Supplementary Material

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# Data Visualization Assessment Form.

Assessor

o Assessor 1

o Assessor 2

Data visualization ID

▼ ID1 … ID180

 Year article

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 First impression

o 1: poor

o 2

o 3

o 4

o 5: good

 Viz type

▢ Violin

▢ Density plot

▢ Boxplot

▢ Histogram

▢ Scatter plot

▢ Connected scatter plot

▢ Bubble plot

▢ Area plot

▢ Stacked area plot

▢ Stream plot

▢ Line chart

▢ Ridge line

▢ Correlogram

▢ Heatmap

▢ Dendrogram

▢ Bar chart

▢ Stacked bar chart

▢ Lollipop chart

▢ Doughnut chart

▢ Treemap

▢ Circular packaging plot

▢ Venn diagram

▢ Sunburst diagram

▢ Spider plot

▢ Sankey diagram

▢ Network plot

▢ Chord diagram

▢ Arc diagram

▢ Hive plot

▢ Hierarchical edge bundling

▢ Other\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

▢ Combined

 Faceting (multiple groups in a grid)

o Yes

o No

Actions

▢ Analyze

▢ Search

▢ Query - Identify

▢ Query - Compare

▢ Query - Summarize

Attributes

o 1

o 2

o 3

o 4

o 5

o 6

 Attribute names and types

|  |  |  |
| --- | --- | --- |
|  | Attribute name | Attribute type |
| Name | Categorical | Ordinal | Quantitative | NA | Mismatch |
| Attr. 1 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 2 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 3 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 4  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 5  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 6  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |

 Marks

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Points | Lines | Areas | NA | Mismatch |
| Attr. 1 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 2 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 3 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 4  | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 5  | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 6  | ▢ | ▢ | ▢ | ▢ | ▢ |

 Channels / position

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Horizontal | Vertical | Both | NA | Mismatch |
| Attr. 1 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 2 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 3 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 4  | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 5  | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 6  | ▢ | ▢ | ▢ | ▢ | ▢ |

Channels / colour - shape – tilt

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Color | Shape | Tilt | NA | Mismatch |
| Attr. 1 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 2 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 3 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 4  | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 5  | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 6  | ▢ | ▢ | ▢ | ▢ | ▢ |

 Channels / size

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Length | Area | Volume | NA | Mismatch |
| Attr. 1 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 2 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 3 | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 4  | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 5  | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 6  | ▢ | ▢ | ▢ | ▢ | ▢ |

 Channels effectiveness for ordered attributes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Position on common scale | Position on unaligned scale | Length (1D size) | Tilt/angle | Area (2D size) | Depth (3D position) | Color luminance / Color saturation | Curvature / Volume (3D size) | NA | Mismatch |
| Attr. 1 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 2 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 3 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 4  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 5  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 6  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |

 Channels effectiveness for categorical attributes:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Spatial position | Color hue | Motion | Shape | NA | Mismatch |
| Attr. 1 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 2 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 3 | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 4  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 5  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |
| Attr. 6  | ▢ | ▢ | ▢ | ▢ | ▢ | ▢ |

Describe what is visualized:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Interpretability without text

o 1 Not at all

o 2 Partially

o 3 Yes

 Choice of plot type

o 1: poor

o 2

o 3

o 4

o 5: good

What can be improved?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Remarks (e.g. chart junk)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Last impression

o 1: poor

o 2

o 3

o 4

o 5: good

# Visualization types per attribute.

|  |
| --- |
| **Table S2** |
| **Attribute** | **Line chart** | **Bar chart** | **Stacked bar chart** | **Dendrogram** | **Forest plot** | **Range plot** | **Bubble plot** | **Pie chart** | **Tornado plot** | **Scatter plot** | **Bma image plot** | **Heatmap** | **Stacked area plot** | **Correlogram** |
| Antimicrobial | 31.03% | **34.48%** | 24.14% |  |  |  |  | 6.90% |  |  | 3.45% |  |  |  |
| Antimicrobial consumption | **46.15%** | 23.08% | 25.64% |  |  |  |  | 2.56% |  | 2.56% |  |  |  |  |
| Bacteria | 8.33% | **58.33%** | 8.33% |  |  |  | 8.33% |  |  |  |  | 8.33% | 8.33% |  |
| Case |  |  | 16.67% | 16.67% |  | **66.67%** |  |  |  |  |  |  |  |  |
| Confidence Interval | 18.18% | 27.27% |  |  | **45.45%** |  |  |  |  | 9.09% |  |  |  |  |
| Cohort | 20.00% | **40.00%** | 20.00% |  |  | 20.00% |  |  |  |  |  |  |  |  |
| Compliance | 11.11% | **77.78%** | 11.11% |  |  |  |  |  |  |  |  |  |  |  |
| Cost | **40.00%** |  |  |  |  |  |  |  | **40.00%** | 20.00% |  |  |  |  |
| Count | 14.81% | **33.33%** | 18.52% |  | 3.70% | 7.41% | 14.81% |  |  | 7.41% |  |  |  |  |
| Cut-off | **30.77%** | 15.38% |  | 15.38% | 15.38% |  | 7.69% |  | 7.69% | 7.69% |  |  |  |  |
| Diagnosis |  | **44.44%** | 33.33% |  |  |  | 11.11% | 11.11% |  |  |  |  |  |  |
| Error |  | **80.00%** |  |  |  | 20.00% |  |  |  |  |  |  |  |  |
| Event | **25.00%** | **25.00%** | **25.00%** |  | 8.33% | 16.67% |  |  |  |  |  |  |  |  |
| Incidence | **37.04%** | 22.22% | 22.22% |  | 3.70% | 7.41% |  |  |  | 3.70% |  |  | 3.70% |  |
| Numeric value | **47.83%** | 26.09% |  |  | 13.04% | 4.35% |  |  |  | 4.35% | 4.35% |  |  |  |
| Percentage | 7.41% | **51.85%** | 22.22% |  | 3.70% |  |  | 11.11% |  |  |  | 3.70% |  |  |
| Regression | **62.50%** |  |  |  |  |  | 12.50% |  |  | 25.00% |  |  |  |  |
| Resistance | 35.14% | **40.54%** | 10.81% |  | 2.70% |  | 5.41% |  |  | 5.41% |  |  |  |  |
| Sample |  | 8.33% | 8.33% | **50.00%** |  | 16.67% |  |  |  |  |  | 8.33% |  | 8.33% |
| Setting | 15.22% | **41.30%** | 19.57% | 2.17% | 8.70% | 4.35% |  | 2.17% |  | 4.35% |  | 2.17% |  |  |
| Similarity |  |  |  | **80.00%** |  |  |  |  |  |  |  | 10.00% |  | 10.00% |
| Statistics | **33.33%** | **33.33%** |  |  | 16.67% |  |  |  | 8.33% |  |  | 8.33% |  |  |
| Survey answer |  | **50.00%** | 37.50% |  |  |  | 12.50% |  |  |  |  |  |  |  |
| Time | **52.63%** | 25.00% | 10.53% |  |  | 6.58% | 2.63% |  |  | 1.32% |  |  | 1.32% |  |

# Visual characteristics per attribute.

|  |
| --- |
| **Table S3** |
| Attribute | Channel - position |  | Channel - marks |  | Channel - colour/shape/tilt |  | Channel - size |
| Horizontal | Vertical | Both |  | Areas | Lines | Points |  | Color | Shape | Tilt |  | Area | Length | Volume |
| Antimicrobial | **72.73%** | 27.27% |  |  |  |  |  |  | **64.71%** | 35.29% |  |  |  |  |  |
| Antimicrobial consumption | 3.13% | **96.88%** |  |  | 3.03% | **48.48%** | **48.48%** |  | 33.33% | **66.67%** |  |  | 6.25% | **93.75%** |  |
| Bacteria | **71.43%** | 14.29% | 14.29% |  |  |  |  |  | **80.00%** | 20.00% |  |  |  |  |  |
| Case | 20.00% | **80.00%** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Confidence interval | **60.00%** | 30.00% | 10.00% |  |  | **81.82%** | 18.18% |  |  | **100.00%** |  |  |  | **100.00%** |  |
| Cohort | 40.00% | **60.00%** |  |  |  |  | **100.00%** |  | **75.00%** | 25.00% |  |  |  |  |  |
| Compliance |  | **100.00%** |  |  |  | **83.33%** | 16.67% |  | **100.00%** |  |  |  |  | **100.00%** |  |
| Cost | 40.00% | **60.00%** |  |  |  | **50.00%** | **50.00%** |  |  |  |  |  |  | **100.00%** |  |
| Count | 23.81% | **76.19%** |  |  | 5.26% | **63.16%** | 31.58% |  | **100.00%** |  |  |  | 18.75% | **75.00%** | 6.25% |
| Cut-off | **66.67%** | 11.11% | 22.22% |  | 12.50% | **75.00%** | 12.50% |  | **100.00%** |  |  |  | **50.00%** | **50.00%** |  |
| Diagnosis | **80.00%** | 20.00% |  |  |  |  |  |  | **75.00%** | 25.00% |  |  |  |  |  |
| Error | 40.00% | **60.00%** |  |  |  | **100.00%** |  |  | **100.00%** |  |  |  |  | **100.00%** |  |
| Event | **100.00%** |  |  |  |  | 33.33% | **66.67%** |  | 25.00% | **75.00%** |  |  |  | **100.00%** |  |
| Incidence | 8.70% | **91.30%** |  |  | 5.00% | 45.00% | **50.00%** |  | 28.57% | **71.43%** |  |  | 9.09% | **90.91%** |  |
| Numeric value | **55.00%** | 40.00% | 5.00% |  | 6.67% | 40.00% | **53.33%** |  |  |  |  |  | 33.33% | **66.67%** |  |
| Percentage | 34.78% | **60.87%** | 4.35% |  | 12.50% | **75.00%** | 12.50% |  | **66.67%** | 33.33% |  |  | 8.70% | **78.26%** | 13.04% |
| Regression |  | **71.43%** | 28.57% |  |  | **71.43%** | 28.57% |  | 33.33% | **66.67%** |  |  |  |  |  |
| Resistance | 7.41% | **92.59%** |  |  | 3.70% | **51.85%** | 44.44% |  | **77.78%** | 22.22% |  |  | 7.14% | **92.86%** |  |
| Sample |  | **100.00%** |  |  |  |  |  |  | **100.00%** |  |  |  |  |  |  |
| Setting | **60.87%** | 39.13% |  |  |  | 33.33% | **66.67%** |  | **59.38%** | 40.63% |  |  |  |  |  |
| Similarity | **100.00%** |  |  |  |  | **100.00%** |  |  |  |  |  |  |  | **100.00%** |  |
| Statistics | 22.22% | **77.78%** |  |  |  | **50.00%** | **50.00%** |  | **66.67%** | 33.33% |  |  |  | **100.00%** |  |
| Survey answer | 40.00% | **60.00%** |  |  |  |  | **100.00%** |  | **75.00%** | 25.00% |  |  |  |  |  |
| Time | **100.00%** |  |  |  |  | **100.00%** |  |  | **55.56%** | 33.33% | 11.11% |  |  | **100.00%** |  |

# Channel effectiveness for quantitative, ordinal and categorical attributes.

|  |
| --- |
| **Table S4** |
| Effectiveness | Quantitative | Ordinal | Categorical |
| Position on common scale | **82.8%** | **83.0%** |  |
| Position on unaligned scale | 1.1% | 1.0% |  |
| Length (1D size) | 3.4% | 2.0% |  |
| Area (2D size) | 6.7% | 2.0% |  |
| Depth (3D position) | 0.4% |  |  |
| Color luminance/Color saturation | 5.6% | 12.0% |  |
| Spatial position |  |  | 1.3% |
| Color hue |  |  | **68.9%** |
| Shape |  |  | 29.8% |

# Problems and illustrative quotes.

|  |
| --- |
| **Table S5.**  |
| Code (axial) | Code (open) | Illustrative quotes | Count |
| Missing labels, annotations, legend and/or abbreviation explanations | Legend/caption is missing/unclear | Legend is missing. | 26 |
| Labels for lines/points are missing/unclear | Line is not labeled and it is unclear what it represents. | 23 |
| Labels for axes are missing/unclear | Y-axis label is missing. | 20 |
| Annotation/direct labeling overflow | Difficult to read which sites are statistically significantly different. | 14 |
| Abbreviations not explained | Abbreviations not explained. | 12 |
| Use of colours not explained | Not clear what colours mean in visualization. | 7 |
| Subtotal  | 102 |
| Axes not readable | Axis intervals uneven (within visualization and between faceted visualizations) | Plots use different y-axis, so it is difficult to compare them. | 17 |
| Axes texts not clearly readable | Too much text in y-axis labels. | 11 |
| Too short/dense axes/intervals | Lines are cut above 100. | 5 |
| Uneven bar placement | White separation lines not shown for each bar. | 1 |
| Axis intervals unlogical (within visualization and between faceted visualizations) | X-axis intervals are not easy to read/compare. | 1 |
| Subtotal  | 35 |
| Colour scheme mismatch | Groups not distinguishable by colours | Use of similar colours, so hard to distinguish. | 14 |
| Non-intuitive colour schemes used | Counter-intuitive coding (colour luminance levels for min max should be switched). | 6 |
| Categorical colours used for ordered attribute | Mismatch of categorical colours for order attribute. | 5 |
| Groups not distinguishable from background | Colour for one group should not be the same as background (white). | 2 |
| Subtotal  | 27 |
| Hidden data points by overlaps | Overlap of shapes problematic | Points could be double, but not differentiable because of overlap. | 7 |
| Subtotal  | 7 |
| Using suboptimal channel effectiveness | Groups not distinguishable by shapes | Shapes are very difficult to differentiate. | 12 |
| Sub-effective channel is chosen | Shape/annotation not most effective in distinguishing between colonized/infected (colour higher effectiveness) | 3 |
| Subtotal  | 15 |
| Size scale indistinguishable | Differences in size not clear | Standard errors difficult to read (too small). | 10 |
| Groups not distinguishable by shape size | Difference in study weight (represented with square size) not readable. | 3 |
| Contrasts between groups not clear | Difficult to follow one patient line. | 2 |
| Subtotal  | 15 |
| Missing channel | Line types not used to distinguish between groups | Different line types could improve distinguishing the different groups. | 2 |
| Colors not used to compare between visualization/groups | Colours could have been used to make comparison of isolates across groups easier. | 2 |
| Subtotal  | 4 |
| Visualization type does not (optimally) fit data | Other visualization type preferred | Too many categories for the plot type (e.g. bar chart) would be better). | 21 |
| Subtotal  | 21 |
| Data points/lines on double axes | Double Y-axes difficult to read | Double y-axis confuse (not easy to apprehend which line is on which axis). | 11 |
| Subtotal  | 11 |
| Channel overflow | Double use of shape and colour | Unnecessary use of two channels for one attribute. | 8 |
| Unnecessary use of shape sizes | Unequal size of point marks (without meaning). | 1 |
| Unnecessary use of colour | Unnecessary colour channel for intervention period. | 1 |
| Too many colours | Too many colours. | 1 |
| Subtotal  | 11 |
| Attribute overflow | Too many attributes | Plot is overloaded with attributes. | 2 |
| Relating attributes that are not related | Stacked bar chart used for unrelated attributes (stacking does not make sense) | 1 |
| Subtotal  | 3 |
| Information sparsity | Could be text | Almost too little information. | 1 |
| Subtotal  | 1 |
| Incoherent ordering | Data not ordered coherently | Colonized/infected not consequently ordered in bars. | 1 |
| Subtotal  | 1 |
| Grand Total | 253 |