Injury Maps and Vehicle Damage Maps in Vanessa

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Introduction

Historically at ICAM, vehicle damage maps (*for pedestrian cases*) and person injury map diagrams (*for all cases*) generally appeared as shown below (fig. 1):

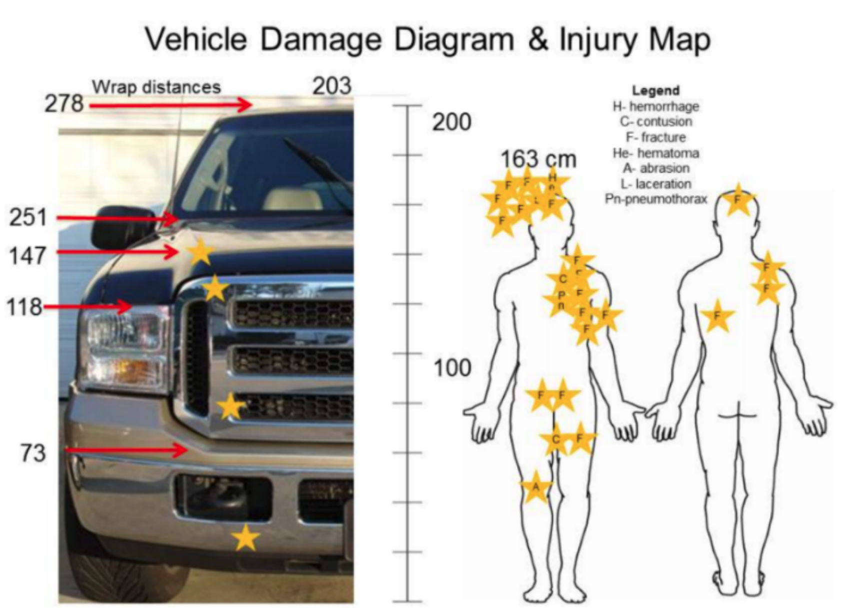


Fig. 1. A typical vehicle damage and person injury map diagram from a pedestrian case.

These diagrams were informative, but:

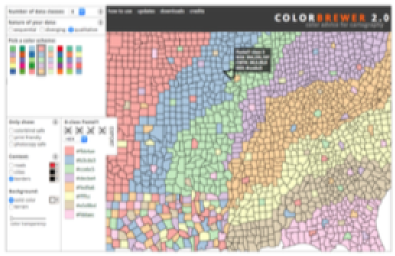
- *they were all tediously produced by hand*
- *consisted of static images*
- *in general a unisex silhouette/mannequin was used*
- *stars were used to mark the locations of damage on the vehicle or injuries on the person*
- *the star markers were *not* differentiated using different colors (to distinguish different types of injuries)*
- *sometimes nearly illegible black marker letters appeared on a dark red background (as in fig. 2)*
- *no skeletal or major internal organ details were shown*

Improvements

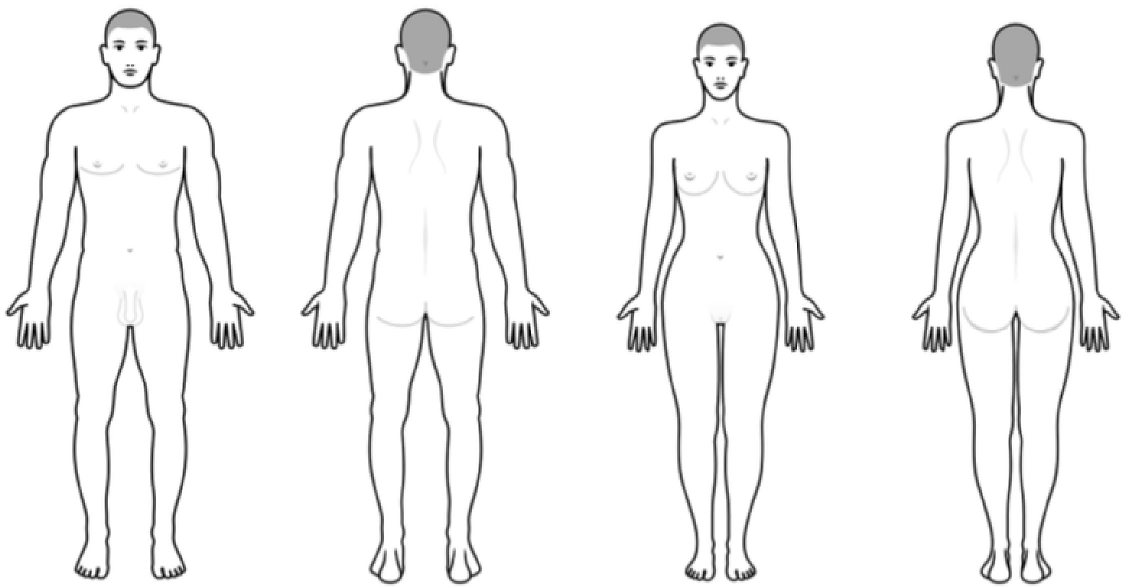
There were a number of things that could be done to improve upon both the vehicle damage map and person injury map diagrams. Suggestions that I proposed to the team at ICAM included the following:

1. *Use circular discs instead of stars as markers. It is much easier to see letter labels on circular discs:*

2. *Use a palette of different colors to represent different types of injuries on the person injury maps.* The colors should generally be lighter pastel colors. Excellent color schemes can be obtained from resources such as http://colorbrewer2.org. For example, using a qualitative color scheme from ColorBrewer2, we have:



3. *For the injury map, use a higher quality silhouette mannequin(s).*



4. Ideally it would be nice to have mannequins with a skeletal and internal organ layer visible as well.

5. Use technology to automate the production of these maps.

6. Make the maps interactive.

These were just a few of the ideas that I had.

The most challenging aspect of automating the production of the maps was translating the injury description lists into coordinate locations on the 2D mannequins.

Initially I created a proof-of-concept implementation. The key was the creation of a table of regular expressions that would identify unique regions on the body. Part of my proof-of-concept implementation included the ability to manually move around the circular labels until they were satisfactorily positioned, and then save the final coordinates in the database table.

In addition to *x* and *y* coordinates, it was also necessary to record whether the body part was paired (e.g., *legs, eyes, etc.*) vs. unpaired (*heart*), and whether it should be displayed on the anterior (*liver*) or posterior (*kidneys*) mannequin.

After much work and collaboration with colleagues who were nurses and medical imagery experts, we had a table with about 370 entries covering all regions of the body and every injury found in our complete injury database:

```
id  | model | region |                    description                         | anterior_posterior | aspect | paired |  x  |  y
 92 | 2D_01 |      4 | lung|pulmonary                                         | anterior           |        | t      | 146 | 224
 93 | 2D_01 |      4 | upper +back                                            | posterior          |        | t      | 143 | 191
 98 | 2D_01 |      6 | spine                                                  | posterior          |        | f      | 180 | 260
364 | 2D_01 |      1 | circle of willis                                       | posterior          | none   | f      | 180 |  87
...
 73 | 2D_01 |      7 | scapular? coracoid process                             | posterior          |        | t      | 113 | 183
101 | 2D_01 |      7 | humer(us|al)  (head|greater tubercle|lesser tubercle)  | anterior           |        | t      |  96 | 196
173 | 2D_01 |      8 | \bleg\b                                                | anterior           |        | t      | 133 | 535
 97 | 2D_01 |        | flank                                                  | anterior           |        | t      | 116 | 301
 27 | 2D_01 |      1 |  (bas(e|ilar)  +)?skull|skull +bas(e|ilar)             | posterior          |        | f      | 180 |  93
 71 | 2D_01 |      7 | clavic(le|ular)|collar( ?bone)?                        | anterior           |        | t      | 137 | 174
… etc …
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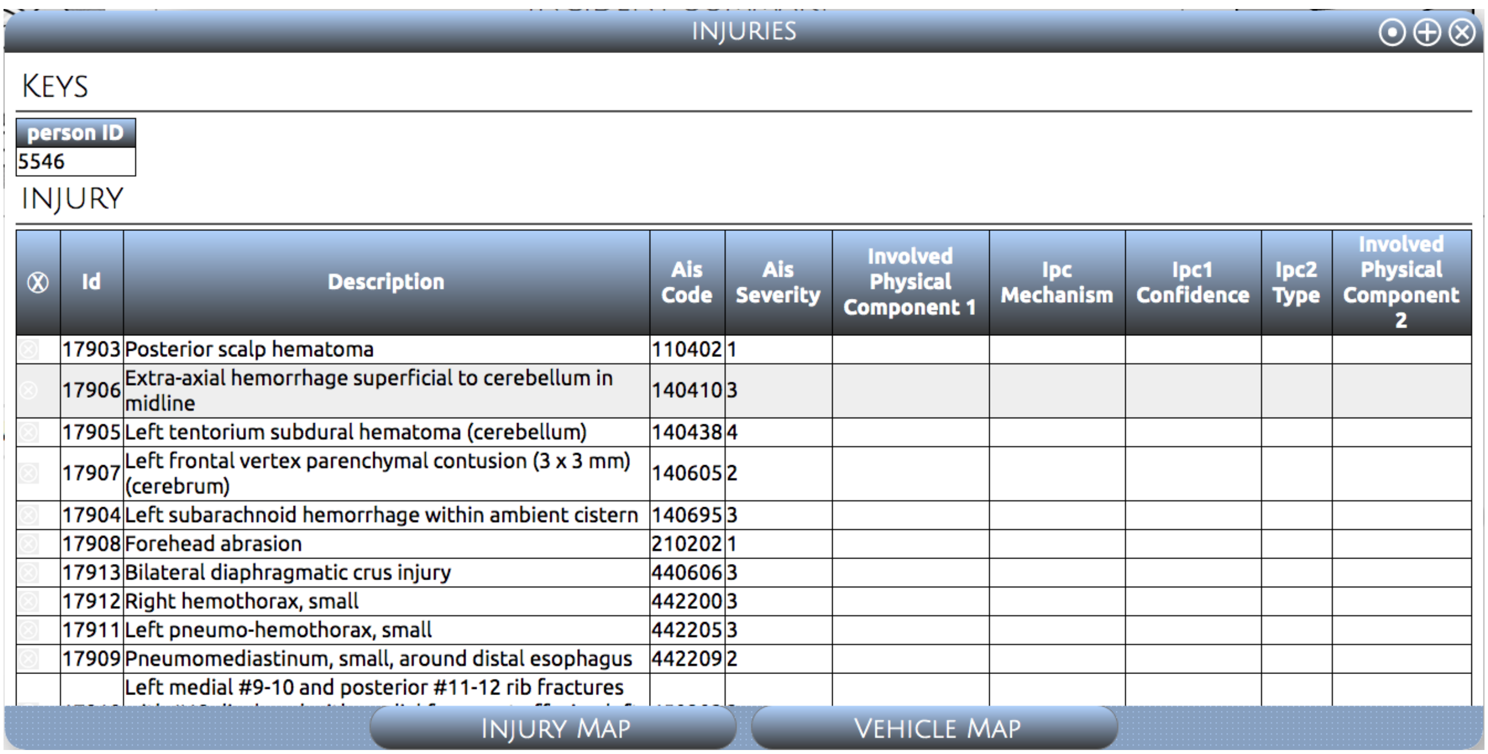
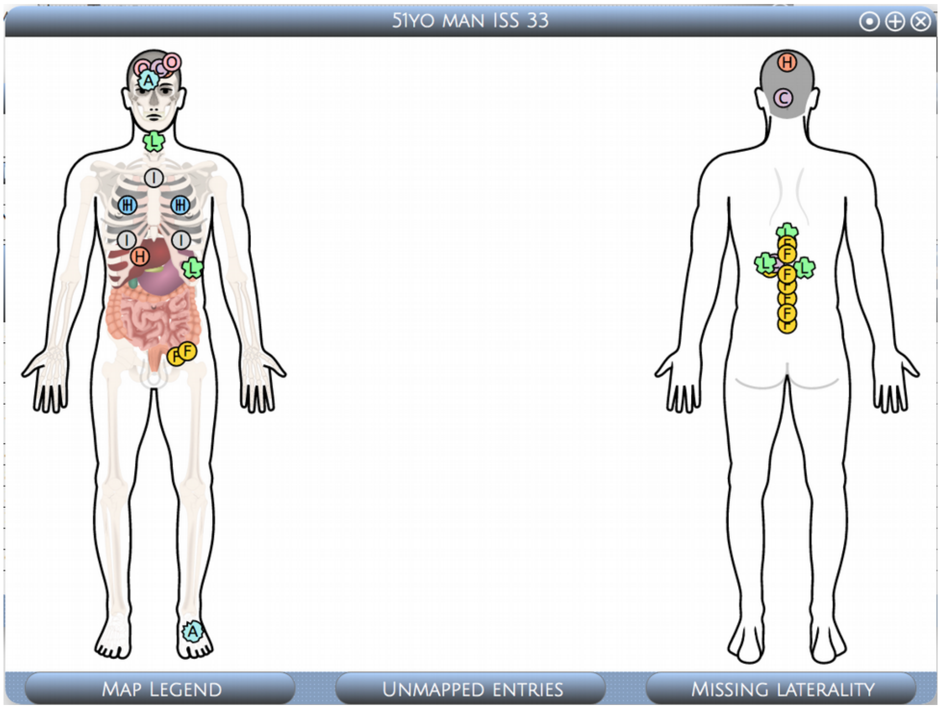
The final implementation in Vanessa “reads” an injury list such as the following:



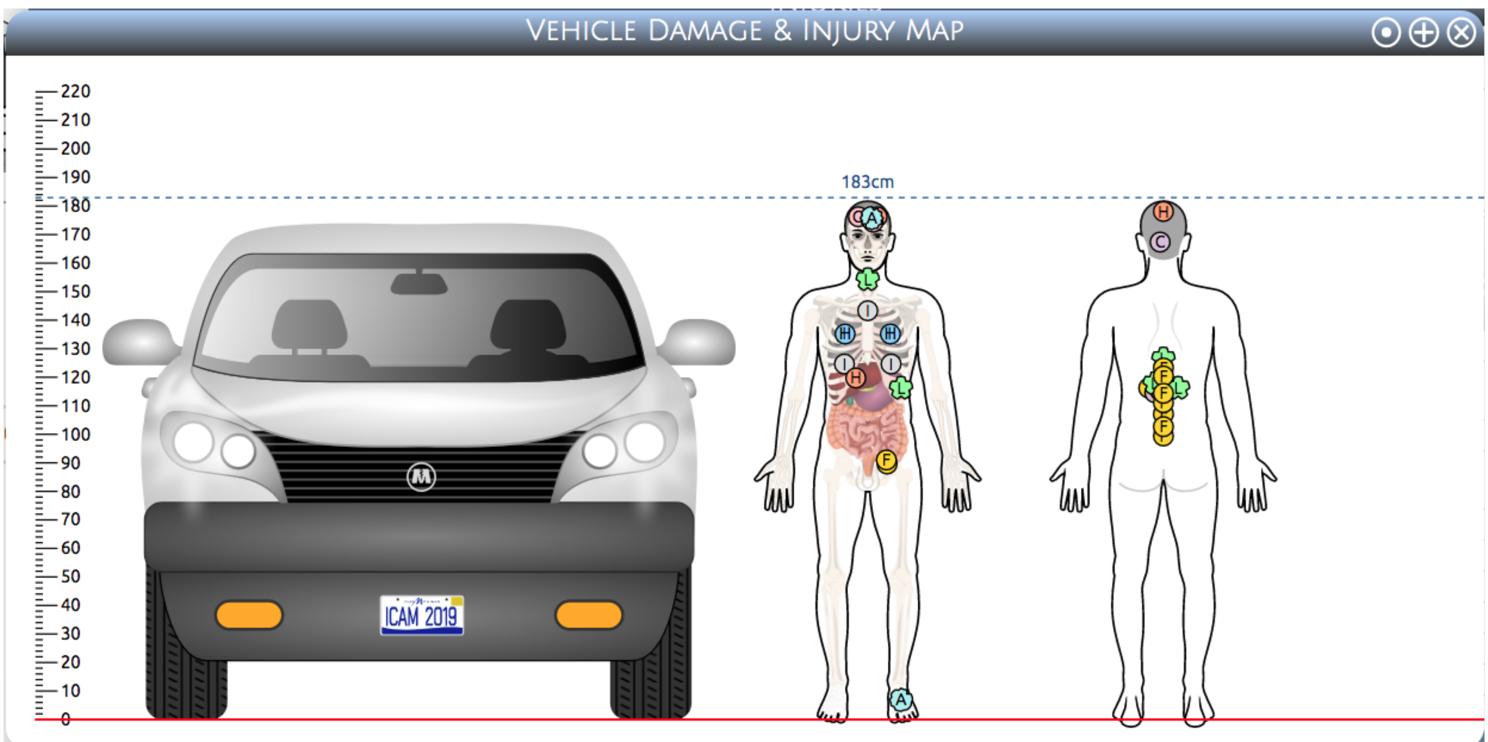
⊗	Id	Description	Ais Code	Ais Severity	Involved Physical Component 1	Ipc Mechanism	Ipc1 Confidence	Ipc2 Type	Involved Physical Component 2
	17903	Posterior scalp hematoma	110402	1					
	17906	Extra-axial hemorrhage superficial to cerebellum in midline	140410	3					
	17905	Left tentorium subdural hematoma (cerebellum)	140438	4					
	17907	Left frontal vertex parenchymal contusion (3 x 3 mm) (cerebrum)	140605	2					
	17904	Left subarachnoid hemorrhage within ambient cistern	140695	3					
	17908	Forehead abrasion	210202	1					
	17913	Bilateral diaphragmatic crus injury	440606	3					
	17912	Right hemothorax, small	442200	3					
	17911	Left pneumo-hemothorax, small	442205	3					
	17909	Pneumomediastinum, small, around distal esophagus	442209	2					
		Left medial #9-10 and posterior #11-12 rib fractures							

and automatically produces results such as this:



Hovering with the mouse over an injury disc will automatically display injury details.

Vehicle maps in which the vehicle and mannequin are correctly scaled to actual dimensions are also generated on-the-fly at the click of a button:



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