

2016

Version 9 New Features

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Recommended Citation

Meyers, Roy, "Version 9 New Features" (2016). *Web-HUMAN Systems Physiology Simulation*. 2.
https://creativematter.skidmore.edu/bio_fac_webhuman/2

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New Features (web-HUMAN 9)

A. Brief History of Addition of New Features (perspective)

The pace of the addition of new features has fallen into three phases, each more intense than the previous.

1) Each year since its introduction in 1990, we have yearly always *incrementally* added new features/functionality in response to my experiences in the Skidmore classroom with what sorts of added function would improve student the educational experience.

2) On my last sabbatical, given the *larger block of available time, major new improvements* were introduced including the On-Line Help System for variables and the On-Line Help System outlining how to carry out entire procedures was introduced.

3) With my shift to phased employment (2009), suddenly *each year* an entirely new *large block of free time* was available to work on *major new features* [the off semester in the on/off phased system]. Indeed, the opportunity to do this time intensive HUMAN work was one of the major deciding factors in my decision to choose to enter phased employment.

B. New Major Features Added: Overview- The major new features introduced in the newest version, HUMAN Version 9.

HUMAN 9 represents the *most radical, intensive, coordinated major changes ever introduced* into the Skidmore College *web-HUMAN* Teaching Simulation. This suite of new features was created in direct response to perceived Skidmore student classroom needs in two of my most recently offered courses, Comparative Vertebrate Physiology and Medical Physiology.(see elsewhere in this annual report for details of course use). Changes of this scope were only made possible by having the off-semester time period of my phased employment almost entirely available for this intensive work. An interesting by-product of this HUMAN 9 project (and also any other previous major project) has been a major increase in out-the-college use of *web-HUMAN* (see the use statistics section that follows).

The *time span of the new HUMAN 9 introduction* (it was a piece by piece introduction of each new major feature or revision of a pre-existing one) covers the approximate time period June 2011 - June 2012 and thus spans slightly more than the current academic year. However, since this newest version's changes are of all one logical piece, they are recounted as such in this year's annual report.

C. List of Major New Features Introduced in web-HUMAN 9

These include but are not limited to

- 1) Single click experiments (approx. June, 2011)
- 2) Greatly increased ability/functionality for users to save and retrieve web-HUMAN experiments (approx. mid-2011 but in stages)
- 3) Web-HUMAN clinical patient availability - phase 1 - the introduction of the specialized separate Patient Pages (Approx. July 11, 2011)
- 4) Web-HUMAN clinical patient availability - phase 2
 - The addition of extensive guided teaching Hints to the the Patient section
 - The addition of an extensive, pedagogically-oriented Analysis section (i.e. the diagnosis, the

answers, the logic and data by which one arrives at them) to the patient section. (Approx. Dec. 11, 2011)

D. More detail *only one* major set of changes, the *availability of Clinical Patients*

This includes both the Clinical Patient Availability step (3 above) and the addition of Patient pedagogical student-oriented Resources (Hints and Analysis sections, 4 above).

I know that even the most committed reader of this section can not wade through all the detail of each of the 4 sections listed above. So I have *picked only one section* of the HUMAN 9 project to explain in some modest depth. The *purpose to give the reader a feeling* for what was done, why it was done and how it was done. Some reference to this section (and to the other not-here discussed major improvements) will also be made in the completely separate numerically-oriented effectiveness analysis section.

a) Why it was done - The new Patient sections were created for use in my then upcoming Spring 2012 Medical Physiology course.

In Medical Physiology 2010 and previously in Mammalian Physiology (Bi 306) and Cardiovascular Physiology (Bi 305), *web-HUMAN* clinical patients had already been employed somewhat extensively. [although, given the difficulties in employing them described immediately below, often in a custom recreated-by-me accessible format].

But access to Patients was very crude and limited.

Steps in accessing pre-HUMAN 9 Patients

Step 1) They were only available via a simple initial choice (see below, left) when first activating *web-HUMAN* via the opening screen (see relevant left hand portion of the screen below).

Run the Model

<input checked="" type="radio"/> Experiment	number <input type="text" value="1"/>	Run for <input type="text" value="10"/> min.	Printing every <input type="text" value="10"/> min.
<input type="radio"/> Patient			

Do it

Note above that Patients could only be accessed via clicking the Patient (P) button instead of the default Experiment (E) button.

Step 2) Plus the older second step presented to the user in response to choosing a Patient (P) in step 1 above was a second screen that simply asked

Enter Patient Number (1-15)
and press <return>

Bottom line: Since Patients were rarely used, we essentially retained the original HUMAN model's simple 2 stage text choices and simply "webified" them even though the other choice, Experiment (E), entered the *web-HUMAN* user into a highly sophisticated, advanced set of web site

navigation/choice tools.

b) **Clinical patient availability - phase 1** - the introduction of the specialized separate Patient Pages

1) To make the Patients more easily available, we created a new choice on web-HUMAN's opening screen that splits off to *either a main Patient Page or a main Experimental Page*. This new screen is shown below.

- Notice below at the center of the opening screen the choice of either
Start a Physiology Experiment
OR
Run a HUMAN Patient

**web-Human Physiology Teaching Simulation
(Physiology in Health, Disease and During Treatment)**

One click Experiments
[High Altitude](#)
[Body Temperature Regulation](#)
[Blood Flow Regulation](#)
[Norepinephrine-Cardiovascular Effects](#)
[Acid-Base Balance](#)
[Fick Cardiac Output Calculation](#)
[Under Development](#)
[1-Exercise - Basic Aerobic Exercise](#)
[2-Exercise - at 3 intensity levels](#)

Welcome user rmeyers
[Get a saved experiment.](#) [Adjust my preferences](#) [Logout](#)
Start a Physiology Experiment
OR
Run a HUMAN Patient .
Welcome to web-Human Version 9.
 Version 9 is based on the same Coleman model but updates the web interface, improves graphing, adds one-click experiments and facilitates Patient access.

Resources
[About HUMAN-1st time users](#)
[How To - introductory tutorial](#)
[Users Manual](#)
[Contact Roy Meyers](#)
[Credits.](#)

Above: The new opening HUMAN screen with Experiment/Patient separation

2) This then leads to the new main Patient page itself.

**web-Human Physiology Teaching Simulation
(Physiology in Health, Disease and During Treatment)**

About web-HUMAN Patients [[link](#)]

HUMAN Clinical Patients				
Summary	Emergency Clinic*	Physiology Lab**	Hints	Analysis/Diagnosis
Motorcycle accident	Go to Clinic	Go to Lab		
Overweight, some edema	Go to Clinic	Go to Lab		
Since childhood: skinny, poor exercise tolerance	Go to Clinic	Go to Lab		
Tires easily; can't get any air	Go to Clinic	Go to Lab		

Take note of three major improvements (a-c) here:

a) Column 1 **Summary- Patients are no longer anonymous numbers.** They are *real clinical cases*. E.g. the old Patient 1 now becomes the "Motorcycle accident" Clinical Patient case, etc..

b) Next notice Column 2 "**Emergency Clinic***" and the [Go to Clinic](#) links for each case. This change is a more subtle one.

These [Go to Clinic](#) links each lead to the original and *only* form in which the HUMAN patients were previously made (obviously) available. In *this form* [i.e. **Emergency Clinic**], the *patient's underlying physiology was locked away* and not allowed to be viewed by the users. That is, this is the single most stringent & most difficult to diagnose form of Patient presentation and the user is expected to be able to *diagnose solely* on the basis of what was presented at the emergency room; no tests, no underlying physiology, nothing else was allowed.

c) Now notice column 3, the **Physiology Lab** and its [Go to Lab](#) links for each clinical case case. What we have done here is unlocked the Patients from the restrictions in the Clinic mode. Students can now *view the underlying physiology*, have the *ability to carry out clinical tests*, etc. That is, this is now *transformed into a physiology teaching tool!!* The students can poke around and explore until they figure out *why* this Patient has come to have the problem they have (e.g. you can show by exploration that the "motorcycle patient" is still hemorrhaging, therefore losing blood, and experiencing dangerous blood pressure drops due to the blood loss). That is case diagnosis via understanding cause. And then, you prove your diagnosis physiologically by transfusing blood into him at exactly the rate he is losing it, thereby stabilizing him. That is, you can confirm your physiologically arrived at diagnosis via treatment.

For example, for our bleeding motorcycle friend's treatment, from the now somewhat newly available **Help** section (below- left) to treat we would pick **Transfuse Whole Blood** (5th from bottom). This will yield (see below- right) a pop-up screen that tells us how to do so, step-by-step (Note: only the top half of the help screen is shown). The list of *tests and procedures* (left below) that can now be run and the instructions on *how to perform them* (below- right) were simply not available to students in the locked mode.

The image shows two side-by-side screenshots from a software application. The left screenshot displays a 'Help' menu with a search bar and a list of options. The right screenshot shows a 'Human: How to help' window titled 'Transfuse Blood' with instructions on how to perform a blood transfusion.

Help

Help info on:

Tips: How Do I?

View

Variab

Patient

Choos

Graph

Norm

- Use Artificial Heart
- Dialize (artificial kidney)
- Artificial Respirator
- Blood Gas Sample
- Control Dietary Intake
- Hemorrhage
- Infuse Electrolytes
- Exercise the model
- 24 Hour Urine Sample
- Take Urine Specimen
- Transfuse Whole Blood
- Administer Drugs
- Induce Pathology
- Create Cardiac Shunts
- View Patient Charts/Tests

Human: How to help

Transfuse Blood

These are barebones instructions.
Click on the Variables links for more detail.

To effect a blood transfusion, 3 variables may be set.

- 1) The **total transfusion volume** [TRNVOL](#) must be set.
- 2) The **total time** [TRNMIN](#) over which the transfusion occurs should be set.
- 3) The **hematocrit** [TRNHCT](#) of the transfused blood may be set.

Thus, a volume of 600 ml. infused over 60 min. will result in a transfusion rate [TRNRT](#) of 10 ml. per min. for a total duration of 1 hour.

C) **Clinical patient availability - phase 2** - the addition of a Hints teaching section and of an Analysis/Diagnosis/teaching section

The next and final objective was to not simply open the Patients physiology up to the students simply for to enable their own ability to explore the underlying physiology and therefore learn the nuts and bolts of the why these Clinical Patients have that particular condition but rather to *guide them in how to engage in such a process*. These new additions (Hints, Analysis) actually guide them, step by step, in *learning how to think through such problems systematically* so that they are no longer approaching discovering the underlying physiology hit or miss intuitively but rather with a framework of how to systematically approach such process. That is, these are meant to be powerful *pedagogical additions* to the new Patient page.

1) To make these newer functions available we hung the new Hints and new Analysis pages off of the the newly design Clinical Patient Cases page as is shown in the next figure.

Here we notice the addition in **Hints** column of links to Hints for each clinical case and the addition under the **Analysis/Diagnosis** column of Analysis links to each individual clinical case. To mildly discourage students from jumping immediately to what they think is the "answer", the /Diagnosis, access to the last column requires registration and log-in.

web-Human Physiology Teaching Simulation (Physiology in Health, Disease and During Treatment)				
About web-HUMAN Patients [link]				
HUMAN Clinical Patients				
Summary	Emergency Clinic*	Physiology Lab**	Hints	Analysis/Diagnosis
Motorcycle accident	Go to Clinic	Go to Lab	Hints	Analysis
Overweight, some edema	Go to Clinic	Go to Lab	Hints	Analysis
Since childhood: skinny, poor exercise tolerance	Go to Clinic	Go to Lab	Hints	Analysis

Top portion of the new Stage 2 Patient Page

2) The Hints link for any particular clinical case leads directly to the Hints page or pages for that case. These pages consist of a series of different sub-sections each of which is structured to get the student *to work through a process of physiological investigation* that reveals some underlying physiology relevant to the case and then leads to the next logical investigation of the physiology. When one is finished pursuing all items on that Hints page, one has all the logical pieces to make the diagnosis.

To see how these pages are structured as directed learning tools, I have picked one Clinical Condition as an example, the Back pains case (below).

Back pains, shivering, "problem with my urine"; Run me for 10 more days.	Go to Clinic	Go to Lab	Hints	login
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Above: Case 6 extracted from the main Phase 2 Patient page

This is Miss Ann Urism (yes they each have names on their "Your Patient's Chart"). Notice Ann's symptoms in the left column ("back pains, etc.") and her [Hints](#) link.

Clicking on the link reveals Ann's **Hints** page. The length of these pages makes it impractical to show the entire page in this document. From this Hints page I extract two successive typical sub-sections below to illustrate the pedagogical strategy.

The first extracted sample sub-section ('**III. Running the patient for 10 days to obtain...** ') appears *on the next page* of this document.

As we read through this Hints page section, we see progressively how to investigate renal (i.e. kidney) function ("problem with my urine") by successively being shown

1) How to

A] Setup the investigation, sub-step by sub-step

A-1] which **variables to display**

A-2] **Choosing Charts and Tests to display**

2) And finally the

B] Results of the experiment then run using the above outlined setup whose first part is

B-1] Pattern of the variables as they change over 10 days and an analysis of this pattern. Often there are also directed questions to get student to think about the data.

III. Running the patient for 10 days to obtain a fuller data set

A) Setup:

The report of urinary problems leads us to focus on renal function. To do so we choose *output variables* and *tests* that yield information targeted to renal function.

A-1) Choosing output variables to display

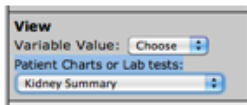
Variables: Change View output: to show a selection of renal-related variables, (see below) especially those that will not show up readily on <Patient Charts or Lab tests>.



These are, left to right, mean arterial pressure (AP), blood urea nitrogen, excretion of urea (mg/min), an acid-base profile [blood arterial pH, plasma BICARBONATE and total lung ventilation.

A-2) Choosing Charts and Tests to display

Charts: We request <Patient chart..> that shows a **Kidney Summary**. (see immediately below)



B) Results:

We now run the model for 10 days (10d) with 1 day (1d) between printouts to observe developing trends.

B-1) Pattern of the physiological variables

10.0000	Days	are	14400.0	Minutes			
1.00000	Days	are	1440.00	Minutes			
DAY/HR	AP	BUN	EXUR	PH	BICARB	VENT	
1-12:10 AM	100.7	15.42	3.274	7.405	23.50	5.731	
2-12:10 AM	98.38	24.50	5.218	7.388	22.50	6.314	
3-12:10 AM	98.18	30.03	6.145	7.381	21.53	6.473	
4-12:10 AM	97.82	33.88	6.569	7.374	20.71	6.620	
5-12:10 AM	97.67	36.94	6.786	7.369	20.02	6.767	
6-12:10 AM	97.40	39.70	6.814	7.365	19.41	6.884	
7-12:10 AM	97.22	42.49	6.766	7.359	18.87	6.996	
8-12:10 AM	97.35	45.37	6.693	7.355	18.33	7.114	
9-12:10 AM	97.07	48.52	6.427	7.348	17.80	7.213	
10-12:10 AM	96.45	52.30	6.077	7.343	17.20	7.388	
11-12:10 AM	95.81	56.74	5.672	7.334	16.54	7.581	

Ann Urism
+ DAY: 11 TIME: 12:10 AM
This lady has complained of back pains and lethargy.

Some trends in the above data to think upon here include

- what do the blood urea nitrogen and kidney urea excretion patterns suggest about renal function?
- what do the pH, bicarbonate and ventilation patterns suggest about the acid/base situation and therefore renal function?

A similar pedagogical approach is also used for the second portion of the results

B-2) Patterns in the Patients Kidney Chart (a.k.a. Kidney test results). This is presented on the next page without comment and can be seen via a read through to use a similar pedagogical approach.

Note well that you have just examined about 1/4 of this single Hints page!

A good number of cases have 2 serially successive Hints pages.

The top portion of the kidney chart shows the Patient's actual Chart. Note in it the name **Ann Urism** and her litany of complaints, "I've got a problem with my feet swelling", .. with my urine",
" . . . and I don't feel all that good."

Directly below- the **B-2] Patterns in the Patients Kidney Chart** (Kidney test results)

We also now run and compare the Kidney Summary chart at day 10 with that of a "normal" subject (run a Physiological experiment to obtain Mr. Norm L. Subject's Kidney chart).

B-2] Patterns in the patient's kidney chart

```
Ann Urism
+      DAY: 11      TIME: 12:10 AM
This lady has complained of back pains and lethargy.
She says:
I've got a problem with my feel swelling.
I've got a problem with my urine.
...And, I don't feel all that good.
..... KIDNEY .....
Arterial Pressure: 96. mmHg
Renal Perfusion Pressure: 96. mmHg
Renal Blood Flow: 237. Ml/Min
Renal Plasma Flow: 136. Ml/Min
Glomerular Filtration Rate: 23. Ml/Min
Filtration Fraction: .17
Excretion -
Water: 0.497 Ml/Min
Sodium: 0.050 mEq/Min
Potassium: .011 mEq/Min
Urea: 5.7 mg-N2/Min
Protein: .02095 Grams/Min
Acid: 0.03 mMol/Min
pH: 5.3
Plasma Levels -
Renin Activity: 0.0 ng-AI/Ml/Hr
Aldosterone Concentration: 4.6 Ng/Dl
Antidiuretic Hormone: 5.5 Pg/Ml
```

Some items in the above data to think upon include

- Is this a normal Glomerular Filtration Rate (GFR) and if not, what consequences might this have for renal function?
- Are the rates of water excretion (EXH₂O) and urea excretion (EXUR) normal?
- Does protein normally appear in the urine in these amounts?
- Acid handling- are these normal values for renal acid excretion rate and urine pH?

3) The Analysis/Diagnosis link for Ann yields not simply the expected diagnosis ("the answer"- in this case a backed up UTI, but rather presents it all within its own learning framework.

Again the page is too long to display here so the subsections of the analysis page are listed below and then one sub-section is actually shown to give a feeling for the pedagogical approach.

The **Analysis Page** sub-sections are

I. The Case

II. Brief Analysis

III. Treatment - if/as possible

IV. Recreate the case - how to

V. Useful tools- Using Patient Charts to characterize the case

It is instructive to look at the content of one of these sub-sections to understand how they approach the diagnosis pedagogically.

On the next page you will find the **II. Brief Analysis** of Ann's case. I think it is a particularly accessible

case to a general audience because we all have had or know someone who has had at least the first part of this problem, a UTI (a urinary tract infection). Hopefully many fewer of us have had or known someone who has had the second portion, a backup of urinary tract problems to the kidney.

Here is that sub-section for Ann's case immediately below. Notice how it ties together the evidence the students gained step-by-step as they went through their Hints page for Ann. Thus even the diagnosis itself is presented in a pedagogical manner.

II. Brief Analysis

Ms. Urism has renal disease.

This is likely of recent acute onset due to an infection that caused a urine outflow blockage and possibly some direct renal damage.

The *renal disease itself* is evident in

- the clear signs of a *uremic state* including
 - *urea retention* - low urea excretion, high BUN and the
 - *metabolic acidosis* - low blood and high urine pH, low plasma bicarbonate and hyperventilation (to blow off CO₂ in an attempt to compensate).

The likelihood of the renal failure being *acutely caused by an infection* that led to a urine outflow blockage and perhaps compromise of the kidney itself is supported by

- the initial reports in the Chart of back pains and shivering ('getting' a fever)
 - a continuing report, from the very beginning, of "problems with my urine".
-