



WoundManager

Basic Edition

v. 2.0

INSTRUCTIONS

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1.INSTALLATION

1.1. Prerequisites

Although best executed on Windows 7, WoundManager™ could be installed and used on any Windows version from Windows XP with service pack 3 ahead. Since it is built to utilize all available system resources to speed up wound image analysis it is necessary to keep Windows updated with Automatic Update tool.

WoundManager™ requires following Microsoft components to be installed:

- Microsoft .NET Framework 4 Client Profile
- Microsoft SQL Server Compact 3.5 SP2 ENU

If missing, these components will be automatically installed by the WoundManager™ installer, but computer should be connected to the Internet for the installer to download required components.

1.2. Installing the product

Installation is contained within `WMBasicxxx.exe` self extracting archive, where “xxx” corresponds to the application version. It is necessary to download that file to local folder and double click it.

After completion, WoundManager™ icon  will be at the desktop and in Windows Start menu. Double click the icon to start the application.

1.3. Location of application files

WoundManager™ will be installed in a folder `C:\Program Files (x86)\WMBasic` on Windows Vista and Windows 7, or `C:\Program Files\WMBasic` on Windows XP.

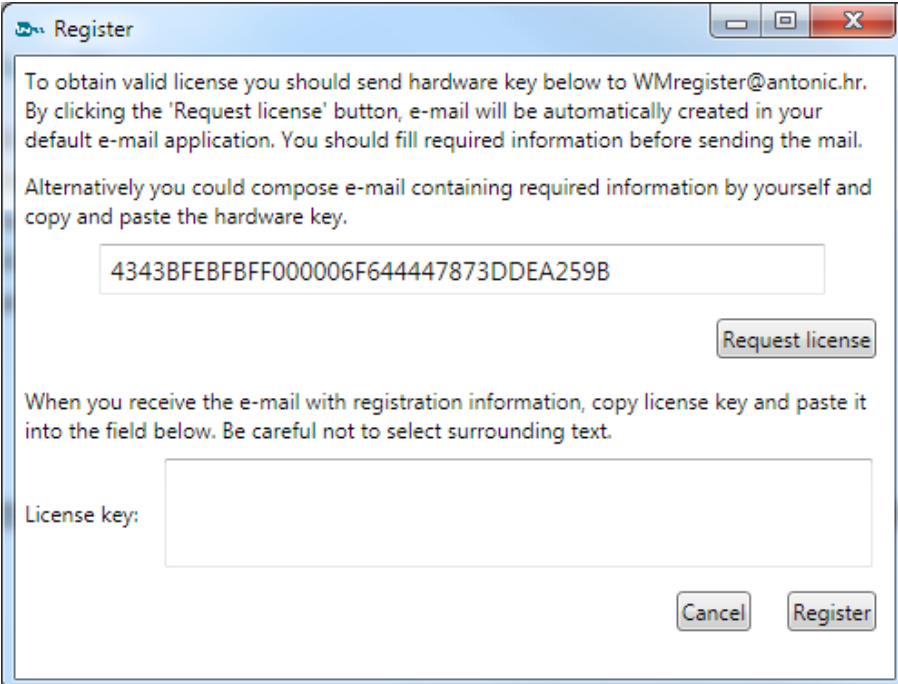
In unhappy case that the application stops working, log file `WMBasicLog.txt` will be created at the user desktop.

1.4. Location of database file

Basic edition uses MS SQL Server 2008 R2 Compact Edition database, which resides on the same computer where application is installed and requires no special administration. Empty database is installed at the same location as the application. On first start it is copied to the application data folder. On Windows 7 it will be the folder `C:\Users\[user_name]\AppData\Roaming\WoundManager`.

1.5. Obtaining license

WoundManager™ will initially work as a demo version time limited to 45 days. To obtain valid license code it is necessary to purchase license and send hardware key to e-mail address WMregister@antonic.hr. Registration form will be displayed either automatically if demo expired or through the Help->Register menu.

A screenshot of a Windows-style dialog box titled "Register". The dialog contains instructions on how to obtain a license by sending a hardware key to WMregister@antonic.hr. It includes a text field with the hardware key "4343BFEBFBFF000006F644447873DDEA259B", a "Request license" button, and a section for pasting a license key received via email. At the bottom are "Cancel" and "Register" buttons.

To obtain valid license you should send hardware key below to WMregister@antonic.hr. By clicking the 'Request license' button, e-mail will be automatically created in your default e-mail application. You should fill required information before sending the mail.

Alternatively you could compose e-mail containing required information by yourself and copy and paste the hardware key.

4343BFEBFBFF000006F644447873DDEA259B

Request license

When you receive the e-mail with registration information, copy license key and paste it into the field below. Be careful not to select surrounding text.

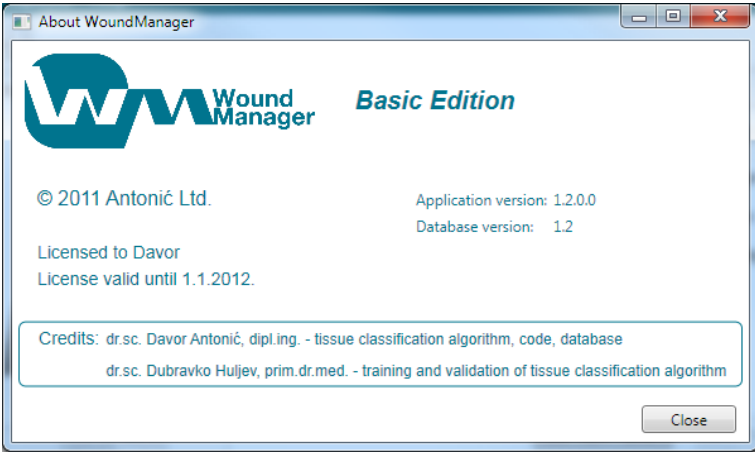
License key:

Cancel Register

Request license button will create new e-mail in default e-mail client. Before sending It is necessary to fill all required information. Alternatively it is possible to manually compose e-mail message (e.g. if webmail is used), copy and paste hardware key and add required information.

Received license key should be copied to the form. Precaution is necessary not to copy surrounding text or omit some characters.

It is always possible to check the license through the Help->About form, which displays copyright information, application and database version and licensing information: registered user and license expiration date.

A screenshot of a Windows-style dialog box titled "About WoundManager". It displays the WoundManager logo and "Basic Edition" text. It provides copyright information for © 2011 Antonić Ltd., application and database versions (1.2.0.0 and 1.2), and licensing details for Davor and Dubravko. Credits for the tissue classification algorithm and training/validation are also listed. A "Close" button is at the bottom right.

About WoundManager

WoundManager Basic Edition

© 2011 Antonić Ltd. Application version: 1.2.0.0
Database version: 1.2

Licensed to Davor
License valid until 1.1.2012.

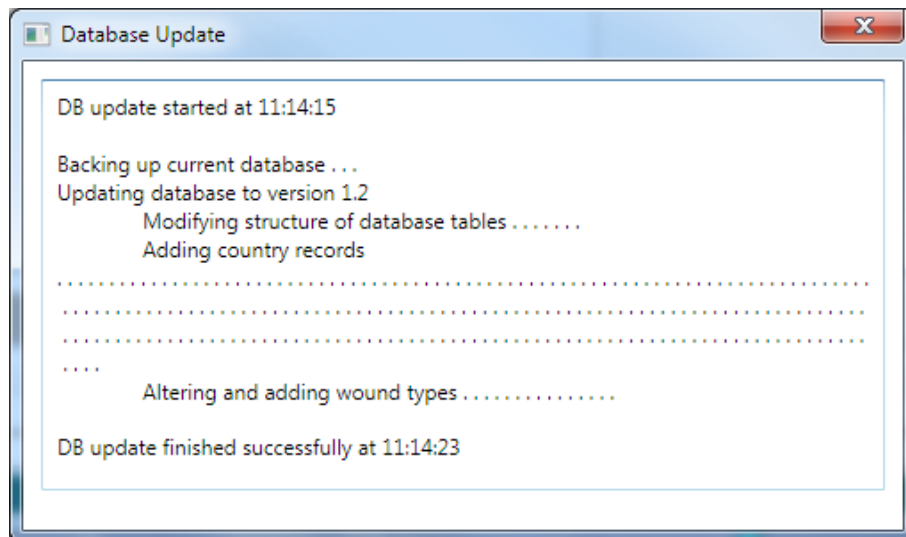
Credits: dr.sc. Davor Antonić, dipl.ing. - tissue classification algorithm, code, database
dr.sc. Dubravko Huljev, prim.dr.med. - training and validation of tissue classification algorithm

Close

1.6. Updating database

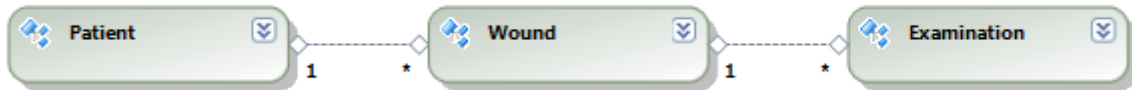
WoundManager™ version from 1.2 above requires database to be updated to version 1.2. Update process will be performed automatically upon starting the application. Backup of old database will be created in the database folder (see 1.4) and named “WMBasicDB_*date_time*.sdf”, where *date* and *time* are current date and time.

Updating progress is displayed during the process.



2.USER INTERFACE

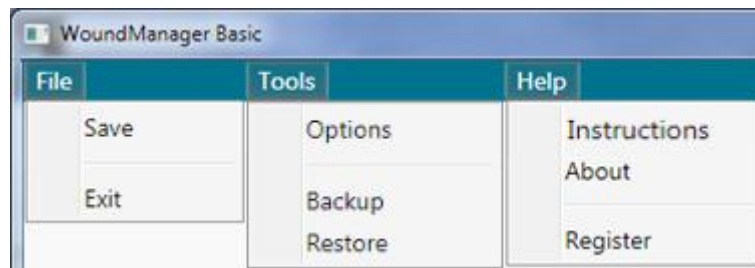
User interface is organized around three sheets (tabs), corresponding to Patients, Wounds and Examinations. That organization reflects the database structure, which is organized around three corresponding main tables connected by “one to many” relationships. That means that each patient can have multiple wounds and each wound can have multiple associated examinations.



Each main tab has an Overview sub-tab and eventually some more sub-tabs. Upper part of the Overview tab contains specific data (opened patient, wound or examination detailed information). Table at the lower part displays all related records (all patients, all wounds associated with selected patient, all examinations related to the selected wound).

2.1. Menu bar

Menu bar contains three command groups: File, Tools and Help.



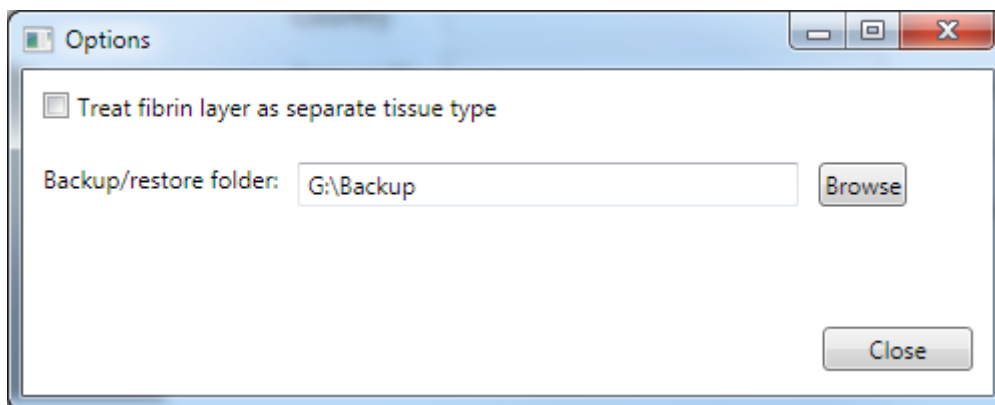
2.1.1. File menu

Under File menu there are Save and Exit commands. Save performs same function as the Save toolbar icon and Save commands displayed on Patients, Wounds and Examinations tabs. Exit closes the application in the same way as pressing the Close button at window title bar. In case data are altered user will be prompted to save data.

2.1.2. Tools menu

Tools menu contains Options command, and commands to Backup and Restore the database.

Options command opens form with two options. “Treat fibrin layer as separate tissue type” is used to determine whether three or four tissue types will be used during wound analysis (see 3.1.1). “Backup/restore folder” specifies location where database will be backed up to / restore from.



Backup command copies database file to the backup/restore folder defined in Options. If backup copy already exists it will be renamed to “WMBasicDB_YYYY-mm-ddThh_mm_ss.sdf”, where date and time corresponds to the database file modification time. Therefore, to restore previous version of the database it is necessary to change the name of selected file to “WMBasicDB.sdf” and perform restore. Excessive copies should be periodically removed from storage media to keep enough space for backup. If more than seven days passed since last backup warning will be displayed in Status bar.



Restore command restores the database from the backup/restore folder defined in Options. Precaution should be taken because working database will be replaced with the backup database. This operation cannot be undone.



Backup – restore sequence could be used to copy the database from one computer to another.



2.1.3. Help menu

Help menu has three commands, for displaying this instructions, information about the application and for registering WoundManager™ (see 1.5).


2.2. Tool bar

Tool bar is positioned at the top of the main application window, just below the menu bar. It contains shortcuts to various commands, depending on context



Save button () commits all changes to the database. Print button () generates preview of the report, which could be printed at any of the installed printers. Report format

depends on context. If patient is opened in Patients or Wounds tab, Patient report will be generated (see section 2.5). If particular examination is opened in Examinations tab, Examination report will be generated (see section 2.8). At the right side of the tool bar

current patient is conveniently displayed. Help icon () displays this instructions.

For wound analysis, additional buttons are displayed, as explained in section 3.2.

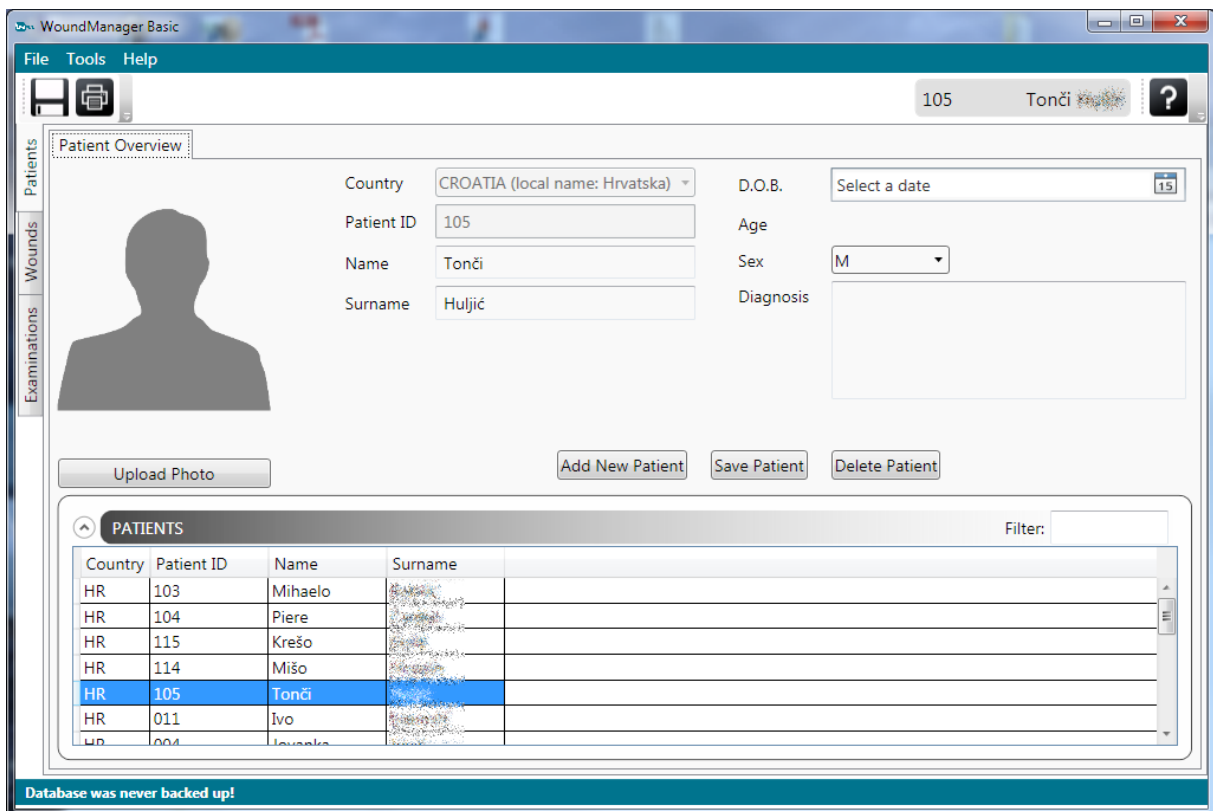
2.3. Status bar

Status bar is at the bottom line of the main application window. It is used for displaying information like license expiration and number of days since last backup.



2.4. Patients Tab

Upper region of Patients Tab contains selected patient's data and buttons for Uploading patient's photo, adding new patient, and saving and deleting selected patient record. Lower region contains table initially displaying all patients sorted by their Surname.



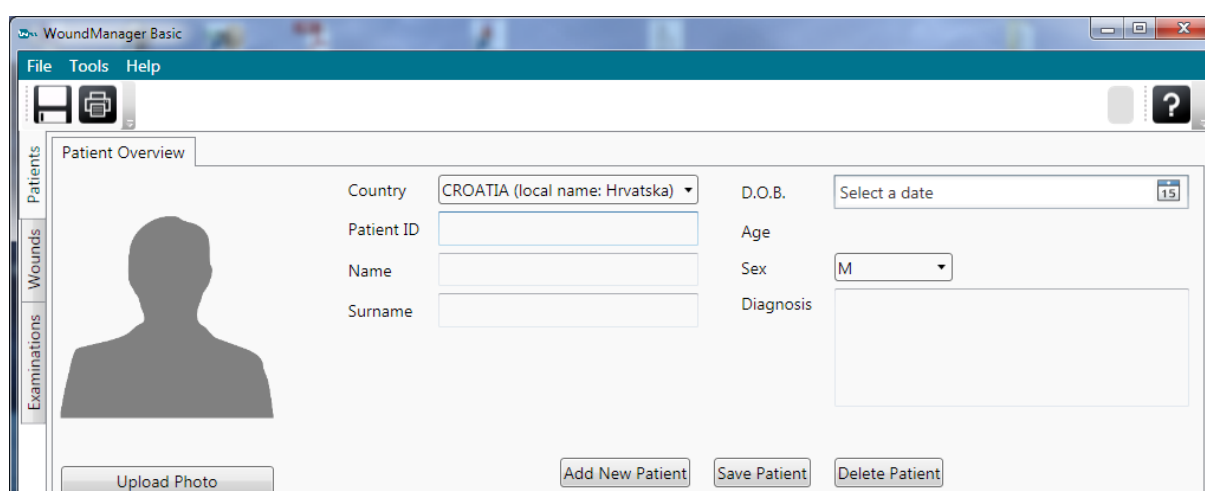
2.4.1. Sorting and filtering

Patient records could be sorted by country, ID and Surname or any combination of these. Sorting is performed by clicking header of corresponding table column. Clicking the same column again reverses sort order. To sort e.g. first by country and then by ID click Country column and then click Patient ID column holding <Shift> key.

Patient records could be filtered by ID and surname by entering first few characters of either ID or patient's surname.


2.4.2. Add new patient

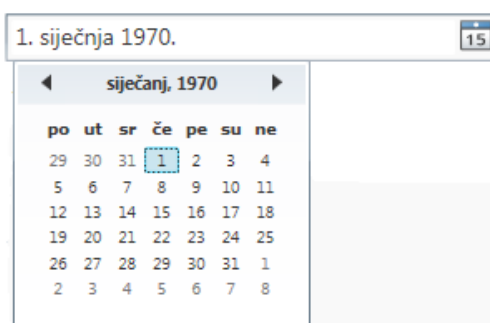
Since the database is initially empty, first operation will be adding new patient record. Click Add New Patient button. Upper part of the Patient Overview tab will look like this:




The screenshot shows the 'Patient Overview' tab in the WoundManager Basic application. On the left is a silhouette icon for a patient photo, with an 'Upload Photo' button below it. To the right of the icon are input fields for 'Country' (set to 'CROATIA (local name: Hrvatska)'), 'Patient ID', 'Name', and 'Surname'. Further right are fields for 'D.O.B.' (with a date picker icon), 'Age', 'Sex' (set to 'M'), and a large 'Diagnosis' text area. At the bottom right are three buttons: 'Add New Patient', 'Save Patient', and 'Delete Patient'.

Country field will be automatically selected from Windows regional settings, which means that selected country will usually be the one you reside in. Cursor will be positioned at PatientID field, which should be unique within the particular country. If patient with the same ID already exists inside the database, application will offer to open that patient.

You could enter other available information. Date fields (like D.O.B.) reflects regional settings for displaying and entering dates. Date could be entered by typing it directly into the field in appropriate format, or it could be selected through the date picker, activated by clicking at the  icon right to the field.



Navigation with the date picker is easy. A left and right arrow at the heading moves to previous and following period (indicated by the heading). Initially period is one month, which could be changed by clicking at the heading. First click changes period to the year, second click to the decade.

All data are kept in memory until saved. You could save data at any moment by issuing `Save` command on any tabs, or by clicking  button at the toolbar. Any `Save` command will save all unsaved data to the database. Application will offer to save data if there are unsaved data and you try to create or open another patient or try to exit the application.

Added patient will be displayed in the patients table only when saved, since that table displays only data physically stored to the database.

2.4.3. Open patient

Patient is opened by clicking appropriate row at the patients table. By double clicking the patient's row you will be directed directly to Wounds or Examinations tab, depending on information exists.


When the mouse cursor is positioned above the patients table you could use the mouse wheel to quickly navigate through patient records.

2.4.4. Delete patient

Patient record could be deleted from the database by clicking at the `Delete Patient` button. Precaution is required because patient record and all related wounds and examinations records will be physically deleted from the database. Only possibility to restore deleted data is through the backup copy of the database, if such exists. For that reason application warns you and asks for deletion confirmation.

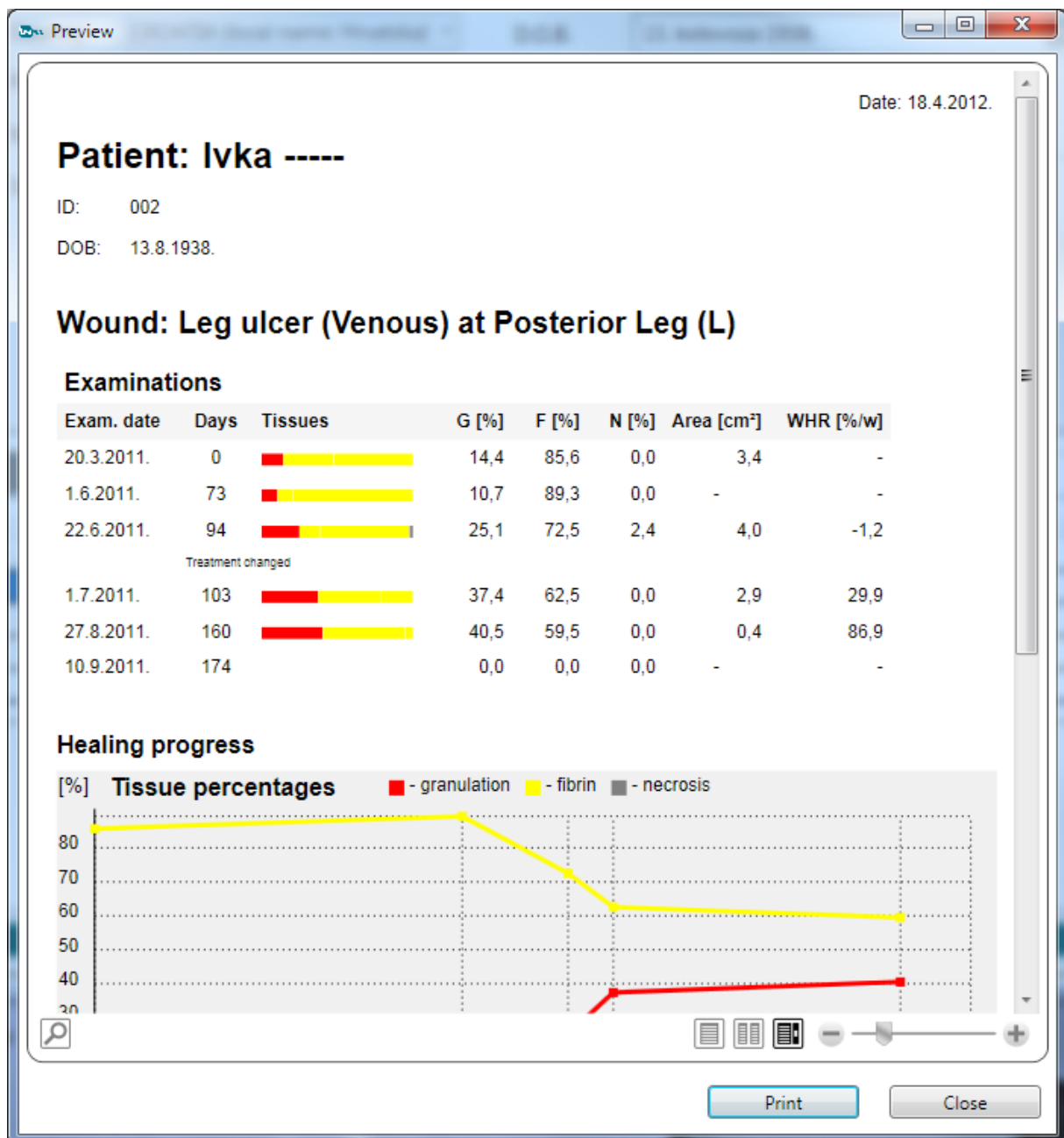


2.5. Print patient report

Tool bar `Print` button () generates patient report, containing basic patient's data, tabular information about all examinations and healing progress graphs. Report is generated in compact form, i.e. data fields that are not filled are completely left out of the report, including the label.

Using toolbar at the bottom of the preview pane it is possible to search the report for particular word or phrase, change the view to page, two page or scroll (default), zoom the preview and print report.





2.6. Wounds Tab

Initially Wound Overview Tab has only one control enabled – Add New Wound button.

After pressing the Add New Wound button new blank row appears in the wounds table. Although not required, it is strongly recommended to define wound type and location. Click at the corresponding field opens list of choices from which appropriate type and location should be selected. If known, the wound formation date could be entered. In that case wound age is automatically calculated. If the Wound Healed checkbox is selected, wound and all examinations are locked and treatment period is calculated.



Save button will save all unsaved data. Delete Wound will delete all wound and related examinations data so it should be used with precautions.

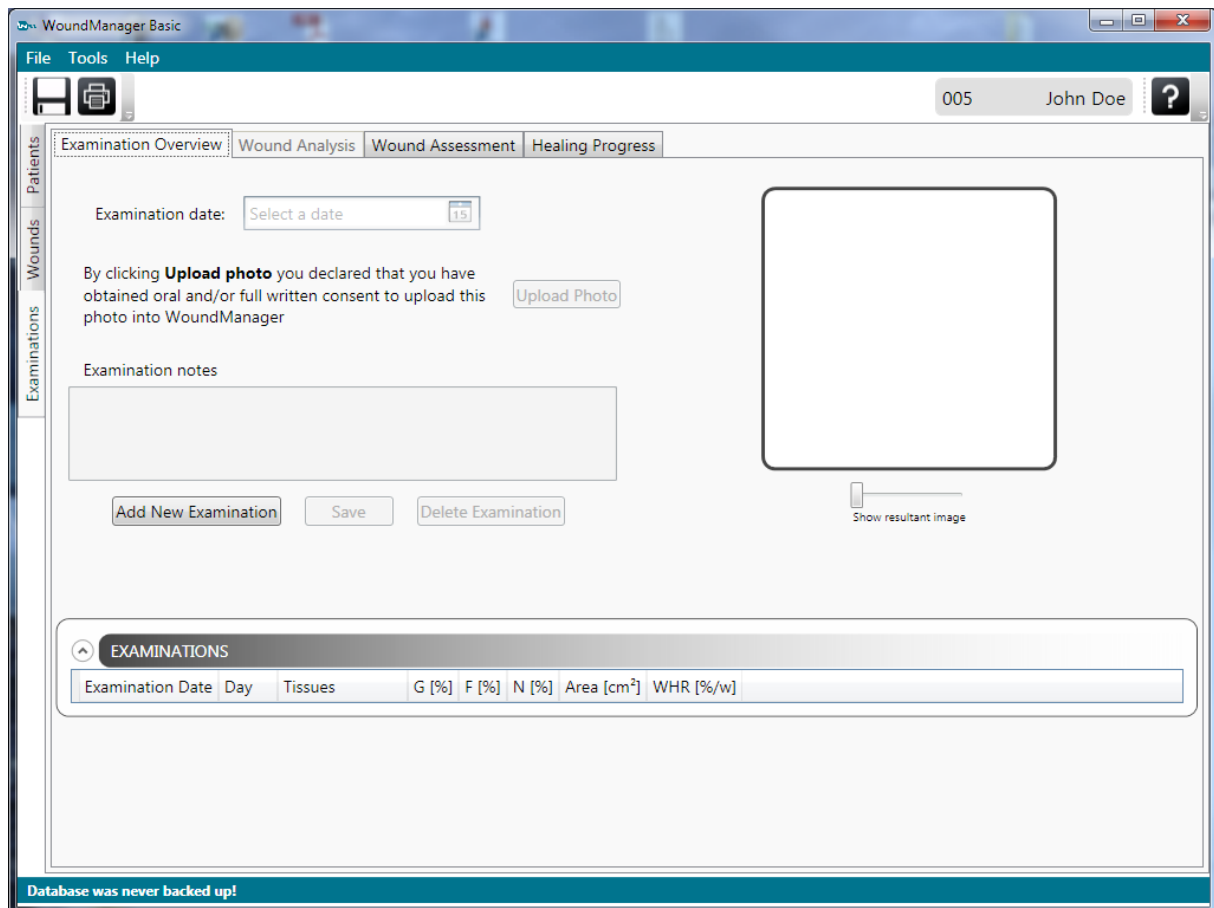
2.7. Examinations Tab

Examinations Tab has four sub-tabs, discussed in following chapters.

2.7.1. Examination Overview Tab

Initially Examinations Overview Tab has only one control enabled – Add New Examination button. In case that button is disabled, check if wound exists for the given patient, because examination could be created only if corresponding wound exists.

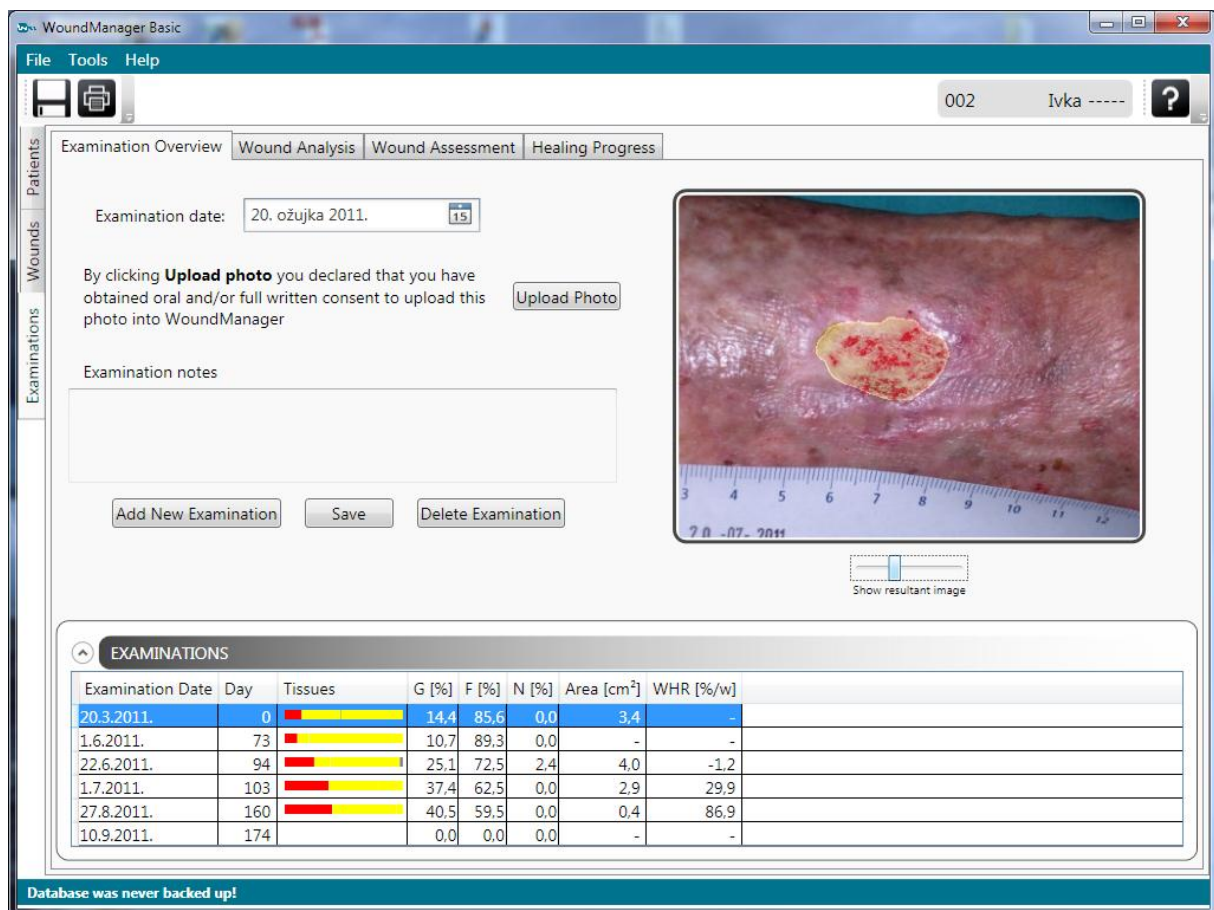
After pressing the Add New Examination button new row appears in the examinations table. Examination date is initially set to the today's date. Examination date could be changed through the corresponding date picker field.



To be able to analyze the wound, wound photo should be uploaded into the application using the `Upload Photo` button. It opens standard Windows file manager window where it is possible to select desired image. Wound images should be in JPEG format.

Examination Overview Tab with multiple examinations is much more informative. Examination date, notes and image for the selected examination are displayed. If analysis was performed it is possible to display resultant image over the wound image, where transparency could be adjusted with the slider below the image. Quick navigation is possible with the mouse wheel, if mouse cursor is either over the wound image or over the examinations table.

Examinations table provides basic information about examinations. Day column displays number of days from first examination. Tissues column gives quick overview of the wound status, graphically and numerically displaying percentages of different tissue types. Area column displays wound area and WHR column wound healing rate, which is calculate as relative weekly change of wound area.

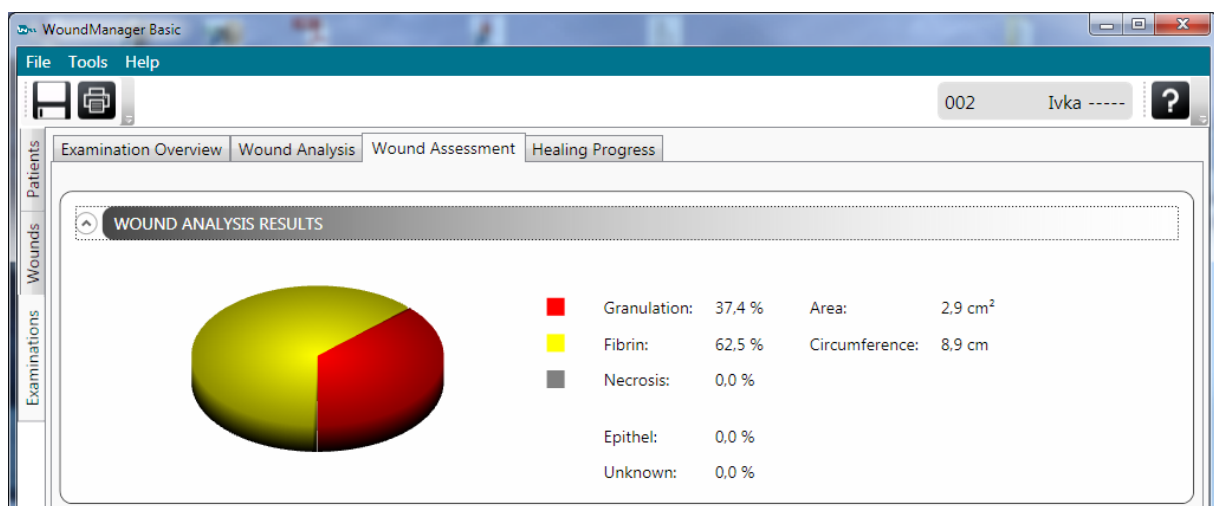


2.7.2. Wound Analysis Tab

Wound analysis tab is the most complex part of the application and will be explained in chapter 3.

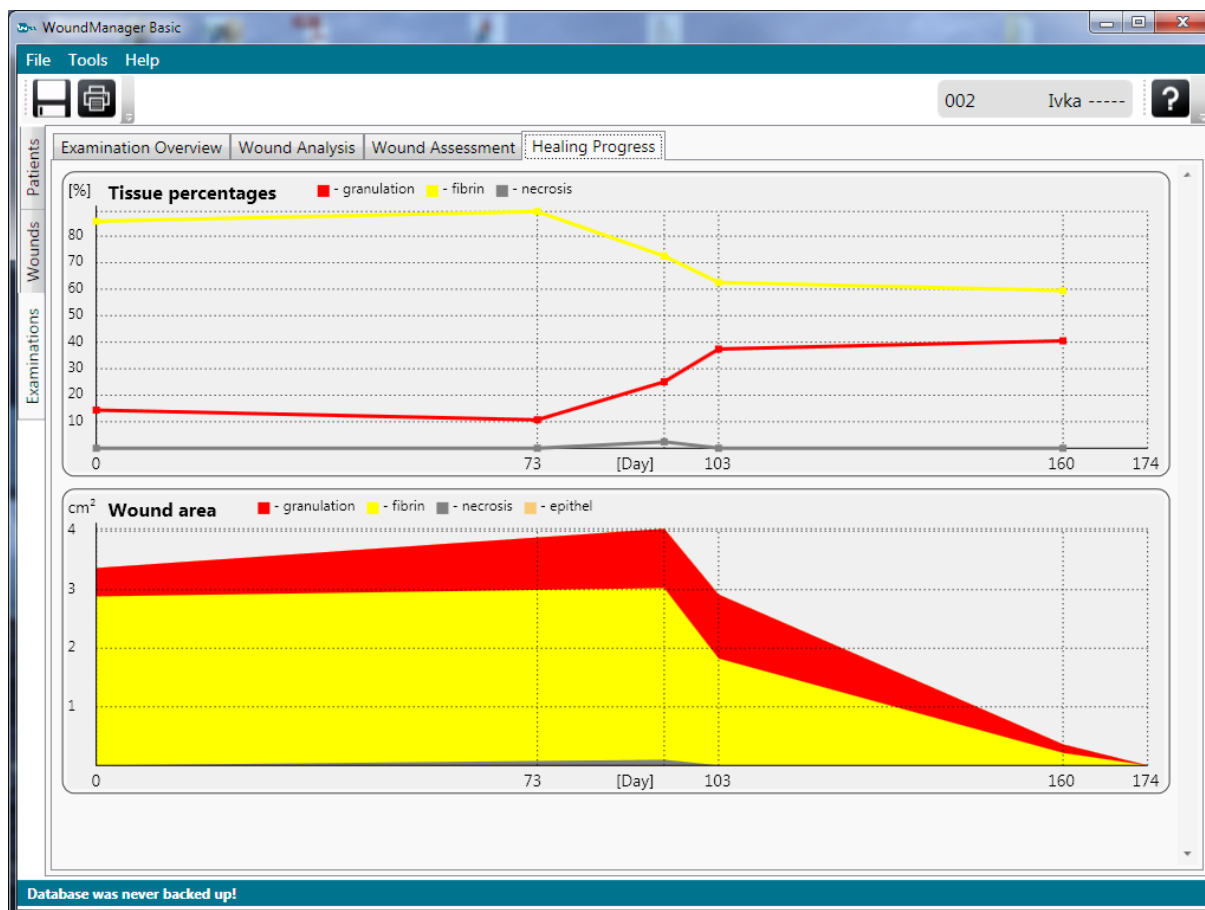
2.7.3. Wound Assessment Tab

At this tab result of the wound analysis for the selected examination is presented graphically and numerically, containing of percentages of different tissue types within the wound and wound dimensions (area and circumference).




2.7.4. Healing Progress Tab

Healing progress tab summarizes wound analysis during whole treatment. Data for particular examination is displayed at corresponding day point from the beginning of treatment. Upper graph presents change of tissue percentages in time and lower one change of wound area with tissue content.



2.8. Print examination report

If Examinations tab is selected tool bar  generates examination report, containing detailed data of selected examination, including wound and resultant image. Report is generated in compact form, i.e. data fields that are not filled are completely left out of the report, including the label.

Preview

Date: 18.4.2012.

Patient: Ivka -----

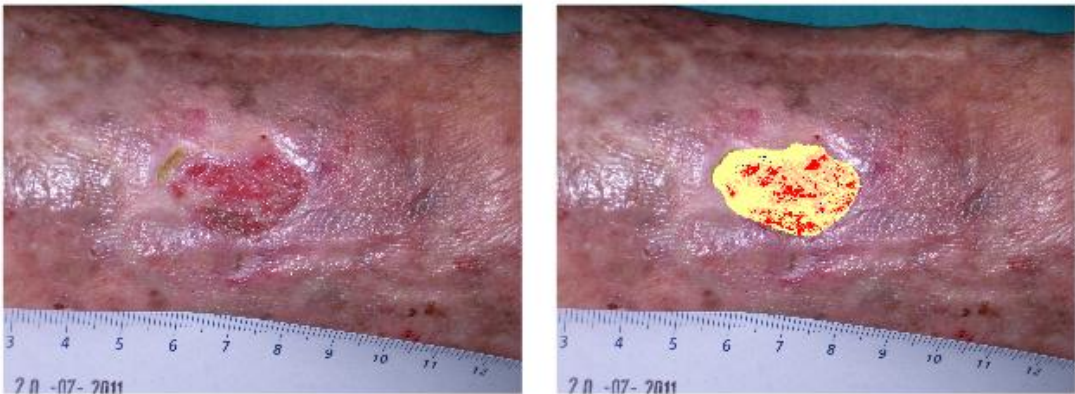
ID: 002








DOB: 13.8.1938.

Wound: Leg ulcer (Venous) at Posterior Leg (L)

Examination

Examination date: 20.3.2011.





Print

Close

14

3.WOUND IMAGE ANALYSIS

3.1. Image Analysis Principles

Core of the WoundManager™ application is specially developed digital image analysis algorithm based on artificial intelligence. It learns from medical doctor – expert for chronic wounds. On selected set of wound photographs wound expert manually marked particular tissue types. Generated training data was used to train the classifier. Maximal classification error is 5% for reasonable quality photographs (sharp photograph with good color reproduction)¹.

3.1.1. Four tissue types – Why?

Normally clinicians deals with three usual tissue types: fibrin, granulation and necrosis. We introduced additional tissue type: fibrin layer, which basically consists of thin fibrin layer covering granulation tissue. Normally such a tissue is considered as fibrin.

Separate treatment of the fibrin layer assisted in improved classification accuracy, because it is otherwise difficult to distinguish reddish color of fibrin layer from normal granulation tissue. Separate treatment of the fibrin layer makes sense in medical terms too, because such tissue will turn into granulation quicker than pure fibrin tissue.

Through the Tools->Options command it is possible to select whether four tissues will be used or analysis will be based on classical three tissue types. In that case fibrin and fibrin layer are displayed simply as fibrin.

3.1.2. Epithelization


Often islands of epithelization are formed within granulation tissue. Current version of image analysis algorithm is not able to distinguish epithelization from fibrin tissue and therefore manual method of selecting epithelization islands is implemented (see 3.2.4).

3.2. Wound Analysis Tab

Majority of the wound analysis tab is dedicated to wound image display.

When the tab is active, six additional icons are displayed inside the toolbar at the top of the screen:

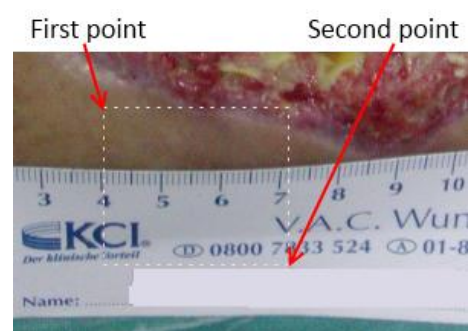
¹ D. Huljev, Chronic wound tissue characterization based on digital wound photography, **Ph.D. thesis**, University of Zagreb, School of Medicine, 2011. (in Croatian)

- Calibrate button  for image calibration,
- Mask button  for defining wound region,
- Epithelization button  for defining regions of epithelization,
- Analyze button  for starting wound analysis
- Show/hide button  for showing and hiding results
- Adjust button  for adjusting classifier.



3.2.1. Zoom image region

Default action when no other command is selected is to zoom image in and out. E.g. to zoom the ruler displayed at the right image, position mouse cursor to the top left corner of area of interest, press left button,




drag the mouse cursor to the bottom right corner and release the button.

To display image in original size (fit to window) just click the right mouse button anywhere at the image.

3.2.2. Calibrate image

To determine absolute wound dimensions it is necessary to calibrate the image, which is performed by marking distance of 1 cm, requiring that the ruler with centimeter scale be photographed near the wound. Click


Calibrate button , then click at the first point of 1 cm line, release the mouse button and finish calibration by clicking the second point. Marked distance is shown by blue line.



If there is no ruler at the wound image you may skip the calibration step. In that case wound dimensions will not be calculated and you will get only percentage of tissue types.

3.2.3. Marking wound borders


It is necessary to manually draw mask around the wound area. Zoom to the wound area as

described in 3.2.1 and click Create mask button . Button remains pressed and mouse cursor changes to the pencil. Start drawing the mask by left clicking at the starting point anywhere at the wound border. There is couple of options how to draw the mask:

- To draw straight line segment, release the left button, move the mouse pointer to the next point and left click to mark that point.
- To draw curved segment, keep left button pressed while moving the mouse pointer. Release the left button to finish the curved segment.
- To delete last segment, press the right mouse button (you could repeat that action).
- To finish drawing the mask, double click at the last point, which should be near the beginning point.

3.2.4. Marking epithelization regions


Procedure of marking epithelization regions is similar to marking wound border. Difference is that it is possible to mark multiple epithelization regions. Closing current region by double clicking the last point did not exit the command and the next region could be marked.

Therefore it is necessary to exit the command by clicking the Epithelization button  again.

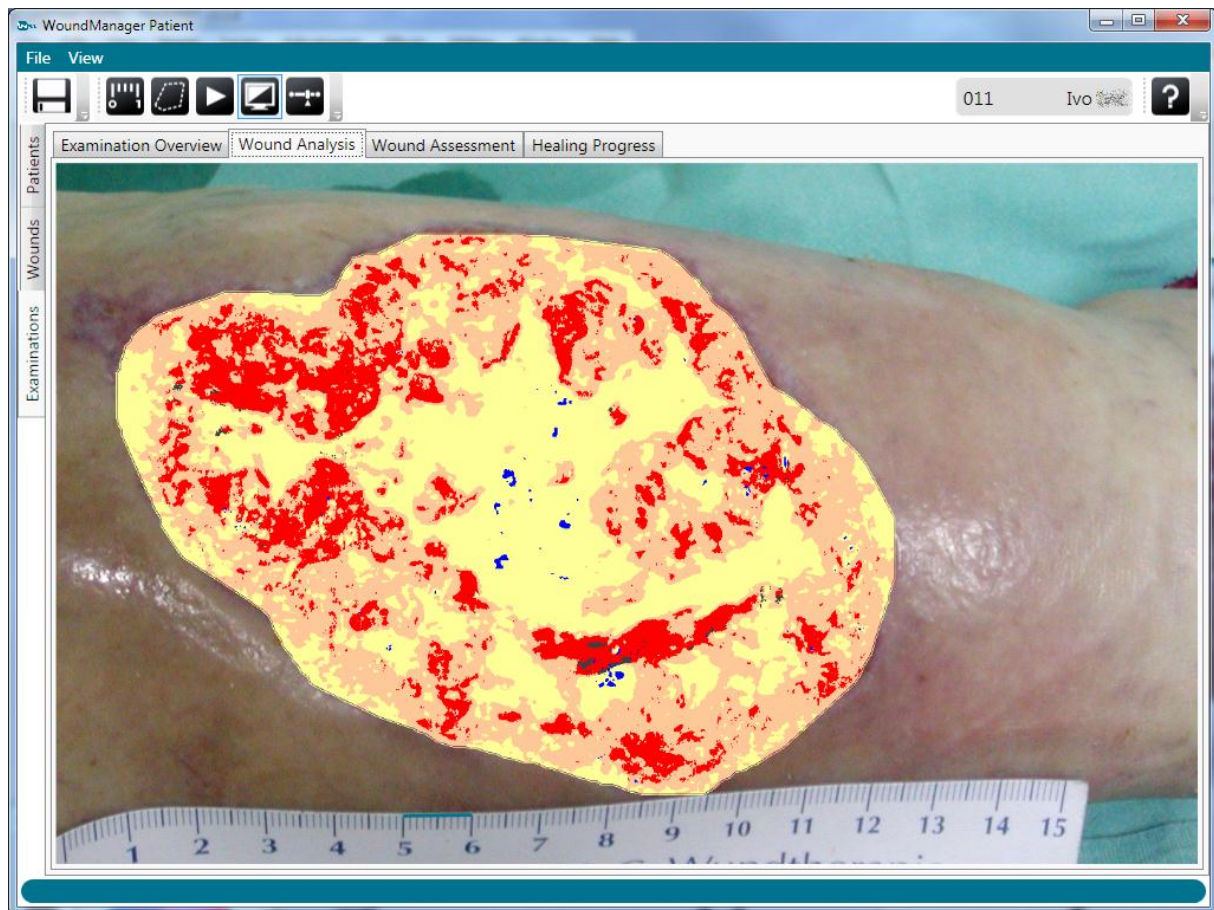
Switching Epithelization button on and then off without drawing any epithelization segment will remove epithelization marking.




3.2.5. Wound Analysis


To analyze the wound click the **Analyze** button . After few seconds, depending on image size and computer speed, analysis will finish and resulting image will be displayed over the wound image. Granulation tissue is displayed red, fibrin layer covering granulation tissue pink, fibrin yellow, necrotic tissue gray and unknown tissue blue.


At the resultant image there is couple of blue spots of unclassified tissue caused by flash reflections.

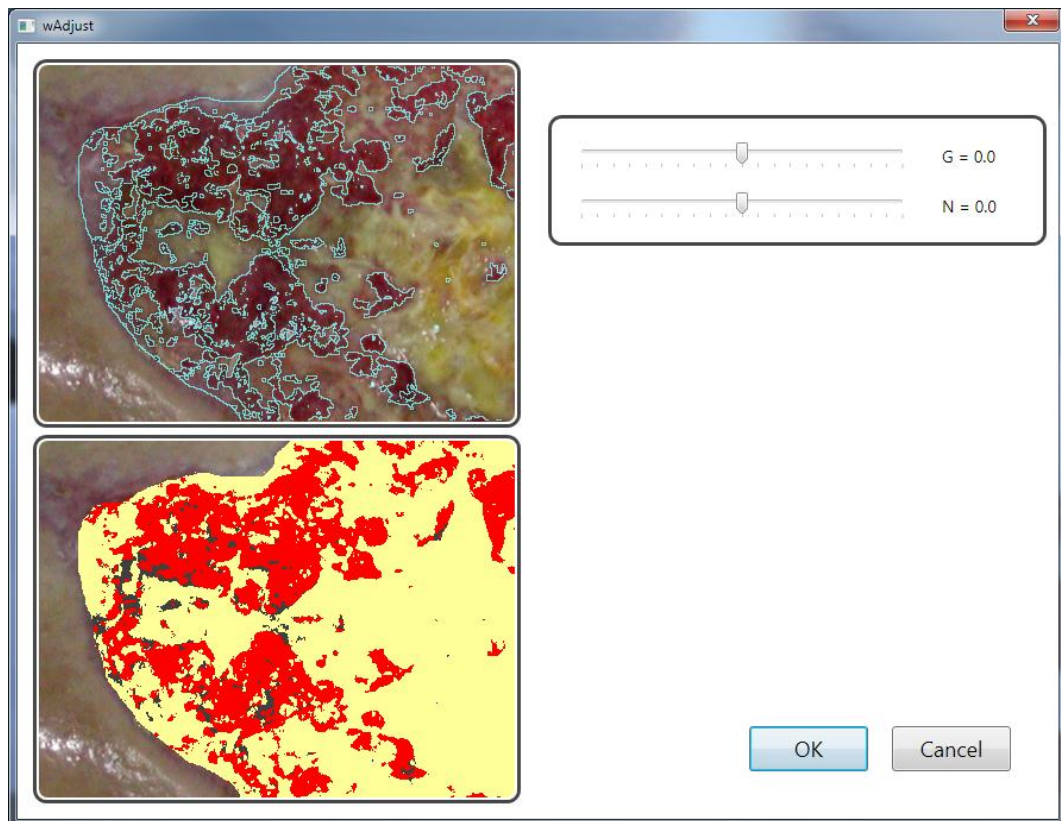


Resultant image could be displayed over original wound image or hidden by pressing the Show/hide button .

Tissue classification is not perfect. It is influenced by photographing conditions, especially by illumination. At the above example some dark spots are misclassified as necrotic tissue, which is not present in the particular wound. To correct such issues it is possible to manually

adjust classification parameters using Adjust command . Since manual adjustments influence objectivity, that option is intended only for an expert knowing how to properly adjust classifier, and only in case of poor quality image where manual adjustments will improve quality of the analysis.

To enable adjustment it is necessary to perform fresh image analysis, even if results of previous analysis exist. Clicking Adjust button () opens form for tissue classifier adjustment:



Two panels at the left present original wound image and resultant image in pseudocolors. To simplify adjustments, boundaries between different tissues are superimposed to the original wound image. G and N sliders are used to increase or decrease granulation and necrotic tissue relative to other surrounding tissue types. Pressing **OK** button will close the adjustment form and perform analysis with adjusted parameters.

4.CONTACT

You are encouraged to provide feedback about usability of the product, features you wish to see implemented into the next version, bugs (log file `WMBasicLog.txt` will be created at the user desktop if application crashed, please send it to us), and any other inquiry.

E-mail: WMinfo@antonic.hr

Web: <http://www.woundmanager.com/>