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Interactive Data Visualization of Adverse Events Clinical Trial Data with the D3.js script library

Johann Laurent, Novartis, Basel, Switzerland
Hugh McDevitt, Novartis, Basel, Switzerland

ABSTRACT

Interactive data visualization of data can provide a clear and straight forward way of quickly communicating information. For example adverse events clinical trial data represented with force directed graph. Each node is represented by a pie chart and its size is proportional to adverse events frequency. Seriousness of adverse events is identified with the outer radius length of the pie chart. Information is broken down from MedDRA System Organ Class (SOC) to Adverse Reaction Terms.

INTRODUCTION

The purpose of this paper is to demonstrate the potential to display adverse events information using a force directed graph motif. This approach makes it is possible interact with the display, for example, to drag pie charts around and zoom in and out with standard browser functionality. Graphic lines represent the hierarchy between MedDRA System Organ Class (SOC) and Adverse Reaction Terms. Size of each pie slice is proportional to the frequency of adverse events. Outer radius of pie charts is double when the adverse event is serious. Inner radius is reduced by half when it is SOC category element. Color represents the medicinal product group; it could be the dose regimen for a clinical study.

METHODS

The data structure is the key element. We have transformed raw data to structured json format which contains node information then children details. Several functions from D3.js library was used to perform this data visualization. Firstly, the d3.layout.tree() function parses our preformatted data structure and builds links between elements, then this d3.layout.force() function allow us to draw force directed graph. And finally, the d3.layout.pie() and the d3.svg.arc() functions are used to display nodes. The web page needs to be served from a web server to enable the JavaScript library to run and to be accessed from a JavaScript enabled web browser.

RESULTS

Figure 1 below shows the typical representation of the selected data. As can be seen a considerable amount of data can be displayed in one view.

Figure 1 *Interactive data visualization force directed graph of Adverse Events with the D3.js script library* showing the distribution of adverse events broken down by SOC and then treatment regimen.

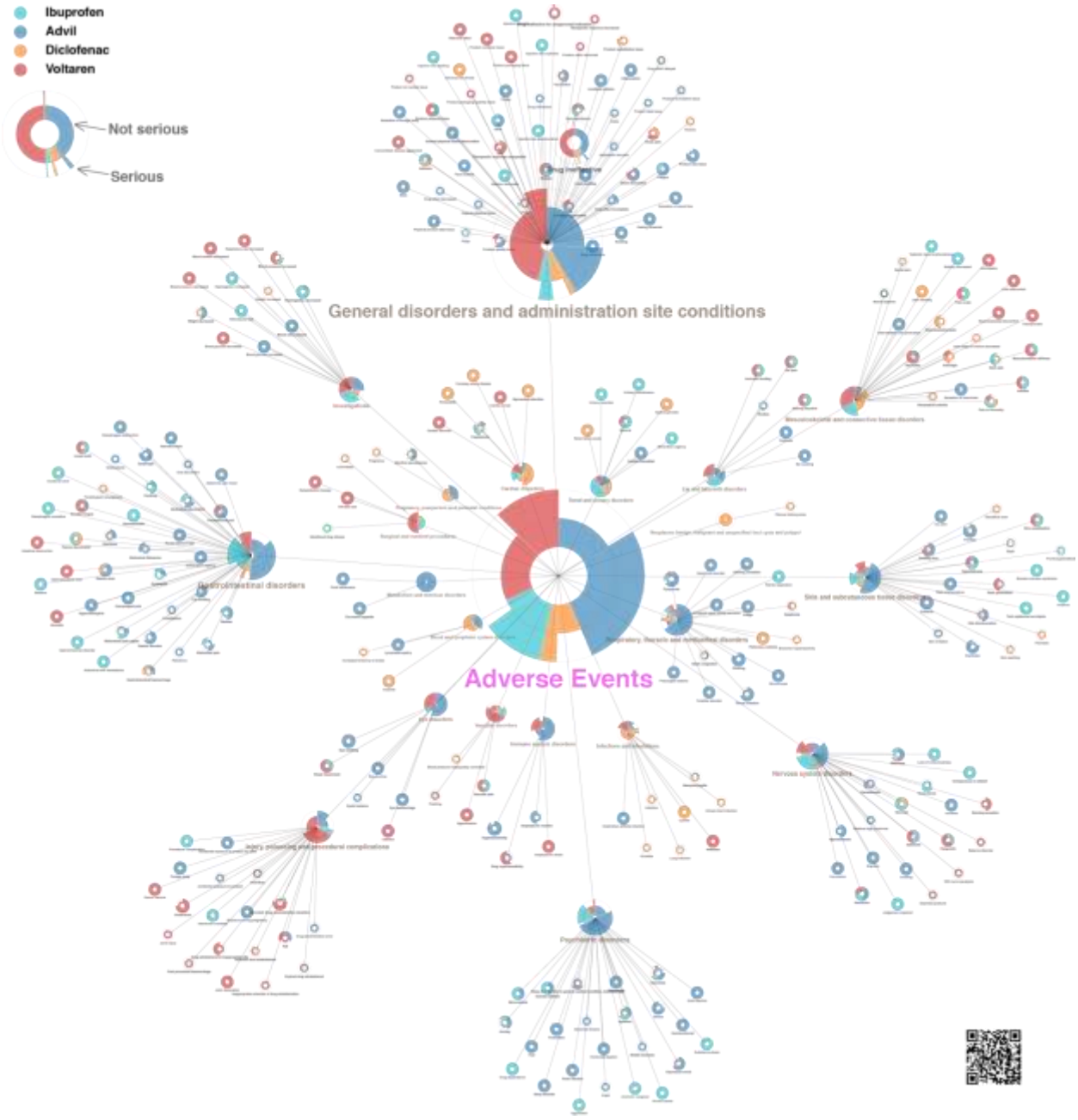

Figure 1 – Interactive data visualization force directed graph of Adverse Events with the D3.js script library

Note: The display here does not show the interactive nature of the display which is a major value driver in terms of the use of this approach. Figure 2 demonstrates that additional information can be surfaced to the user when hovering over a particular pie chart.

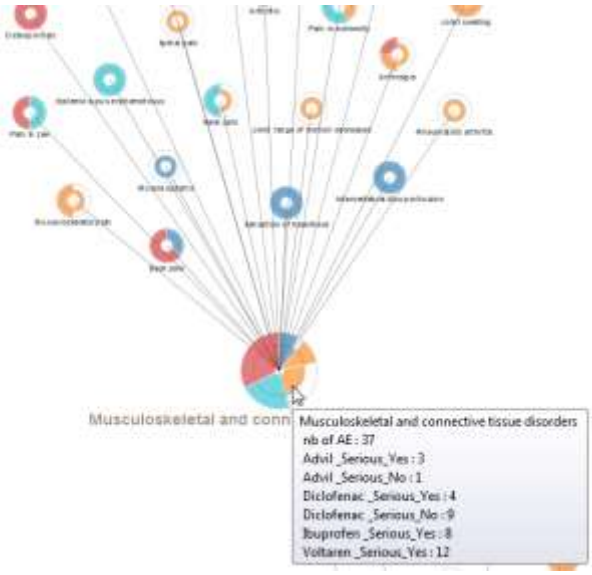

Figure 2 – Drill down to more specific data on hovering over a particular pie slice

CONCLUSION

This interactive data visualization provides a powerful overview of adverse events. One way of displaying a complex arrangement of hierarchical data is shown. However, clearly there are many different approaches that can be considered. Many alternatives are possible. Equally important is that such analysis can be performed quickly and easily.

Use of the D3 library makes it easy and straight forward to produce these kinds of visualization.

This approach can be extended to facilitate search of a specific adverse event or drill down to the actual data when a pie chart is hovered over. It clearly offers huge potential to display all sorts of data inside and outside clinical research.

REFERENCES

Information extracted from the Canada Vigilance Adverse Reaction Online Database on the 17th of April 2014:
http://webprod3.hc-sc.gc.ca/arquery-rechercheei/index-eng.jsp

Further details about interpretation of suspected adverse reaction data on Health Canada website:
http://www.hc-sc.gc.ca/dhp-mps/medeff/databasdon/conditions_search-recherche-eng.php

Nota bene, numerical comparisons should not be made between reactions associated with different health products on the basis of the data in these line-listings.

D3 Data-Driven Document JavaScript library version 3.4.6 downloaded on the 17th of April 2014:
http://d3js.org/

The actual visualization that this poster is based on can be currently viewed at http://johannlaurent.com/demo/ or by following the RF codes in the figures above.

ACKNOWLEDGMENTS

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ANNEXES

Information was extracted from the Canada Vigilance Adverse Reaction Online Database.

Selection of Data:

- Period selected was from 01-01-2013 to 31-12-2013
- Only records which contained either "advil", "ibuprofen", "diclofenac" or "voltaren" in the product description
- Keep only adverse events records which have Health Product Role as "Suspect" (remove "Concomitant")
- Records flagged as duplicate have been removed

Products description concerned:

Frequency of Adverse Reaction Term	Not Serious	Serious	Total
Advil	**137**	**226**	**363**
ADVIL	31	33	64
ADVIL COLD & SINUS LIQUI-GELS	1	1	2
ADVIL COLD AND SINUS CAPLET	1		1
ADVIL COLD AND SINUS NIGHTTIME CAPLET	4		4
ADVIL COLD AND SINUS NOS	6	50	56
ADVIL COLD AND SINUS PLUS	9		9
ADVIL EXTRA STRENGTH		9	9
ADVIL EXTRA STRENGTH CAPLETS	2		2
ADVIL EXTRA STRENGTH LIQUI-GELS	19	70	89
ADVIL LIQUI-GELS	21	33	54
ADVIL MUSCLE AND JOINT	8	1	9
ADVIL NIGHTTIME LIQUIGELS	28	12	40
ADVIL PEDIATRIC DROPS		4	4
ADVIL TABLETS	1		1
CHILDREN'S ADVIL	3	4	7
CHILDREN'S ADVIL COLD & FLU MULTI-SYMPTOM	1	3	4
CHILDREN'S ADVIL FEVER FROM COLDS OR FLU	1		1
JUNIOR STRENGTH ADVIL	1	6	7
Diclofenac	**56**	**27**	**83**
DICLOFENAC	39	24	63
DICLOFENAC SODIUM	4	1	5
PMS-DICLOFENAC	1		1
PMS-DICLOFENAC-SR	9	2	11
SANDOZ-DICLOFENAC SR	3		3
Ibuprofen	**24**	**96**	**120**
APO-IBUPROFEN	3		3
IBUPROFEN	21	96	117
Voltaren	**162**	**104**	**266**
VOLTAREN	7	22	29
VOLTAREN EMULGEL	143	72	215
VOLTAREN EMULGEL - JOINT PAIN	12	10	22
Total	**379**	**453**	**832**

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the authors at:

Johann Laurent
Novartis Pharma AG
Advanced Quantitative Sciences
Novartis Campus, WSJ-027.6.055.9
4002 Basel
Switzerland
Work Phone: +41 61 324 9034
Email: johann-dan.laurent@novartis.com

Hugh McDevitt
Novartis Pharma AG
Advanced Quantitative Sciences
Novartis Campus, WSJ-027.6
4002 Basel
Switzerland
Work Phone: +41 61 324 3954
Email: hugh.mcdevitt@novartis.com