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National, real-time monitoring of MS immunotherapy patterns with Visualisation and Analysis Platform (VAP) implemented in Swedish MS Registry

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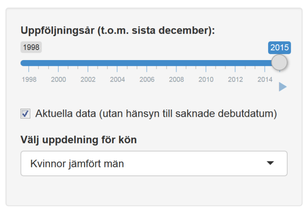
Background

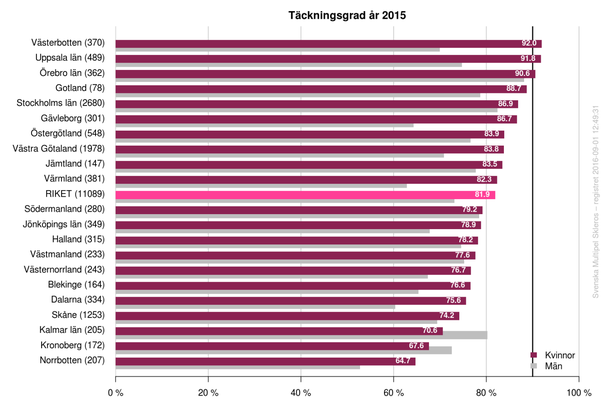
Multiple Sclerosis patients can be offered a wide range of immunomodulating therapies nowadays. Many new potential treatments for MS are in phase 2 or 3 clinical trials and will soon contribute to the broad choice of possible therapies.

Disease modifying drugs (DMD) have different biological actions of proven efficacy. They can be prescribed according to the traditional strategy of 1st or 2nd line treatments, be ordered in line with the national guidelines, tailored to an individual patient's medical status and predicted response, or administered along with individual neurologists' preferences, restricted by local conditions.

Due to these reasons, which affect how DMDs used to be prescribed, the space and time patterns of MS treatment on national or county levels, are difficult to acquire and almost impossible to find out for selected groups of patients.

Fig.1 Coverage of Swedish MS registry.
The figure shows percentual NEUROregistries/MSregistry coverage by county and gender. Number of living MS patients registered in MSreg is compared with the number of prevalent MS cases in Sweden. % coverage is evaluated as a ratio of all prevalent MS cases documented in a National Patient Registry (PAR) according to the selected criteria. PAR keeps track on all the patients' visits at inpatient and outpatients care centers in Sweden since 1968. MS diagnosis, defined by ICD-8-9: 340 and ICD-10: G35.9 codes, has been registered there since 1969. Current national coverage of MS registry is almost 80% with some local variations easily seen on the diagram. The national goal level for MS registry's coverage is 90% (depicted on the graph with a straight line).





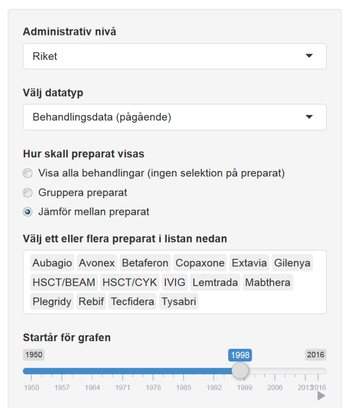
Objectives

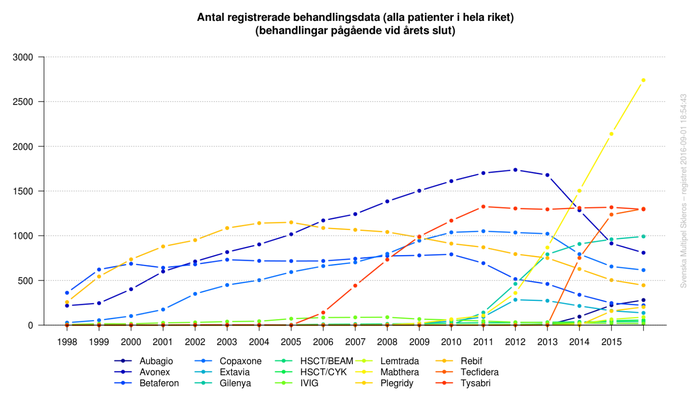
In the advances of treatment options, development of a real-time, easy and flexible monitoring system of DMD use, has been highly requested. The flexibility was understood in this context as a possibility to select a single DMD or a group of drugs and show them for a particular subgroup defined by several other parameters.

Our intention was to create the possibility to perform cross sectional comparisons and monitor longitudinal follow-up of treatment strategies.

The aim of the project was to design and implement a system, with an intuitive user interface, real-time data, on-the-fly calculations and easy access through a standard internet browser.

Fig.2 Longitudinal changes in ongoing MS treatment patterns in Sweden.
The diagram shows changes in DMD treatment strategies with time on a national level, when novel and more effective medicines have been introduced on the market. Availability of a drug, therapy effect, number of adverse events, national recommendations, personalized medicine approach, an individual neurologist choice or a price of treatment influenced which drug has been most used at a particular time point. A user can select several individual drugs and visualize them separately or pooled together. A set of selection tools is implemented including a choice of an administrative level (from a group of neurologist's own patients and the clinic, up-to the country level), gender, a type of treatment (ongoing, new started, discontinued), a time interval and a time grid (annual, monthly), etc.



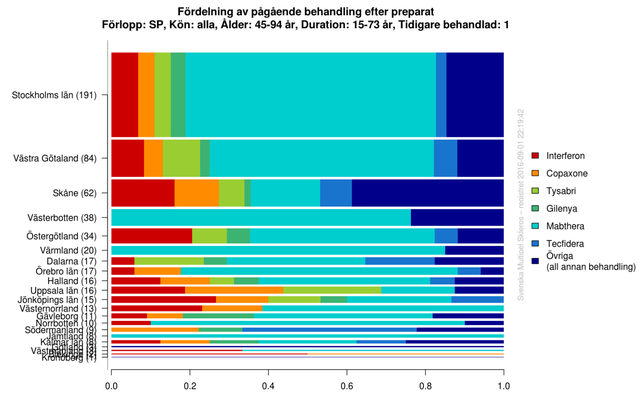


Methods

All the 60 neurological clinics in Sweden are involved in collecting DMD data of MS patients in MS Registry (MSreg) on a regular, however not mandatory basis. MSreg covers 80% of prevalent MS patients (Fig.1) i.e. 15,600 (11,900 females) of 19,500 estimated patients. Total number of registered DMDs is 30 thousand of 13,100 unique MS patients with 9,600 currently ongoing treatments.

VAP is built in SQL and R language, using a collection of R libraries including a powerful web framework – Shiny. Treatment data are automatically retrieved from the MS registry to VAP.

Fig.3 Comparison of DMT patterns for different clinical courses, disease durations and age groups.
The diagram shows DMD treatment patterns in different counties of a selected group of SPMS patients with disease duration ≥ 15 years and age ≥ 45 years. This type of diagram, so called a "*Mosaic plot*", takes into account number of patients contributing to each group (a width of a bar), showing it together with the proportion of different drugs. A number of DMD treated SP patients is small and treatment administered only in the early phase of SPMS. Proportion of the 1st line treatments i.e. interferons is low, what can be easily seen in the graph.



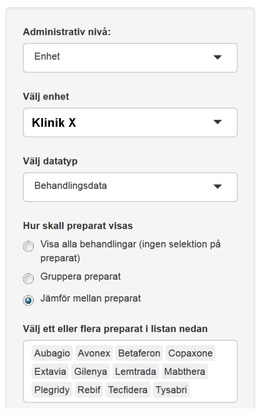
Conclusions

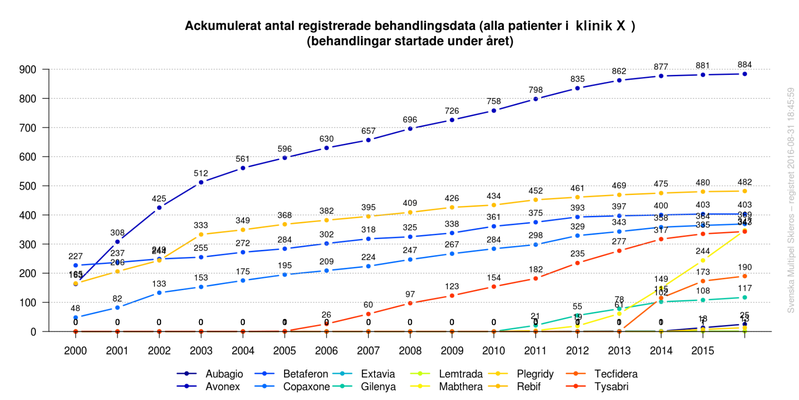
Visualization and Analysis Platform - VAP offers a wide range of flexible, real-time reports, statistics and visualization options to monitor DMD treatment in MS.

It opens the possibility to easily customize and compare diagrams on different administrative levels of healthcare providers.

VAP satisfies the needs of delivering detailed information on treatment patterns to decision makers, clinicians and researchers, which is otherwise challenging to gather.

Fig.4 Accumulated number of new prescribed DMDs at one selected neurological clinic X.
The diagram depicts accumulated number of new prescribed DMDs with time at a single, large neurological clinic X. Every clinic can monitor total number of new prescribed or discontinued DMDs up to a chosen date for its own patients and compare them with the patterns of other Swedish counties or on the national level. The diagram's "*control panel*" allows a choice of drugs and visualizes them together or separately (as shown below in the figure). Other options include selection of a gender, time interval and more.





Results

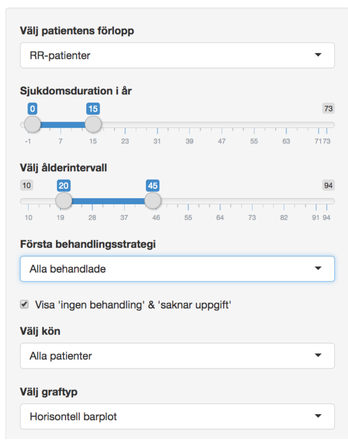
Real-time monitoring of DMDs in VAP is divided into two groups of customized diagrams: cross-sectional comparisons (current status or status at a selected time point) (Fig.1,3,5) and longitudinal comparisons (monthly and annually) (Fig.2,4,6). The user can compare the drug use in multiple ways.

Started, discontinued and ongoing treatments can be selected. All, treatment-naïve patients or secondary/further treatment patients can be chosen. Division by gender, clinical course, disease duration and age groups has been implemented.

Monitoring can be done on five administrative levels: from a neurologist's own patients (Fig.5), through the clinic (Fig.4,5,6), county, region, up to the national level (all figures).

The system is controlled by an intuitive user interface with reactive programming, supported by simple graphical selection tools - a "*control panel*".

Fig.5 Comparison of DMD therapy patterns between a selected group of neurologist's own patients with her/his clinic, all the counties and the whole country.
The diagram allows any neurologist a unique possibility to compare current treatment strategies used for a selected group of her/his patients with a treatment pattern at the clinic, all Swedish counties and the whole country. A broad set of selection tools allow the user to define a group of patients with a particular clinical course, MS duration, age group, gender and treatment strategy (all treatments, naïve treatments, further drug). Proportions between patients using specific drugs and not treated patients can be shown as well.



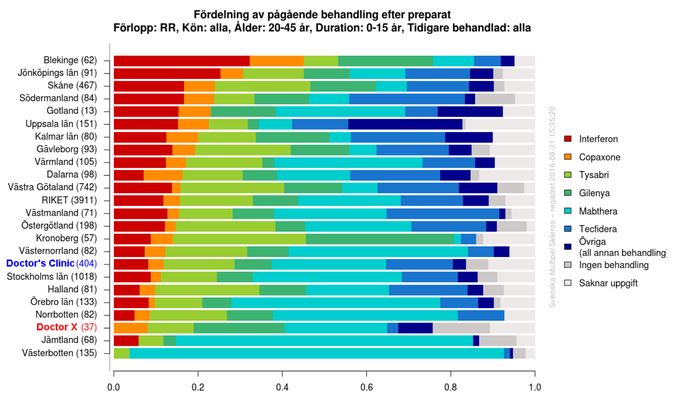
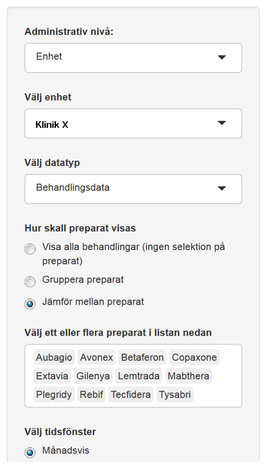
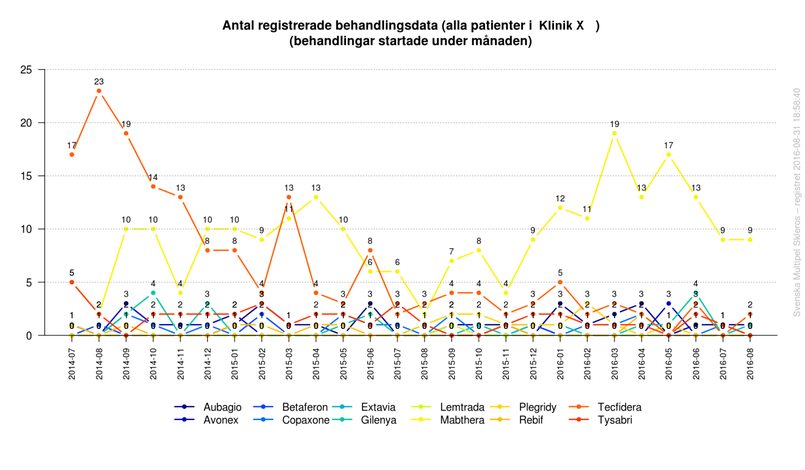


Fig.6 An example of the clinic's monthly activity reports, showing use of different DMD treatments.
Neurological clinics use to monitor their own activity on a monthly basis. They have defined several so-called process measures and outcome measures and follow them with time. Some of the most important reports are treatment reports.
The diagram below presents monthly statistics of new administered DMD treatments at one, large neurological clinic. Neurologists can in a similar way monitor ongoing DMD treatments or discontinued treatments on monthly or annual basis.





Conflict of interests / Disclosure

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LS, EH and HE have nothing to disclose.
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