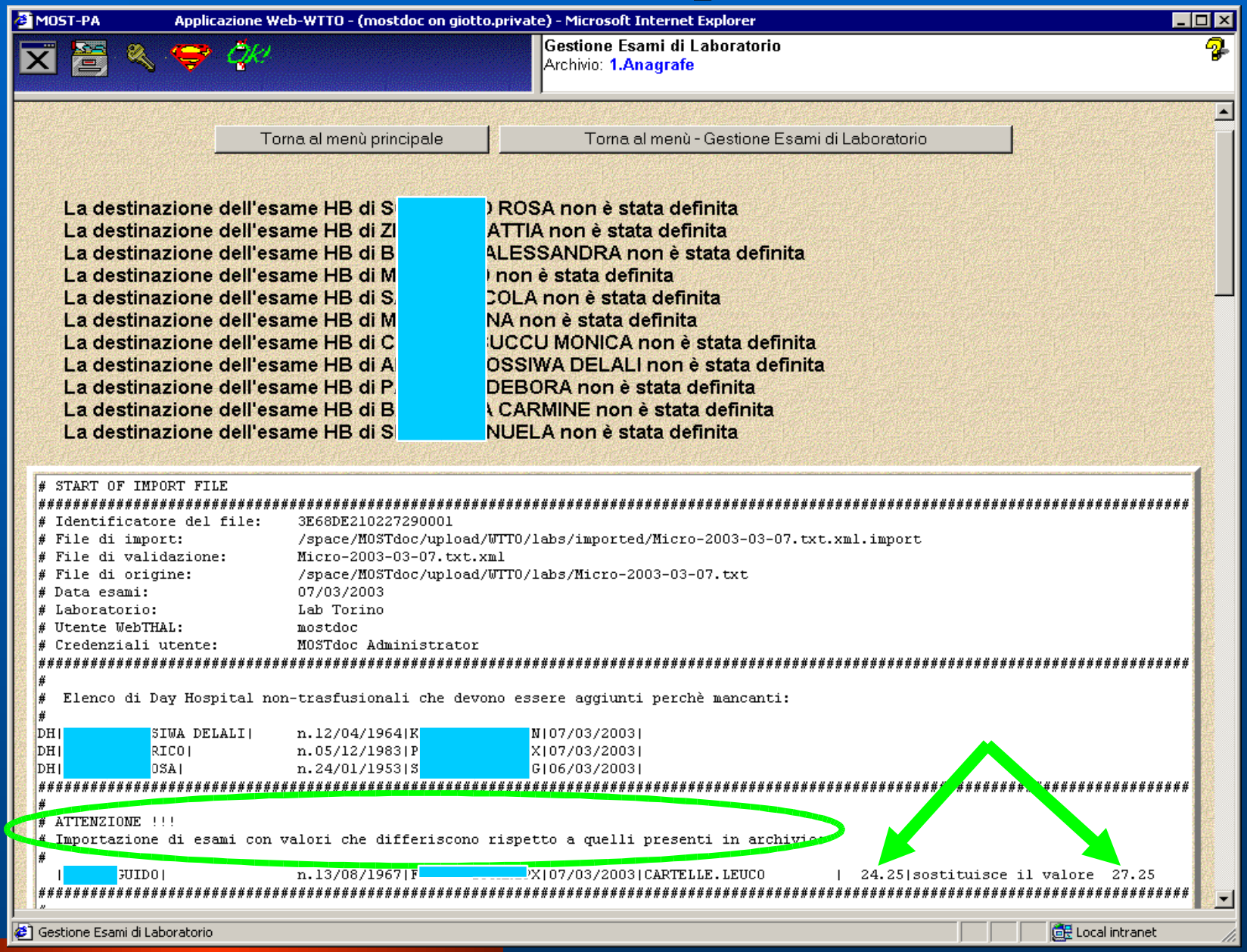
# Manual and automatic exams overlap ( case of matching values)



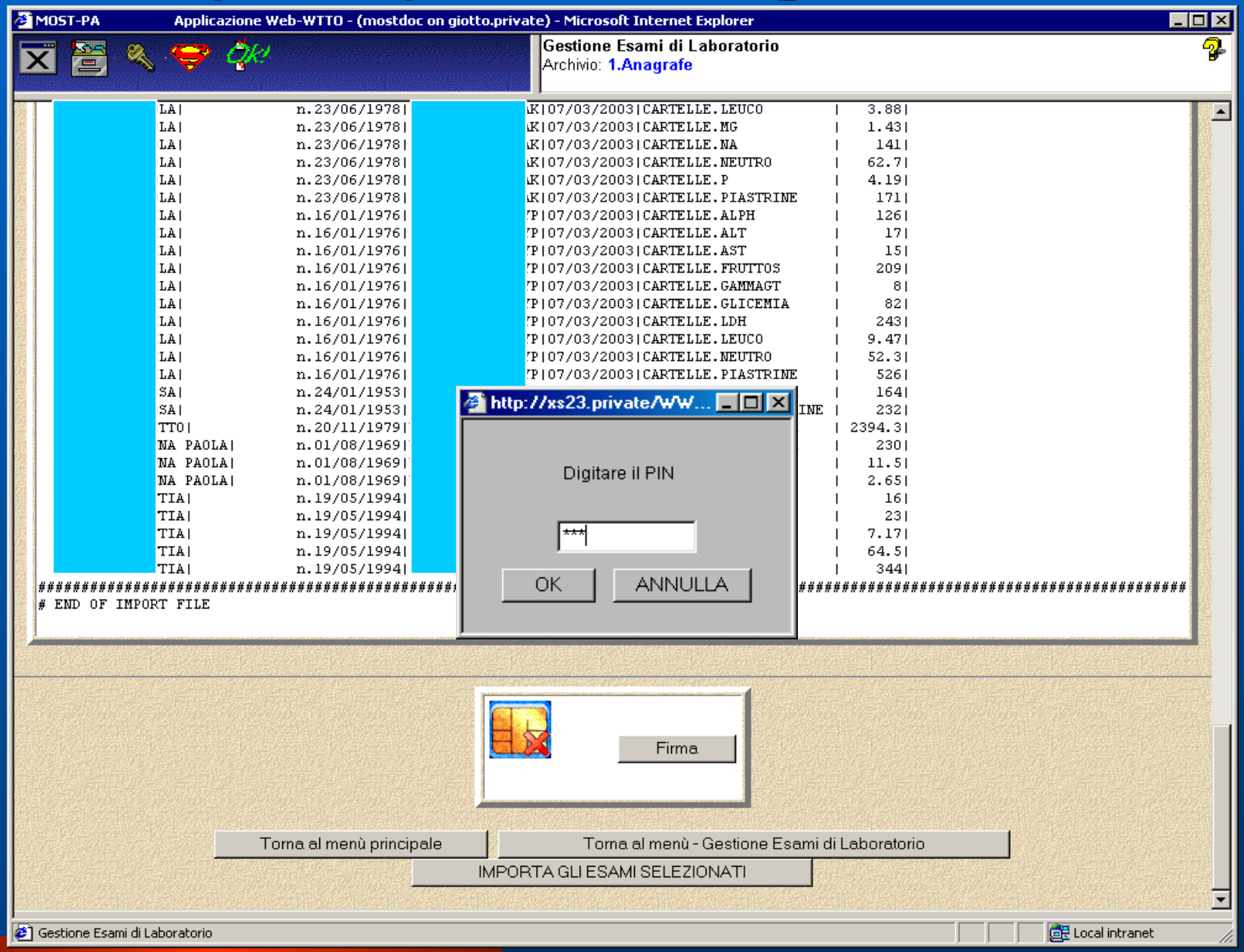
# Manual and automatic exams overlap (case of mismatching values)



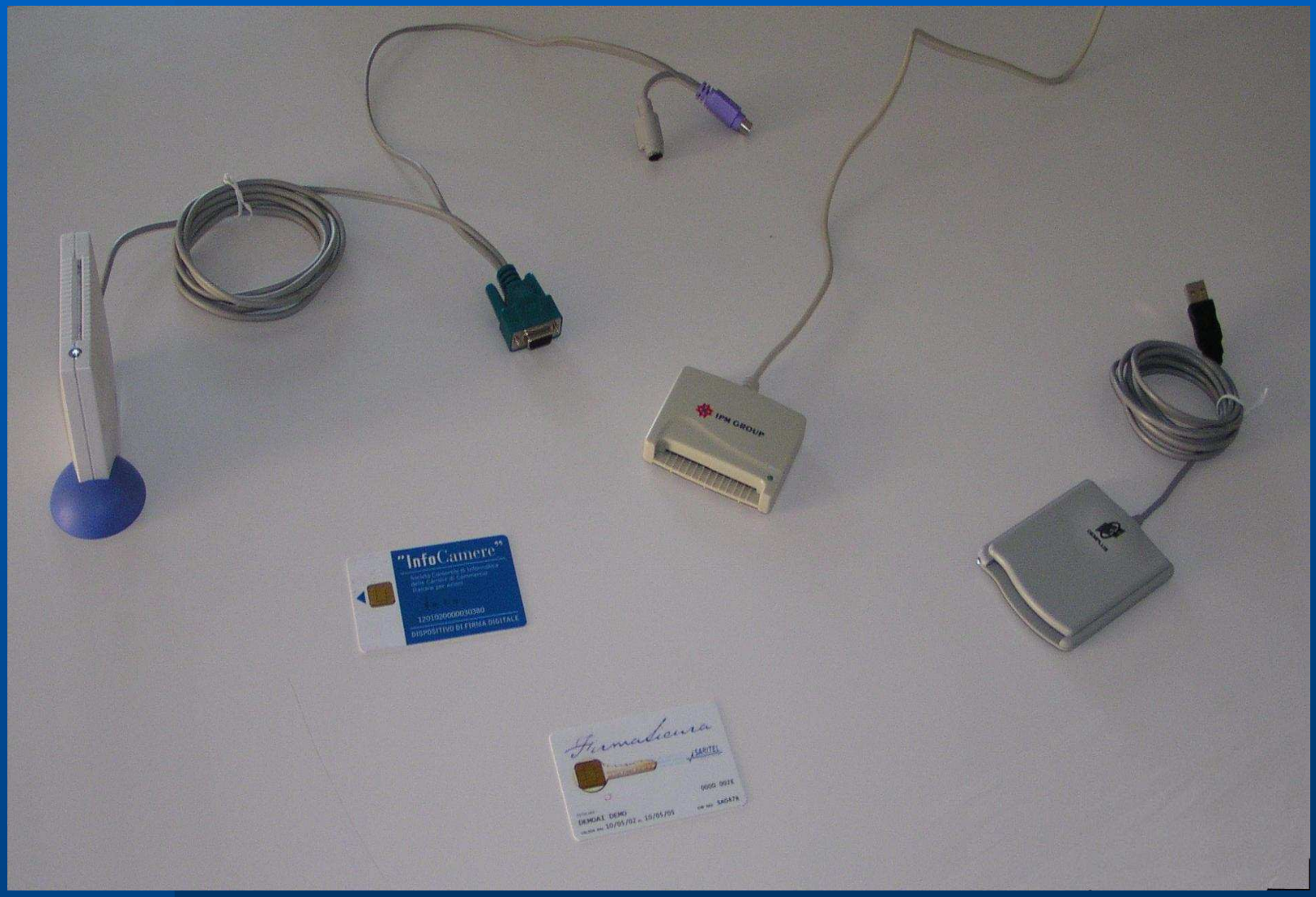
# Validation phase



# Digital signature of imported data



# Smart-card readers for digital signing



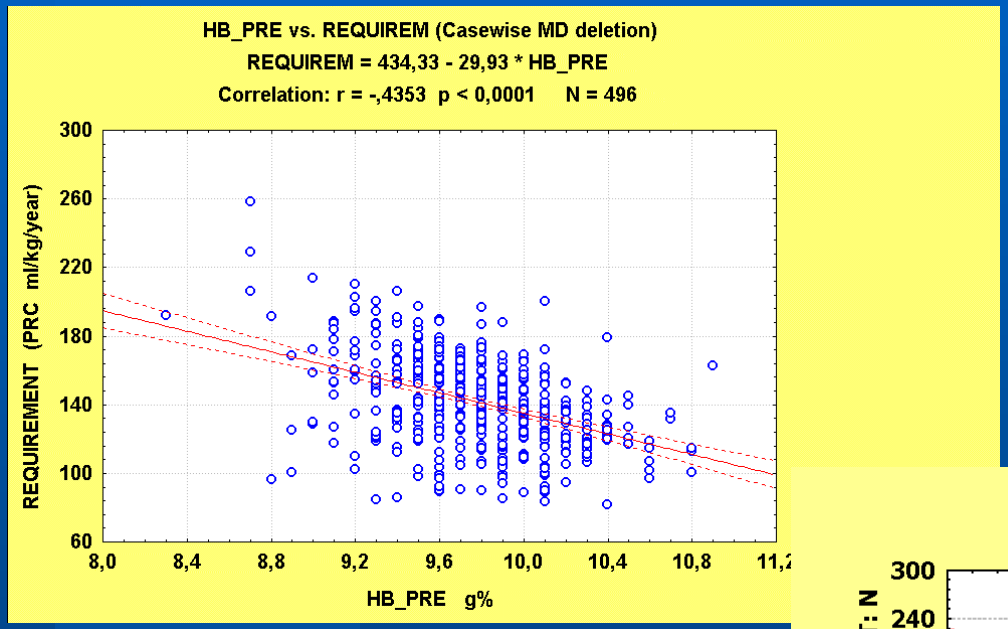
# Smart-card readers for digital signing

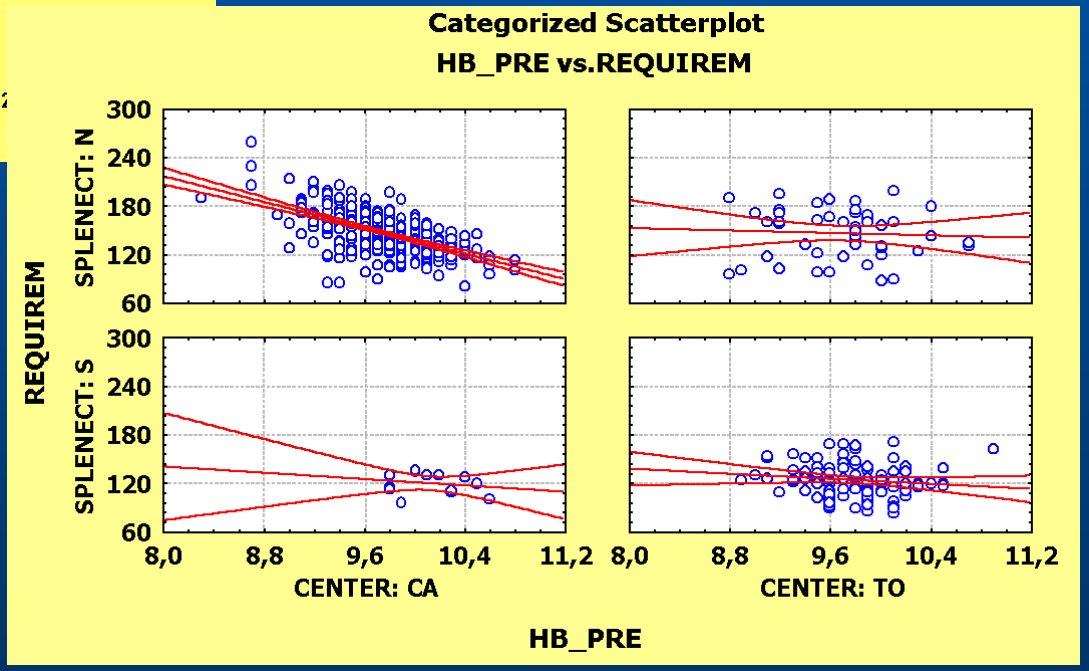
MOST

# Multi-center Studies

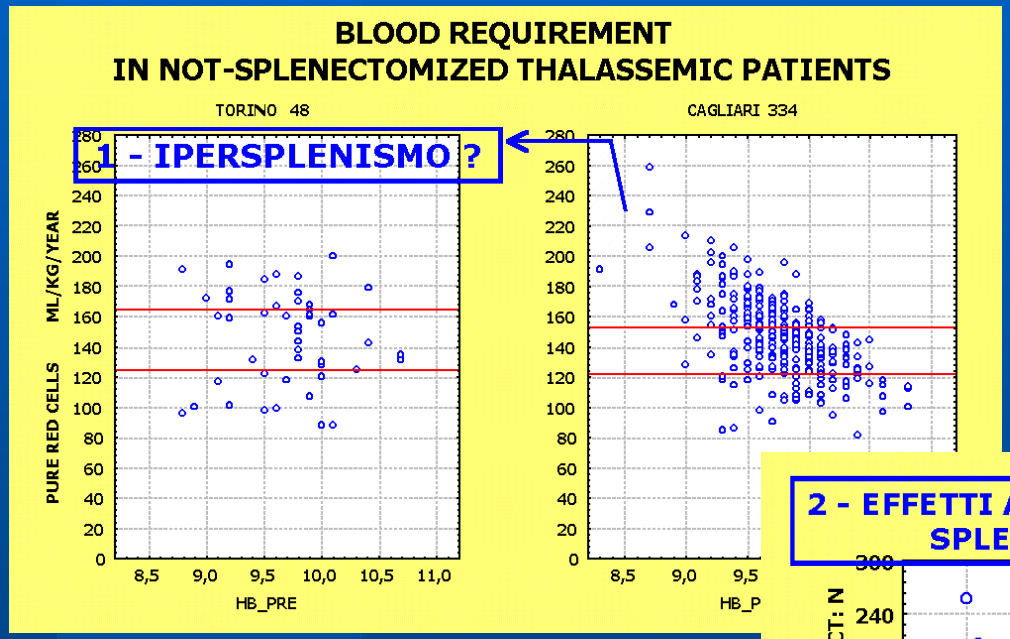
- Splenectomy (2001)
- Complications (2002)

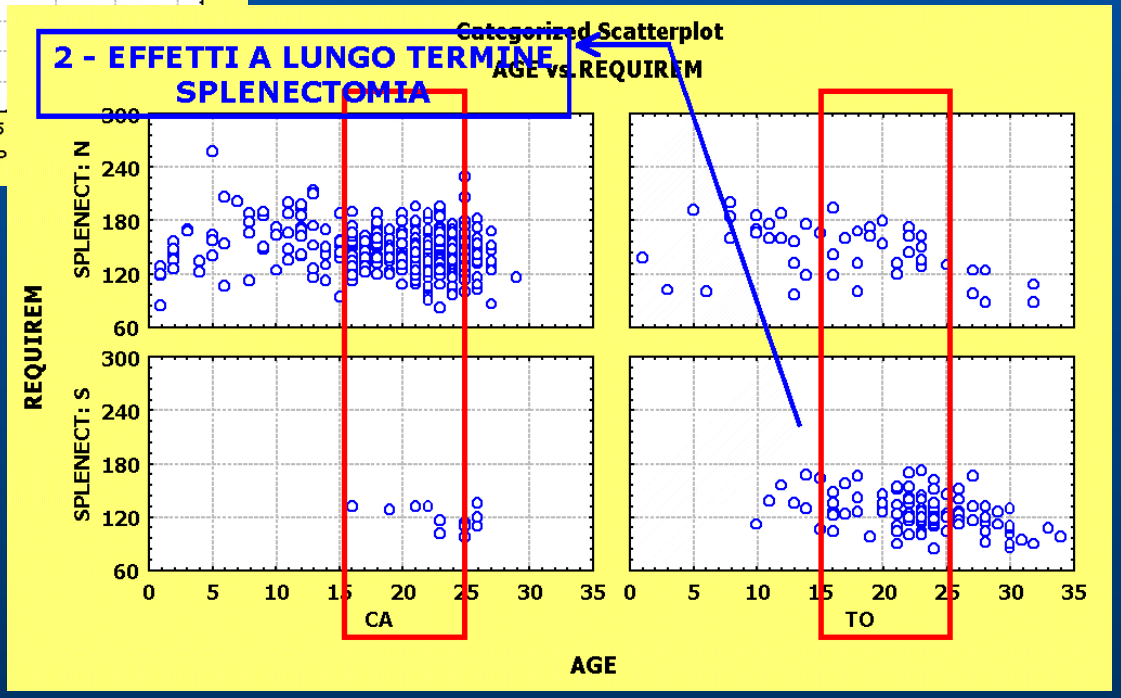
# Splenectomy study



# Splenectomy study



# Complications study

| | COMPLICANZE | | | TERAPIA | |
|---|---|---|---|---|---|
| 1 | CARDIOPATIA | si | no | si | no |
| 2 | IPOTIROIDISMO | si | no | si | no |
| 3 | DIABETE | si | no | si | no |
| 4 | IPOGONADISMO | si | no | si | no |
| 5 | IPOPARATIROIDISMO | si | no | si | no |
| 6 | EPATOPATIA | si | no | si | no |
| 7 | OSTEOPATIA | si | no | si | no |
| 8 | COLELITIASI | si | no | si | no |
| 9 | NEFROLITIASI | si | no | si | no |
| 10 | COAGULOPATIA | si | no | si | no |
| 11 | INFEZIONI | si | no | si | no |
| 12 | ALTRO | si | no | si | no |

| anno | CARDIOPATIA | IPOTIROIDISMO | IPOGONADISMO | IPOPARATIR | DIABETE | EPATOPATIA | COLELITIASI | EFROLITIASI | OSTEOPATIA | COAGULOPATIA | ALTRO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1979 | | | | | | | | | | | |
| 1980 | | | | | | | | | | | |
| 1981 | | | | | | | | | | | |
| 1982 | | | | | | | | | | | |
| 1983 | | | | | | | | | | | |
| 1984 | | | | | | | | | | | |
| 1985 | | | | | | | | | | | |
| 1986 | | | | | | | | | | | |
| 1987 | | | | | | | | | | | |
| 1988 | | | | | | | | | ### | | |
| 1989 | | | | | | | | | | | |
| 1990 | | | | | | ### | | | | | |
| 1991 | | | | | | | | | | | |
| 1992 | | | | | | | | | | | |
| 1993 | | | ### | | | | | | | | |
| 1994 | | | | | ### | | | | | | |
| 1995 | | | | | | | | | | | |
| 1996 | | | | | | | | | | | |
| 1997 | | ### | | | | | | | | | |
| 1998 | | | | | | | | | | | |
| 1999 | | | | | | | ### | | | | |

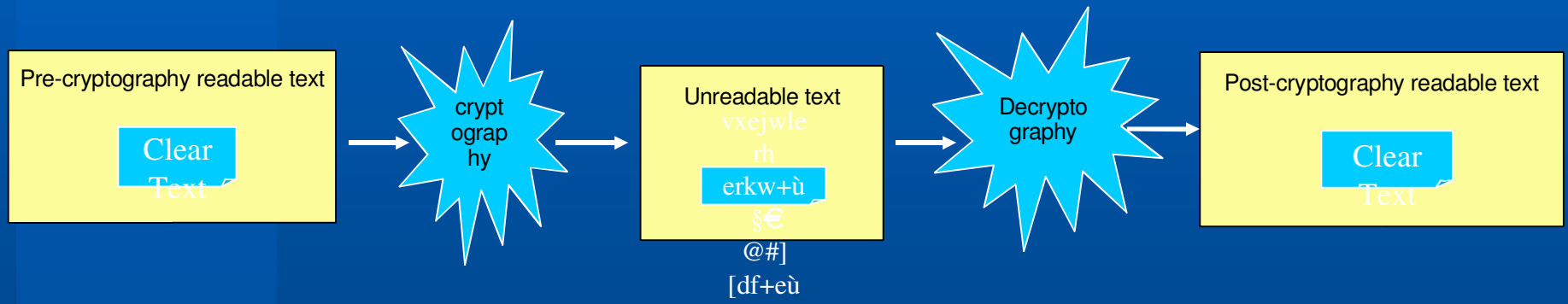
MOST

# Security and privacy of data

- Username and password authentication
- Https security web protocol
- Security inside the servers

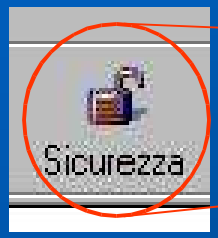
# The HTTPS protocol

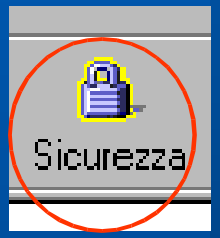
- **Cryptography of network traffic**

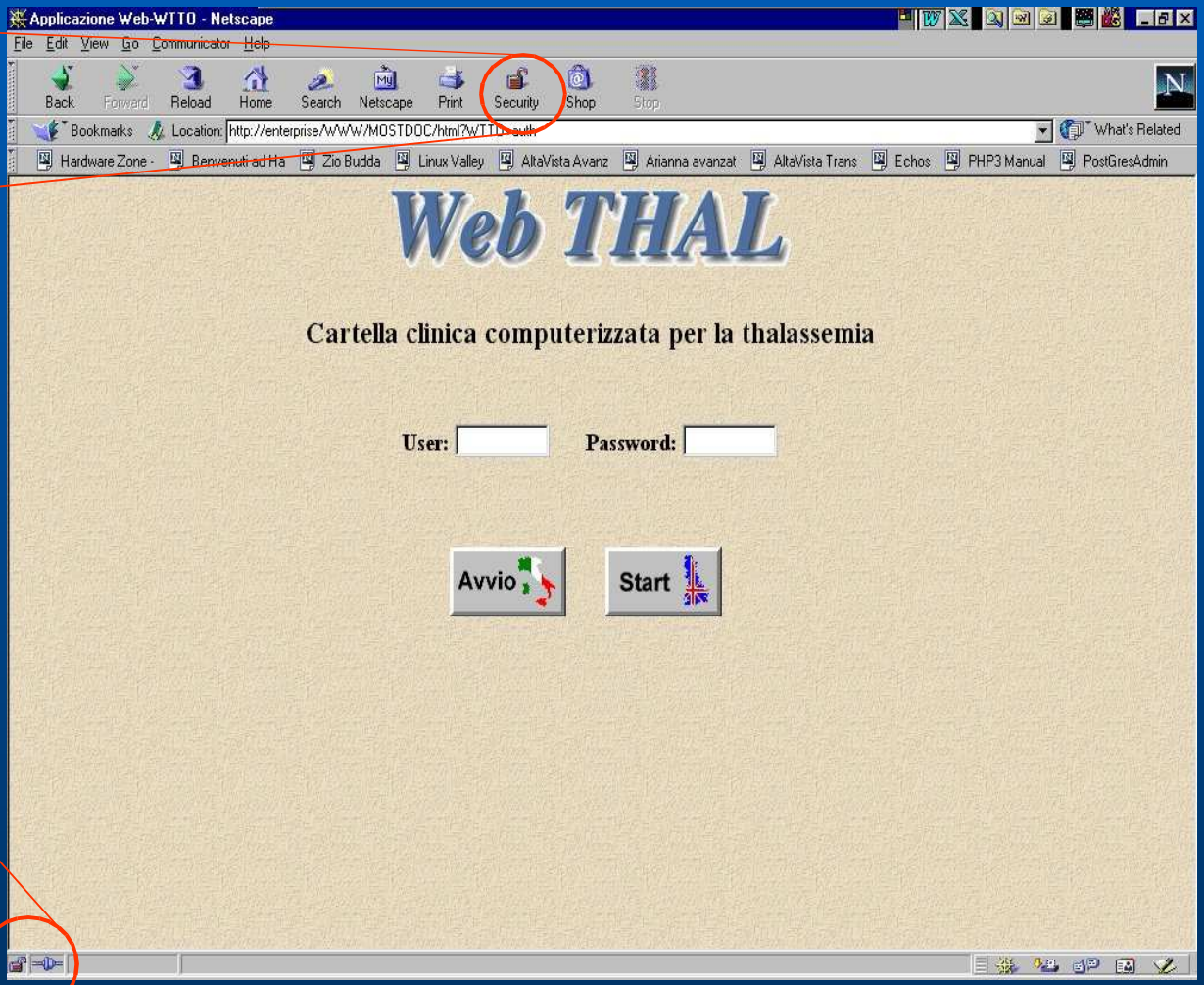


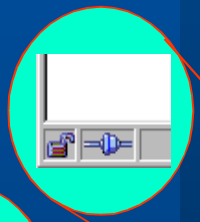

- **User certificate**

# Authentication



# Privacy

- Personal user Login

- Password changing

- Login with different profiles:
  - Read-only
  - Delete
  - Export
  - Archives subset (database view)

MOST

# Security

- **Encrypted communication**
  - HTTPS protocol

OpenSSL
SSL 2.0/3.0

- **Server security**
  - User authentication on the server
  - Professional DBMS security

ORACLE PostgreSQL Informix

  - Unix Operating System

# Archives security

- Reliability given by professional DBMS
- Data is shared only by means of an explicit action by the physician

# Data security

- Professional DBMS reliability (transactional systems, logging, recovery)
- Automatic nightly backup
- Monthly backup on CD of historical data of the national and international centers

Max 24 h of lost work

It's time to save data...

# Data security

- Compliance with national security laws (dpr 196/03)
- Worst case scenario: in case of disaster max 24 h of lost data
- In case of local server troubles, the national server may be used as a fallback (weekly sync of data)

# Support

- Hot-line service

- Security upgrades (firewall, security hole)
- Operating system and WebTHAL application upgrades
- Backup

# Support

- Hardware turnover
- 28 server deployed and managed
- Hardware rotation: WebTHAL servers are changed every three years

# Logistic / Administration

- Bailment contract (fixed serial number)
- Asset management
- HW purchase and storage
- Warranty (HW replacement)
- Non internet connected servers: GPRS board

# Evolutions

- Printing in PDF format – 2003/2005
- Versioning of records - 2004
- Digitally signed media (CNIPA/AIPA rules)
- Barcodes for transfusional requests
- Endocrinological records
- Disease costs computation

# Evolutions

- Transplants  follow up
- Hb F sintesis induction
- drepanocitosis
- Intermediate thalassaemia
- Interactions with the National Sanitary service (Sanitary card)

# Main MOSTdoc References

- **SEAT Pagine Gialle**
  - Data filtering and delivery of customer letters (invoices etc), using hybrid print
- **COSTA Cruises**
  - Pictures and catalogues archive
- **Cedacri**
  - C.O.L.D. and scanned documents for primary italian banks
- **San paolo/IMI**
  - E-mail archive
- **CSI Piemonte**
  - Document archiving solutions, conforming to the official requirements for the government agencies.

# Main References: Banca Popolare di Bergamo

- **The bank handles every single piece of non numeric information using MOSTdoc:**
  - **Cheques Acquisition and archiving**
  - **Register of official documents**
  - **Print spools**
  - **Internal documents and manuals**
  - **Phone calls of the on line bank**
  - **Credit line attachments**