Trends of Disease Activity among People with Multiple Sclerosis in the Age of Disease-Modifying Therapy: an analysis of a prospective clinic cohort, 2000-2016

Liang Liang PhD, Tianrun Cai, Howard Weiner, MD, Tanuja Chitnis, MD, Tianxi Cai, ScD, Zongqi Xia, PhD, MD

January 03, 2020

## Abstract

**Background**: Disease-modifying treatments (DMT) reduce relapse rates in multiple sclerosis (MS).

**Objective**: To investigate the temporal trend of disease activity over time in people with MS in relation to DMT usage.

**Design, Setting, and Participants**: We analyzed prospectively collected research registry data from a well-characterized clinic cohort based in Boston from 2000 to 2016, and integrated with electronic health records data.

**Main Outcomes and Measures**: We assessed the temporal trend of relapse rate (any, clinical or radiographic), percentage of the cohort receiving any DMT. We additionally assessed the trend of average 25-OH vitamin D level, average disease duration, average number of diagnostic code for MS and average number of any diagnostic code.

**Results**: We assessed the research registry data of xx people with MS between 2000 and 2016: mean age = xx years, mean disease duration = xx years, female to male ratio = xx :1. We found…

**Conclusion and Relevance**: This detailed examination of relapse rate in relation to MS treatments confirms the benefit of DMT, and…

**Trial Registration**: N/A

**Funding**: NINDS NS098023

## Introduction

Multiple sclerosis (MS) is a chronic neurological disease with a high socioeconomic burden [@noteworthy2000medical;@compston2008multiple;@asche2010all;@hartung2015cost]. Since the approval of the first disease-modifying therapy (DMT) in 1993, MS treatment has shifted from primarily managing acute relapses to reducing disease activity and delaying disability as DMTs have become the standard of care for people with MS[@hartung2015cost]. Currently, there are at least 15 Food and Drug Administration (FDA) approved DMTs, including injectable, oral and infusion options[@hartung2015cost].

…

In this study, we report the trends of disease activity among people with MS in a prospective clinic cohort from 2000-2016…

## Methods

### Study Population

In this study, we obtained research registry data from the Comprehensive Longitudinal Investigation of Multiple Sclerosis at the Brigham and Women’s Hospital (CLIMB) study based at Boston MA, from 2000-2016. We additionally obtained electronic health records data for patients in the CLIMB study from the Partners HealthCare[@xia2013modeling]. The Institutional Review Board of Partners HealthCare approved the use of research registry data and electronic health records data.

### Analysis of incidence relapse rate, DMT usage and other trends

Relapse included clinical, radiographic, or either. We examined all available DMTs during the study period: injectable [interferon-beta (including all brands), glatiramer acetate], oral [fingolimod, dimethyl fumarate, teriflunomide], and infusion [mitoxantrone, natalizumab, alemtuzumab]. Due to the small sample size in our data set, we excluded the following drugs: alemtuzumab, anti-CD20, daclizumab, and mitoxantrone. The trend of median vitamin D level, estimated incident relapse rate relative to the placebo, average disease duration, MS diagnostic code, and any diagnostic code are calculated as comparisons to the trend of the incident relapse rate.

### Statistical Analysis

Information from the EHR data are extracted and mapped to the CLIMB data with the help of the i2b2 mapping table to improve the accuracy of the CLIMB data. Specifically, the first and last ICD code dates from the EHR data in combination with the enrollment/first diagnosis date and last visit date from the CLIMB data lead to a more precise estimation on follow-up period. The resulting start/end of follow-up period are further manipulated using the standard rules, i.e., entries with missing years are deleted while the entries with missing months and days are imputed by July and 15th, respectively. Besides, vitamin data are extracted and analyzed to explore its potential relationship with MS.

The patients characteristics, such as total number of patients, percentage of females, and median and IQR duration of follow-up, are calcuted among CLIMB data and EHR data, separately. Missing values in sex and race are excluded in the calculation as the missing rates are 0.4% and 2.9%, respectively.

The incident, clinical, and radiographic relapse rates over 2000-2016 and the corresponding 95% normal CIs were computed. The former one is given in Figure 1 while the later two are provided in the supplimentary material. The 95% CI for the overall anualized relapse rate during 2000-2016 are calculated using the bootstrap method and provided in Table 1.

The trend of any DMT usage and each of the DMT usage, along with the normal CIs, are summarized in Figure 1 and 2, respectively. Table 2 listed the mean treatment duration and corresponding normal CIs for each of the DMT of interest.

The trend of estimated incident relapse rate relative to the placebo is given in Figure 1. There are two factors influence the relative relapse rate. The effectiveness of and the proportion of patients under each DMT. Specifically, patients under a more effective drug will have a lower chance of replase compared to that under a less effective drug. Besides, the higher proportion of patients under an effective drug in the cohort it is, the fewer relapses there will be. Let be the reduction rate of the th DMT and be the proportion of the patients under the th DMT. The overall incident relapse rate is estimated by

Here, the is obtained by extracting the reduction rates of all the DMTs from various literatures and then taking the average. See Table 3 for the specific values of used in the calculation.

The trend of median vitamin D level and median disease duration are provided in Figure 1, along with the normal CIs, due to the heavy skewness in the data.

The average number of MS diagnostic code and any diagnostic code are calculated as comparisons to the trend of the incident relapse rate, and are shown in Figure 3.

All the data analysis are performed using R version 3.4.2 (? do we need to specify the version?).

## Results

### Demographics

From 2000 to 2016, xx enrolled in the CLIMB cohort. The CLIMB cohort represents a predominant subset of a “virtual cohort” of MS derived from the electronic health records data. The patient characteristics are shown in Table 1. Consistent with the EHR cohort, the mean age in the CLIMB cohort was xx years old, and the female to male ratio was xx:1. The mean disease duration in the CLIMB cohort was xx. The mean follow-up duration was xx in the CLIMB cohort and xx in the EHR cohort.

### Trend of Incident Relapse Rate

….

### Trend of Disease-Modifying Treatment Prescription

…

### Trend of 25-OH Vitamin D Level

…

### Trend of Diagnostic Code for MS

…

## Discussion

In this study , we examined the temporal trends of relapse rate in a large well-characterized prospective clinic-based cohort of MS. Our main findings are…

Our analyses have several limitations. First, ….

## Acknowledgments

We thank xx.

## Funding

Dr. Xia was a recipient of the Clinician Scientist Development Award from the National Multiple Sclerosis Society and the American Academy of Neurology and is supported by NIH K08-NS079493. The funding organizations and sponsors played no role in any of the following: design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Table 1: Demographics of the Study Population

|  |  |  |
| --- | --- | --- |
|  | CLIMB | EHR |
| Total number of patients | 2375 | 5482 |
| Num belongs to EHR | 1555 | 5482 |
| Sex (% female) | 73.1 | 73.2 |
| Race (% white) | 92.7 | 81.3 |
| Median (IQR) age at first code | 35.2 (16.2) | 38 (16.8) |
| Median (IQR) age at first symptom onset | 32.9 (14.7) | NA |
| Median (IQR) age at first date | 34.3 (15.9) | NA |
| Median (IQR) duration of follow-up | 13.7 (13.8) | 12.8 (12.4) |
| Median (IQR) number of treatments | 2 (2) | NA |
| % receiving treatments | 80.3 | NA |
| Average Annualized relapse rate 2000-2016 | 0.147 (0.008) | NA |

Supplementary Table: Demographics of the ever treated vs never treated.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Ever Treated | Never Treated | p-value for heter |
| Total number of patients | 1907 | 468 | NA |
| Num belongs to EHR | 1247 | 308 | NA |
| Sex (% female) | 72.9 | 73.9 | 0.644 |
| Race (% white) | 92.2 | 94.5 | 0.107 |
| Median (IQR) age at first code | 34.9 (16.2) | 36.8 (15.7) | 0.098 |
| Median (IQR) age at first symptom onset | 32.6 (15) | 33.8 (13) | 0.07 |
| Median (IQR) age at first date | 34 (16) | 35.6 (15.2) | 0.035 |
| Median (IQR) duration of follow-up | 14.3 (13.6) | 11.2 (13.7) | 1.8e-07 |
| Median (IQR) number of treatments | 2 (3) | 0 (0) | NA |
| % receiving treatments | 100% | 0% | NA |
| Average Annualized relapse rate 2000-2016 | 0.177 (0.01) | 0.015 (0.005) | 2.0e-193 |

Table 2: Prescription pattern of disease-modifying treatments.

|  |  |  |
| --- | --- | --- |
| Treatment | Number of participants | Median treatment duration (95% CI) |
| alemtuzumab | 3 | 13.67 (0.133, 31.6) |
| daclizumab | 73 | 25.17 (20.3, 32.6) |
| dimethyl fumarate | 506 | 31.53 (29, 34.5) |
| fingolimod | 477 | 42.45 (38.5, 45.5) |
| glatiramer acetate | 1131 | 53 (48, 56.9) |
| interferon | 1429 | 55.18 (50.6, 60) |
| mitoxantrone | 21 | 29.7 (17.8, 41) |
| natalizumab | 362 | 28.27 (24, 33.8) |
| ocrelizumab | 3 | 0.53 (0.367, 2) |
| rituximab | 251 | 16.37 (13.9, 19.6) |
| teriflunomide | 118 | 15 (10.5, 19.6) |
| No treatment | 468 | NA |

Table 2: Prescription pattern of disease-modifying treatments.

|  |  |  |
| --- | --- | --- |
| Treatment | Number of participants | Median treatment duration (IQR) |
| alemtuzumab | 3 | 13.67 (15.73) |
| daclizumab | 73 | 25.17 (34.98) |
| dimethyl fumarate | 506 | 31.53 (32.73) |
| fingolimod | 477 | 42.45 (47.04) |
| glatiramer acetate | 1131 | 53 (81.17) |
| interferon | 1429 | 55.18 (91.81) |
| mitoxantrone | 21 | 29.7 (26.3) |
| natalizumab | 362 | 28.27 (55.62) |
| ocrelizumab | 3 | 0.53 (0.82) |
| rituximab | 251 | 16.37 (27.7) |
| teriflunomide | 118 | 15 (23.73) |
| No treatment | 468 | NA |

Figure 1 . Temporal trend of relapse rate in relation to any MS treatment, relative incident relapse rate, 25-OH vitamin D level, and disease duration

## quartz\_off\_screen   
## 2

Trend analysis for Figure 1.

|  |  |  |  |
| --- | --- | --- | --- |
|  | est | bootsd | P-value |
| Incident Rate | -6.0e-03 | 5.8e-04 | 3.9e-25 |
| Trt Percent | 3.0e-02 | 1.2e-03 | 8.5e-136 |
| Untreated Relapse Rate | -3.6e-03 | 5.0e-04 | 5.2e-13 |
| Treated Relapse Rate | -9.1e-03 | 7.8e-04 | 2.4e-31 |
| VD | 6.1e-01 | 2.4e-01 | 1.1e-02 |
| Disease Dur | 5.7e-01 | 2.3e-02 | 8.4e-137 |

Figure 2 . Temporal trend of MS treatment prescription.

## quartz\_off\_screen   
## 2

Figure 3 . Trend of diagnostic code for MS, any diagnostic code, and adjusted MS diagnostic code by notes, any diagnostic codes, and baseline variables.

## quartz\_off\_screen   
## 2

Trend analysis for Figure 3.

|  |  |  |  |
| --- | --- | --- | --- |
|  | est | bootsd | P-value |
| code340 | 1.5e-01 | 1.4e-02 | 2.5e-27 |
| anyICD | 7.1e-01 | 4.8e-02 | 5.0e-51 |
| code340\_adj | -9.8e-02 | 7.0e-03 | 1.5e-44 |

Figure 4 . Trend of NLP mentions over time.

## quartz\_off\_screen   
## 2

Figure 4-2. Trend of NLP mentions over time adjusted by notes, any diagnostic codes, and baseline variables.

## quartz\_off\_screen   
## 2

Trend analysis of Figure 4.

|  |  |  |  |
| --- | --- | --- | --- |
|  | est | bootsd | P-value |
| MultiSc | 2.6e-02 | 1.1e-03 | 2.4e-138 |
| Relapse | 2.9e-02 | 9.4e-04 | 1.9e-215 |
| DMT | 2.9e-02 | 1.1e-03 | 9.7e-145 |
| MultiScRelapse | 3.0e-02 | 9.2e-04 | 1.0e-236 |
| MultiScDMT | 3.0e-02 | 1.1e-03 | 5.7e-165 |
| MultiSc\_Adj | 2.2e-03 | 9.6e-05 | 3.0e-120 |
| Relapse\_Adj | 1.4e-02 | 1.3e-04 | 0.0e+00 |
| DMT\_Adj | 9.7e-03 | 1.8e-04 | 0.0e+00 |
| MultiScRelapse\_Adj | 1.6e-02 | 1.4e-04 | 0.0e+00 |
| MultiScDMT\_Adj | 1.2e-02 | 1.7e-04 | 0.0e+00 |

Figure 5. Trend of health utilization over time.

## quartz\_off\_screen   
## 2

Figure 5-2. Trend of health utilization over time adjusted by notes, any diagnostic codes, and baseline variables.

## quartz\_off\_screen   
## 2

Trend analysis of Figure 5.

|  |  |  |  |
| --- | --- | --- | --- |
|  | est | bootsd | P-value |
| MRI | 2.0e-02 | 1.5e-03 | 2.5e-41 |
| HD | 6.3e-03 | 9.1e-04 | 4.0e-12 |
| ED | 3.6e-03 | 8.4e-04 | 1.8e-05 |
| MRI\_Adj | -2.6e-02 | 1.1e-03 | 2.7e-124 |
| HD\_Adj | 2.8e-04 | 3.6e-04 | 4.5e-01 |
| ED\_Adj | -8.9e-03 | 7.3e-04 | 3.2e-34 |
| MRI\_Prop | 2.0e-02 | 1.0e-03 | 2.9e-86 |
| HD\_Prop | 2.7e-03 | 2.9e-04 | 1.1e-20 |
| ED\_Prop | 1.9e-03 | 4.1e-04 | 1.6e-06 |

Supplementary Table 1: published results.

Table 3. Average reduction rate of DMTs over placebo extracted from various literatures.

|  |  |  |
| --- | --- | --- |
|  | Average reduction rate | Average relapse rate |
| placebo | NA | 0.464 |
| dimethyl\_fumarate | 0.488 | 0.195 |
| fingolimod | 0.557 | 0.263 |
| glatiramer\_acetate | 0.350 | 0.269 |
| interferon | 0.276 | 0.277 |
| natalizumab | 0.604 | 0.242 |
| teriflunomide | 0.310 | 0.306 |

Supplementary Figure 1: Temporal trend of incident clinical and radiographic relapse rate.

## quartz\_off\_screen   
## 2

Trend analysis of Figure S1.

|  |  |  |  |
| --- | --- | --- | --- |
|  | est | bootsd | P-value |
| Clinical Incident Relapse | -4.7e-03 | 4.9e-04 | 1.0e-21 |
| Radiographic Incident Relapse | -5.9e-04 | 2.3e-04 | 1.1e-02 |

Supplementary Figure 2: proportion of patients under each treatment.

## quartz\_off\_screen   
## 2

Trend analysis of Figure S2.

|  |  |  |  |
| --- | --- | --- | --- |
|  | est | bootsd | P-value |
| Methylprednisolone\_Adj | -1.4e-01 | 5.1e-03 | 4.7e-161 |
| Interferon\_Adj | -1.1e-02 | 3.2e-04 | 4.6e-255 |

Supplementary Figure 3: frequency of NLP mentions.

## quartz\_off\_screen   
## 2

Trend analysis of Figure S3.

|  |  |  |  |
| --- | --- | --- | --- |
|  | est | bootsd | P-value |
| MultiSc.Raw | 3.9e-03 | 3.6e-04 | 8.2e-27 |
| Relapse.Raw | 4.3e-03 | 3.2e-04 | 2.5e-41 |
| DMT.Raw | 9.9e-03 | 4.7e-04 | 1.2e-99 |
| Supplementary | Figure 4: | higher vs | standard efficacy drugs |

## quartz\_off\_screen   
## 2

Trend analysis of Figure S4.

|  |  |  |  |
| --- | --- | --- | --- |
|  | est | bootsd | P-value |
| Trt Higher Percent | 1.1e-02 | 5.9e-04 | 1.4e-70 |
| Trt Standard Percent | 2.1e-02 | 1.3e-03 | 1.5e-63 |
| Untreated Relapse Rate | -3.6e-03 | 5.0e-04 | 5.2e-13 |
| Treated Higher Relapse Rate | -5.4e-03 | 3.9e-03 | 1.6e-01 |
| Treated Standard Relapse Rate | -9.4e-03 | 7.9e-04 | 4.5e-33 |

Supplementary Table 2: list of CUIs.

List of CUIs.

|  |  |  |  |
| --- | --- | --- | --- |
| Category | Code | Description | Codes Found in the Cohort (Yes/No) |
| Multiple Sclerosis | C0011302 | demyelinating disease of the central nervous system | TRUE |
| Multiple Sclerosis | C0011304 | demyelination | TRUE |
| Multiple Sclerosis | C0026769 | multiple sclerosis | TRUE |
| Multiple Sclerosis | C0235962 | aggressive multiple sclerosis | TRUE |
| Multiple Sclerosis | C0751964 | primary progressive multiple sclerosis | TRUE |
| Multiple Sclerosis | C0751965 | secondary progressive multiple sclerosis | TRUE |
| Multiple Sclerosis | C0751967 | relapsing remitting multiple sclerosis | TRUE |
| Multiple Sclerosis | C2585570 | benign multiple sclerosis | TRUE |
| Multiple Sclerosis | C2586221 | malignant multiple sclerosis | TRUE |
| Multiple Sclerosis | chip0074 | clinically definitive multiple sclerosis | TRUE |
| Relapse | C0277556 | relapse | TRUE |
| Relapse | C1304680 | attack | TRUE |
| Relapse | C1517205 | flare | TRUE |
| Relapse | chip0100 | æimaging relapse | FALSE |
| Relapse | chip0101 | æneuroimaging relapse | FALSE |
| Relapse | chip0102 | æradiological relapse | TRUE |
| Relapse | chip0103 | æradiographic relapse | TRUE |
| Relapse | chip0104 | attack | TRUE |
| Relapse | chip0105 | clinical attack | TRUE |
| Relapse | chip0115 | new T2/FLAIR lesion | TRUE |
| Relapse | chip0117 | new area of signal abnormality | TRUE |
| Relapse | chip0118 | new plaque | TRUE |
| Relapse | chip0119 | new enhancement | TRUE |
| Relapse | chip0120 | gadolinium enhancement | TRUE |
| Relapse | chip0122 | pathological enhancement | TRUE |
| Relapse | chip0123 | new gadolinium enhancing lesion | TRUE |
| Relapse | chip0124 | evidence of new disease activity | TRUE |
| Relapse | chip0125 | evidence of new or active demyelinating disease | FALSE |
| Relapse | chip0126 | active disease | TRUE |
| DMT | C0058218 | dimethyl fumarate | TRUE |
| DMT | C3556178 | Tecfidera | TRUE |
| DMT | C1699926 | fingolimod | TRUE |
| DMT | C2938762 | Gilenya | TRUE |
| DMT | C0717787 | glaitramer | TRUE |
| DMT | C0289884 | glatiramer acetate | TRUE |
| DMT | C0528175 | Copaxone | TRUE |
| DMT | C4027077 | Glatopa | TRUE |
| DMT | C0015980 | Interferon-beta | TRUE |
| DMT | C0244713 | Interferon-beta-1b | TRUE |
| DMT | C0254119 | Interferon beta-1a | TRUE |
| DMT | C0284968 | Betaseron | TRUE |
| DMT | C0594372 | Avonex | TRUE |
| DMT | C0752980 | Rebif | TRUE |
| DMT | C2719461 | Extavia | TRUE |
| DMT | C3848580 | peginterferon beta-1a | TRUE |
| DMT | C3848664 | Plegridyæ | TRUE |
| DMT | C1172734 | natalizumab | TRUE |
| DMT | C1529600 | Tysabri | TRUE |
| DMT | C1718383 | teriflunomide | TRUE |
| DMT | C3497721 | Aubagio | TRUE |

Supplementary Table 3: list of CPT codes.

List of CPT codes.

|  |  |  |  |
| --- | --- | --- | --- |
| Category | CPT\_code | Description | Codes Found in the Cohort (Yes/No) |
| MRI | C70552 | Magnetic resonance (eg, proton) imaging, brain (including brain stem); with contrast material(s) | TRUE |
| MRI | C70553 | Magnetic resonance (eg, proton) imaging, brain (including brain stem); without contrast material, followed by contrast material(s) and further sequences | TRUE |
| MRI | C70554 | Magnetic resonance imaging, brain, functional MRI; including test selection and administration of repetitive body part movement and/or visual stimulation, not requiring physician or psychologist administration | FALSE |
| MRI | C70555 | Magnetic resonance imaging, brain, functional MRI; requiring physician or psychologist administration of entire neurofunctional testing | FALSE |
| MRI | C70557 | Magnetic resonance (eg, proton) imaging, brain (including brain stem and skull base), during open intracranial procedure (eg, to assess for residual tumor or residual vascular malformation); without contrast material | FALSE |
| MRI | C70559 | Magnetic resonance (eg, proton) imaging, brain (including brain stem and skull base), during open intracranial procedure (eg, to assess for residual tumor or residual vascular malformation); without contrast material(s), followed by contrast material(s) and further sequences | FALSE |
| MRI | C72146 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, thoracic; without contrast material | TRUE |
| MRI | C72147 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, thoracic; with contrast material(s) | TRUE |
| MRI | C72157 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, without contrast material, followed by contrast material(s) and further sequences; thoracic | TRUE |
| MRI | C72141 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, cervical; without contrast material | TRUE |
| MRI | C72142 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, cervical; with contrast material(s) | TRUE |
| MRI | C72156 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, without contrast material, followed by contrast material(s) and further sequences; cervical | TRUE |
| MRI | C70540 | Magnetic resonance (eg, proton) imaging, orbit, face, and neck; without contrast material(s) | TRUE |
| MRI | C70542 | Magnetic resonance (eg, proton) imaging, orbit, face, and neck; with contrast material(s) | TRUE |
| MRI | C70543 | Magnetic resonance (eg, proton) imaging, orbit, face, and neck; without contrast material(s), followed by contrast material(s) and further sequences | TRUE |
| Emergency Department Visit | C99281 | Emergency department visit for the evaluation and management of a patient, which requires these three key components: a problem focused history; a problem focused examination; and straightforward medical decision making. Counseling and/or coordination of care with other providers or agencies are provided consistent with the nature of the problem(s) and the patient’s and/or family’s needs. Usually, the presenting problem(s) are self limited or minor. | TRUE |
| Emergency Department Visit | C99282 | Emergency department visit for the evaluation and management of a patient, which requires these three key components: an expanded problem focused history; an expanded problem focused examination; and medical decision making of low complexity. Counseling and/or coordination of care with other providers or agencies are provided consistent with the nature of the problem(s) and the patient’s and/or family’s needs. Usually, the presenting problem(s) are of low to moderate severity. | TRUE |
| Emergency Department Visit | C99283 | Emergency department visit for the evaluation and management of a patient, which requires these three key components: an expanded problem focused history; an expanded problem focused examination; and medical decision making of moderate complexity. Counseling and/or coordination of care with other providers or agencies are provided consistent with the nature of the problem(s) and the patient’s and/or family’s needs. Usually, the presenting problem(s) are of moderate severity. | TRUE |
| Emergency Department Visit | C99284 | Emergency department visit for the evaluation and management of a patient, which requires these three key components: a detailed history; a detailed examination; and medical decision making of moderate complexity. Counseling and/or coordination of care with other providers or agencies are provided consistent with the nature of the problem(s) and the patient’s and/or family’s needs. Usually, the presenting problem(s) are of high severity, and require urgent evaluation by the physician but do not pose an immediate significant threat to life or physiologic function. | TRUE |
| Emergency Department Visit | C99285 | Emergency department visit for the evaluation and management of a patient, which requires these three key components within the constraints imposed by the urgency of the patient’s clinical condition and/or mental status: a comprehensive history; a comprehensive examination; and medical decision making of high complexity. Counseling and/or coordination of care with other providers or agencies are provided consistent with the nature of the problem(s) and the patient’s and/or family’s needs. Usually, the presenting problem(s) are of high severity and pose an immediate significant threat to life or physiologic function. | TRUE |
| Hospital Admission | CG8979 | Mobility: walking and moving around functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting | TRUE |
| Hospital Admission | CG8980 | Mobility: walking and moving around functional limitation, discharge status, at discharge from therapy or to end reporting | TRUE |
| Hospital Admission | CG8982 | Changing and maintaining body position functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting | TRUE |
| Hospital Admission | CG8986 | Carrying, moving and handling objects functional limitation, discharge status, at discharge from therapy or to end reporting | TRUE |
| Hospital Admission | CG8988 | Self care functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting | TRUE |
| Hospital Admission | CG8989 | Self care functional limitation, discharge status, at discharge from therapy or to end reporting | TRUE |
| Hospital Admission | CG8997 | Swallowing functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting | TRUE |
| Hospital Admission | CG8998 | Swallowing functional limitation, discharge status, at discharge from therapy or to end reporting | TRUE |
| Hospital Admission | CG9172 | Voice functional limitation, projected goal status at initial therapy treatment/outset and at discharge from therapy | TRUE |
| Hospital Admission | CG8983 | Changing and maintaining body position functional limitation, discharge status, at discharge from therapy or to end reporting | TRUE |
| Hospital Admission | CG8991 | Other physical or occupational therapy primary functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting | TRUE |
| Hospital Admission | C99463 | Initial hospital or birthing center care, per day, for evaluation and management of normal newborn infant admitted and discharged on the same date | FALSE |
| Hospital Admission | C99496 | Transitional Care Management Services with the following required elements: Communication (direct contact, telephone, electronic) with the patient and/or caregiver within 2 business days of discharge Medical decision making of high complexity during the service period Face-to-face visit, within 7 calendar days of discharge | TRUE |
| Hospital Admission | C99217 | Observation care discharge day management (This code is to be utilized by the physician to report all services provided to a patient on discharge from “observation status” if the discharge is on other than the initial date of “observation status.” To report services to a patient designated as “observation status” or “inpatient status” and discharged on the same date, use the codes for Observation or Inpatient Care Services [including Admission and Discharge Services, 99234-99236 as appropriate.]) | TRUE |
| Hospital Admission | C99234 | Observation or inpatient hospital care, for the evaluation and management of a patient including admission and discharge on the same date which requires these three key components: a detailed or comprehensive history; a detailed or comprehensive examination; and medical decision making that is straightforward or of low complexity. Counseling and/or coordination of care with other providers or agencies are provided consistent with the nature of the problem(s) and the patient’s and/or family’s needs. Usually the presenting problem(s) requiring admission are of low severity. | TRUE |
| Hospital Admission | C99235 | Observation or inpatient hospital care, for the evaluation and management of a patient including admission and discharge on the same date which requires these three key components: a comprehensive history; a comprehensive examination; and medical decision making of moderate complexity. Counseling and/or coordination of care with other providers or agencies are provided consistent with the nature of the problem(s) and the patient’s and/or family’s needs. Usually the presenting problem(s) requiring admission are of moderate severity. | TRUE |
| Hospital Admission | C99236 | Observation or inpatient hospital care, for the evaluation and management of a patient including admission and discharge on the same date which requires these three key components: a comprehensive history; a comprehensive examination; and medical decision making of high complexity. Counseling and/or coordination of care with other providers or agencies are provided consistent with the nature of the problem(s) and the patient’s and/or family’s needs. Usually the presenting problem(s) requiring admission are of high severity. | TRUE |
| Hospital Admission | C99238 | Hospital discharge day management; 30 minutes or less | TRUE |
| Hospital Admission | C99239 | Hospital discharge day management; more than 30 minutes | TRUE |
| Hospital Admission | C99315 | Nursing facility discharge day management; 30 minutes or less | TRUE |
| Hospital Admission | C99316 | Nursing facility discharge day management; more than 30 minutes | TRUE |
| Hospital Admission | C99435 | History and examination of the normal newborn infant, including the preparation of medical records. (This code should only be used for newborns assessed and discharged from the hospital or birthing room on the same date.) | FALSE |
| Hospital Admission | C99495 | Transitional Care Management Services with the following required elements: Communication (direct contact, telephone, electronic) with the patient and/or caregiver within 2 business days of discharge Medical decision making of at least moderate complexity during the service period Face-to-face visit, within 14 calendar days of discharge | TRUE |
| Hospital Admission | C1110F | Patient discharged from an inpatient facility (eg hospital, skilled nursing facility, or rehabilitation facility) within the last 60 days | TRUE |
| Hospital Admission | C1111F | Discharge medications reconciled with the current medication list in outpatient medical record | FALSE |

Supplementary Table 4: List of electronic prescription codes.

List of electronic prescription codes.

|  |  |  |  |
| --- | --- | --- | --- |
| Category | Code | Description | Codes Found in the Cohort (Yes/No) |
| Methylprednisolone Infusion | CJ1020 | Injection, Methylprednisolone Acetate, 20 Mg | TRUE |
| Methylprednisolone Infusion | CJ1030 | Injection, Methylprednisolone Acetate, 40 Mg | TRUE |
| Methylprednisolone Infusion | CJ1040 | Injection, Methylprednisolone Acetate, 80 Mg | TRUE |
| Methylprednisolone Infusion | CJ2920 | Injection, Methylprednisolone Sodium Succinate, Up To 40 Mg | TRUE |
| Methylprednisolone Infusion | CJ7509 | Methylprednisolone oral, per 4 mg | FALSE |
| Methylprednisolone Infusion | EPRC:60701257 | Methylprednisolone 125mg HC (MGH) | TRUE |
| Methylprednisolone Infusion | EPRC:68801257 | Methylprednisolone 125mg HC (MGH) | FALSE |
| Methylprednisolone Infusion | EPRC:71101257 | Methylprednisolone 125mg HC (MGH) | FALSE |
| Methylprednisolone Infusion | EPRC:47560727 | Methylprednisolone Sod Suc40mg HC (MGH) | TRUE |
| Methylprednisolone Infusion | EPRC:60760725 | Methylprednisolone Sod Suc40mg HC (MGH) | FALSE |
| Methylprednisolone Infusion | EPRC:71160725 | Methylprednisolone Sod Suc40mg HC (MGH) | FALSE |
| Methylprednisolone Infusion | n00364670553 | Methylprednisolone Acetate 40 mg/ml suspension Schein Pharmaceuticals Inc | FALSE |
| Methylprednisolone Infusion | B00907552 | Methylprednisolone acetate 40 mg/ml suspension | TRUE |
| Methylprednisolone Infusion | n00536403601 | Methylprednisolone 4mg tablet Watson/Rugby Laboratories Inc | FALSE |
| Methylprednisolone Infusion | B00909034 | Methylprednisolone 4mg tablet | FALSE |
| Methylprednisolone Infusion | n00536403644 | Methylprednisolone Dose Pack 4mg tablet Watson/Rugby Laboratories Inc | FALSE |
| Methylprednisolone Infusion | B00901870 | Methylprednisolone dose pack 4mg tablet | TRUE |
| Methylprednisolone Infusion | n51285030102 | Methylprednisolone 4mg tablet Duramed Pharmaceuticals Inc | FALSE |
| Methylprednisolone Infusion | B00910716 | Methylprednisolone 4mg tablet | FALSE |
| Methylprednisolone Infusion | n51285030121 | Methylprednisolone Dose Pack 4mg tablet Duramed Pharmaceuticals Inc | FALSE |
| Methylprednisolone Infusion | B00907621 | Methylprednisolone dose pack 4mg tablet | FALSE |
| Methylprednisolone Infusion | n52544079021 | Methylprednisolone Dose Pack 4mg tablet Watson Laboratories Inc | FALSE |
| Methylprednisolone Infusion | B00900546 | Methylprednisolone dose pack 4mg tablet | FALSE |
| Methylprednisolone Infusion | n59762332702 | Methylprednisolone 4mg tablet Greenstone Limited | FALSE |
| Methylprednisolone Infusion | B00910706 | Methylprednisolone 4mg tablet | FALSE |
| Methylprednisolone Infusion | B00900544 | Methylprednisolone 2mg tablet u/d | FALSE |
| Methylprednisolone Infusion | B00901401 | Methylprednisolone acetate 80mg injection 1ml vial | TRUE |
| Methylprednisolone Infusion | B00901881 | Methylprednisolone na 501 -1gm 1000mg injection 1 vial | FALSE |
| Methylprednisolone Infusion | B00901882 | Methylprednisolone na 1 -40mg p 40mg injection 1 vial | FALSE |
| Methylprednisolone Infusion | B00901883 | Methylprednisolone na 41 -125mg 125mg injection 1 vial | FALSE |
| Methylprednisolone Infusion | B00901889 | Methylprednisolone acetate 40mg injection 1ml vial | TRUE |
| Methylprednisolone Infusion | B00901909 | Methylprednisolone 126 -250mg p 250mg injection 1 vial | FALSE |
| Methylprednisolone Infusion | B00901910 | Methylprednisolone na 251 -500 m 500mg injection 1 vial | FALSE |
| Methylprednisolone Infusion | B00904675 | Methylprednisolone succinate 125mg injection vial | FALSE |
| Methylprednisolone Infusion | B00904676 | Methylprednisolone succinate 1gm injection vial | FALSE |
| Methylprednisolone Infusion | B00904677 | Methylprednisolone succinate 40mg injection vial | FALSE |
| Methylprednisolone Infusion | B00905077 | Methylprednisolone succinate 500mg injection 1 ea vial | FALSE |
| Methylprednisolone Infusion | B00940045 | Methylprednisolone sod su | TRUE |
| Methylprednisolone Infusion | B00940047 | Methylprednisolone sod su | TRUE |
| Methylprednisolone Infusion | B00942037 | Methylprednisolone acetate 40mg vial 1ml vial | FALSE |
| Methylprednisolone Infusion | B00942079 | Methylprednisolone 4mg tablet 150 ea blist pack | FALSE |
| Methylprednisolone Infusion | B00942165 | Methylprednisolone sod succ 1000mg vial 1 ea vial | TRUE |
| Methylprednisolone Infusion | B00943932 | Methylprednisolone sod succ 125mg vial 10 ea vial | TRUE |
| Methylprednisolone Infusion | B00944280 | Methylprednisolone sod succ 1000mg vial 1 ea vial | TRUE |
| Methylprednisolone Infusion | B00944560 | Methylprednisolone acetate 200mg vial 5ml vial | TRUE |
| Methylprednisolone Infusion | B00945149 | Methylprednisolone 4mg tablet 100 ea blist pack | FALSE |
| Methylprednisolone Infusion | B00945165 | Methylprednisolone 16mg tablet 50 ea bottle | FALSE |
| Methylprednisolone Infusion | B00945433 | Methylprednisolone sod succ 1000mg vial 1 ea vial | TRUE |
| Methylprednisolone Infusion | B00946340 | Methylprednisolone 4mg tablet 100 ea bottle | FALSE |
| Methylprednisolone Infusion | B00947441 | Methylprednisolone acetate 40 mg/ml vial 1ml vial | TRUE |
| Methylprednisolone Infusion | B00947550 | Methylprednisolone sod succ 40 mg/ml vial 25 ea vial | TRUE |
| Methylprednisolone Infusion | B00947582 | Methylprednisolone sod succ 125 mg/2ml vial 25 ea vial | TRUE |
| Methylprednisolone Infusion | B00949458 | Methylprednisolone sod succ/pf 40 mg/ml vial 1 ea vial | TRUE |
| Methylprednisolone Infusion | B00952532 | Methylprednisolone acetate 40mg vial 1ml vial | TRUE |
| Methylprednisolone Infusion | LMA2691 | Methylprednisolone 0.1% oint - LMR 2691 | FALSE |
| Methylprednisolone Infusion | LMA483 | Methylprednisolone po (medrol dose pack) - LMR 483 | TRUE |
| Methylprednisolone Infusion | LMA484 | Methylprednisolone acetate - LMR 484 | TRUE |
| Methylprednisolone Infusion | LMA485 | Methylprednisolone sod. succ. - LMR 485 | TRUE |
| Methylprednisolone Infusion | LMA4890 | Methylprednisolone dose pak - LMR 4890 | TRUE |
| Methylprednisolone Infusion | LMA4962 | Methylprednisolone dose pak - LMR 4962 | TRUE |
| Methylprednisolone Infusion | M00000125 | Methylprednisolone 500 mg | TRUE |
| Methylprednisolone Infusion | M00824060 | Methylprednisolone | TRUE |
| Methylprednisolone Infusion | M00824100 | Methylprednisolone tab | FALSE |
| Methylprednisolone Infusion | M00824120 | Methylprednisolone | FALSE |
| Methylprednisolone Infusion | M08241600 | Methylprednisolone 4mg tablet | FALSE |
| Methylprednisolone Infusion | OMA:EVDB6-2 | Solumedrol-oncall | TRUE |
| Methylprednisolone Infusion | OMA:EVDB6 | Methylprednisolone-oncall | TRUE |
| ITF-beta | B00910915 | Avonex 30 mcg solution | TRUE |
| ITF-beta | B00911375 | Betaseron 0.3mg powder for injection | TRUE |
| ITF-beta | B00911894 | Interferon beta-1 -a 60 mcg injection,1ml vial | FALSE |
| ITF-beta | ERX:10306 | Interferon Beta-1b 0.3 mg Subcutaneous Solution | TRUE |
| ITF-beta | ERX:125381 | Interferon Beta-1b 0.3 mg Subcutaneous Kit | TRUE |
| ITF-beta | ERX:127854 | Interferon Beta-1a 30 mcg/0.5 ml Intramuscular Pen Kit | TRUE |
| ITF-beta | ERX:127940 | Interferon Beta-1a 30 mcg/0.5 ml Intramuscular Pen Injector | TRUE |
| ITF-beta | ERX:138831 | Interferon Beta-1b Subq | FALSE |
| ITF-beta | ERX:159735 | Interferon Beta-1a 30 mcg/0.5 ml Intramuscular Syringe | TRUE |
| ITF-beta | ERX:161311 | Interferon Beta-1a (Albumin) 22 mcg/0.5 ml Subcutaneous Pen Injector | TRUE |
| ITF-beta | ERX:161313 | Interferon Beta-1a (Albumin) 44 mcg/0.5 ml Subcutaneous Pen Injector | TRUE |
| ITF-beta | ERX:161317 | Rebif Rebidose 22 mcg/0.5 ml Subcutaneous Pen Injector | FALSE |
| ITF-beta | ERX:161318 | Rebif Rebidose 44 mcg/0.5 ml Subcutaneous Pen Injector | FALSE |
| ITF-beta | ERX:163493 | Rebif Rebidose Subq | FALSE |
| ITF-beta | ERX:17213 | Interferon Beta-1a (Albumin) 30 mcg Intramuscular Kit | TRUE |
| ITF-beta | ERX:179442 | Peginterferon Beta-1a 63 mcg/0.5 ml-94 mcg/0.5 ml Subcutaneous Syringe | TRUE |
| ITF-beta | ERX:179443 | Peginterferon Beta-1a 63 mcg/0.5 ml-94 mcg/0.5 ml Subcutaneous Pen Inj | TRUE |
| ITF-beta | ERX:179444 | Peginterferon Beta-1a 125 mcg/0.5 ml Subcutaneous Syringe | TRUE |
| ITF-beta | ERX:179445 | Peginterferon Beta-1a 125 mcg/0.5 ml Subcutaneous Pen Injector | TRUE |
| ITF-beta | ERX:181997 | Interferon Beta-1a (Albumin) Im | FALSE |
| ITF-beta | ERX:22532 | Interferon Beta-1a (Albumin) 44 mcg/0.5 ml Subcutaneous Syringe | TRUE |
| ITF-beta | ERX:22533 | Interferon Beta-1a (Albumin) 22 mcg/0.5 ml Subcutaneous Syringe | TRUE |
| ITF-beta | ERX:32457 | Rebif (With Albumin) 22 mcg/0.5 ml Subcutaneous Syringe | FALSE |
| ITF-beta | ERX:32458 | Rebif (With Albumin) 44 mcg/0.5 ml Subcutaneous Syringe | FALSE |
| ITF-beta | ERX:36417 | Interferon Beta-1a 30 mcg/0.5 ml Intramuscular Syringe Kit | TRUE |
| ITF-beta | ERX:40796 | Interferon Beta-1a (Albumin) 8.8 mcg/0.2 ml-22 mcg/0.5 ml Subq Syringe | FALSE |
| ITF-beta | ERX:707099 | Interferon Beta-1a Skin Test 22 mcg/ml | FALSE |
| ITF-beta | ERX:707100 | Interferon Beta-1a Skin Test 0.022 mcg/ml | FALSE |
| ITF-beta | ERX:707101 | Interferon Beta-1a Skin Test 0.22 mcg/ml | FALSE |
| ITF-beta | ERX:707102 | Interferon Beta-1a Skin Test 2.2 mcg/ml | FALSE |
| ITF-beta | HM31908 | AVONEX (Interferon beta-1a) | FALSE |
| ITF-beta | LHA31908 | AVONEX (Interferon beta-1a) | FALSE |
| ITF-beta | LMA1853 | Betaseron (interferon-beta-1 b) - LMR 1853 | TRUE |
| ITF-beta | LMA2431 | Interferon-beta-1 a - LMR 2431 | TRUE |
| ITF-beta | LMA4154 | Avonex im (interferon-beta-1 a im) - LMR 4154 | TRUE |
| ITF-beta | LMA4155 | Rebif sc (interferon-beta-1 a sc) - LMR 4155 | TRUE |
| ITF-beta | n50419052115 | Betaseron 0.3mg powder for injection Berlex Laboratories | FALSE |
| ITF-beta | n59627000103 | Avonex 30 mcg solution Biogen | FALSE |
| ITF-beta | NDC:44087004403 | 0.5 ml interferon beta-1a 0.088 mg/ml prefilled syringe | FALSE |
| ITF-beta | NDC:44087332201 | REBIF REBIDOSE 22 ug/.5mL SUBCUTANEOUS INJECTION, SOLUTION, EMD Serono, Inc. | FALSE |
| ITF-beta | NDC:44087332209 | REBIF REBIDOSE 22 ug/.5mL SUBCUTANEOUS INJECTION, SOLUTION, EMD Serono, Inc. | FALSE |
| ITF-beta | NDC:44087334401 | REBIF REBIDOSE 44 ug/.5mL SUBCUTANEOUS INJECTION, SOLUTION, EMD Serono, Inc. | FALSE |
| ITF-beta | NDC:44087334409 | REBIF REBIDOSE 44 ug/.5mL SUBCUTANEOUS INJECTION, SOLUTION, EMD Serono, Inc. | FALSE |
| ITF-beta | OMA:DSYQ6-1 | Betaseron-oncall | TRUE |
| ITF-beta | OMA:DTJN8 | Interferon-oncall | TRUE |
| ITF-beta | OMA:DTLJ6-1 | Avonex-oncall | TRUE |
| ITF-beta | OMA:DTLJ6-2 | Rebif-oncall | TRUE |
| ITF-beta | RXNORM:1117364 | Interferon beta-1a 0.06 mg/ml injectable solution | FALSE |
| ITF-beta | RXNORM:1359695 | Interferon beta-1a 0.088 MG/ML Prefilled Syringe [Rebif] | FALSE |
| ITF-beta | RXNORM:1359792 | Interferon beta-1a 24000000 UNT/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1359879 | Interferon beta-1a 12000000 UNT/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1359909 | Interferon beta-1a 0.044 MG/ML Prefilled Syringe [Rebif] | FALSE |
| ITF-beta | RXNORM:1360275 | Interferon beta-1a 0.088 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1360369 | Interferon beta-1a 0.06 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1360434 | Interferon beta-1a 0.06 MG/ML Prefilled Syringe [Avonex] | FALSE |
| ITF-beta | RXNORM:1360464 | Interferon beta-1a 0.044 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:151270 | Interferon beta-1b 8000000 unt/ml injectable solution [Betaferon] | FALSE |
| ITF-beta | RXNORM:153323 | Interferon beta-1a 0.03 mg/ml injectable solution | FALSE |
| ITF-beta | RXNORM:153324 | Interferon beta-1a 0.03 mg/ml injectable solution [Avonex] | FALSE |
| ITF-beta | RXNORM:1546172 | 0.5 ML peginterferon beta-1a 0.188 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1546177 | 0.5 ML peginterferon beta-1a 0.188 MG/ML Prefilled Syringe [Plegridy] | FALSE |
| ITF-beta | RXNORM:1546178 | peginterferon beta-1a 0.188 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1546179 | peginterferon beta-1a 0.188 MG/ML Prefilled Syringe [Plegridy] | FALSE |
| ITF-beta | RXNORM:1546181 | 0.5 ML peginterferon beta-1a 0.126 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1546183 | 0.5 ML peginterferon beta-1a 0.126 MG/ML Prefilled Syringe [Plegridy] | FALSE |
| ITF-beta | RXNORM:1546184 | peginterferon beta-1a 0.126 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1546185 | peginterferon beta-1a 0.126 MG/ML Prefilled Syringe [Plegridy] | FALSE |
| ITF-beta | RXNORM:1546187 | 0.5 ML peginterferon beta-1a 0.25 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1546189 | 0.5 ML peginterferon beta-1a 0.25 MG/ML Prefilled Syringe [Plegridy] | FALSE |
| ITF-beta | RXNORM:1546190 | peginterferon beta-1a 0.25 MG/ML Prefilled Syringe | FALSE |
| ITF-beta | RXNORM:1546191 | peginterferon beta-1a 0.25 MG/ML Prefilled Syringe [Plegridy] | FALSE |
| ITF-beta | RXNORM:1649591 | 0.5 ML peginterferon beta-1a 0.25 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1649593 | 0.5 ML peginterferon beta-1a 0.25 MG/ML Auto-Injector [Plegridy] | FALSE |
| ITF-beta | RXNORM:1649594 | peginterferon beta-1a 0.25 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1649595 | peginterferon beta-1a 0.25 MG/ML Auto-Injector [Plegridy] | FALSE |
| ITF-beta | RXNORM:1649600 | 0.5 ML peginterferon beta-1a 0.126 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1649601 | 0.5 ML peginterferon beta-1a 0.188 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1649603 | 0.5 ML peginterferon beta-1a 0.126 MG/ML Auto-Injector [Plegridy] | FALSE |
| ITF-beta | RXNORM:1649604 | 0.5 ML peginterferon beta-1a 0.188 MG/ML Auto-Injector [Plegridy] | FALSE |
| ITF-beta | RXNORM:1649606 | peginterferon beta-1a 0.126 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1649607 | peginterferon beta-1a 0.126 MG/ML Auto-Injector [Plegridy] | FALSE |
| ITF-beta | RXNORM:1649608 | peginterferon beta-1a 0.188 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1649609 | peginterferon beta-1a 0.188 MG/ML Auto-Injector [Plegridy] | FALSE |
| ITF-beta | RXNORM:1649994 | 0.5 ML Interferon beta-1a 0.044 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1649996 | 0.5 ML Interferon beta-1a 0.044 MG/ML Auto-Injector [Rebif] | FALSE |
| ITF-beta | RXNORM:1649997 | Interferon beta-1a 0.044 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1649998 | Interferon beta-1a 0.044 MG/ML Auto-Injector [Rebif] | FALSE |
| ITF-beta | RXNORM:1650003 | 0.5 ML Interferon beta-1a 0.088 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1650004 | 0.5 ML Interferon beta-1a 0.088 MG/ML Auto-Injector [Rebif] | FALSE |
| ITF-beta | RXNORM:1650005 | Interferon beta-1a 0.088 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1650006 | Interferon beta-1a 0.088 MG/ML Auto-Injector [Rebif] | FALSE |
| ITF-beta | RXNORM:1650011 | 0.2 ML Interferon beta-1a 0.044 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1650012 | 0.2 ML Interferon beta-1a 0.044 MG/ML Auto-Injector [Rebif] | FALSE |
| ITF-beta | RXNORM:1650899 | 0.5 ML Interferon beta-1a 0.06 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1650901 | 0.5 ML Interferon beta-1a 0.06 MG/ML Auto-Injector [Avonex] | FALSE |
| ITF-beta | RXNORM:1650902 | Interferon beta-1a 0.06 MG/ML Auto-Injector | FALSE |
| ITF-beta | RXNORM:1650903 | Interferon beta-1a 0.06 MG/ML Auto-Injector [Avonex] | FALSE |
| ITF-beta | RXNORM:198360 | Interferon beta-1b 0.25 mg/ml injectable solution | FALSE |
| ITF-beta | RXNORM:207059 | Interferon beta-1b 0.25 mg/ml injectable solution [Betaseron] | FALSE |
| ITF-beta | RXNORM:251297 | Interferon beta-1a 0.022 mg/ml injectable solution | FALSE |
| ITF-beta | RXNORM:416121 | Interferon-beta 0.1 unt/mg topical gel | FALSE |
| ITF-beta | RXNORM:485961 | Interferon beta-1a 0.033 mg/ml injectable solution | FALSE |
| ITF-beta | RXNORM:545218 | Interferon beta-1b 0.2 mg/ml injectable solution | FALSE |
| ITF-beta | RXNORM:562139 | Interferon beta-1b 8000000 unt/ml injectable solution | FALSE |
| ITF-beta | RXNORM:72257 | Interferon beta-1b | FALSE |
| ITF-beta | RXNORM:727813 | 0.5 ml interferon beta-1a 0.06 mg/ml prefilled syringe | FALSE |
| ITF-beta | RXNORM:727816 | 0.5 ml interferon beta-1a 0.06 mg/ml prefilled syringe [Avonex] | FALSE |
| ITF-beta | RXNORM:758025 | 0.5 ml interferon beta-1a 0.088 mg/ml prefilled syringe | FALSE |
| ITF-beta | RXNORM:758027 | 0.5 ml interferon beta-1a 0.088 mg/ml prefilled syringe [Rebif] | FALSE |
| ITF-beta | RXNORM:758028 | 0.2 ml interferon beta-1a 0.044 mg/ml prefilled syringe | FALSE |
| ITF-beta | RXNORM:758029 | 0.5 ml interferon beta-1a 0.044 mg/ml prefilled syringe | FALSE |
| ITF-beta | RXNORM:758030 | {6 (0.2 ml interferon beta-1a 0.044 mg/ml prefilled syringe) / 6 (0.5 ml interferon beta-1a 0.044 mg/ml prefilled syringe) } pack | FALSE |
| ITF-beta | RXNORM:758032 | 0.5 ml interferon beta-1a 0.044 mg/ml prefilled syringe [Rebif] | FALSE |
| ITF-beta | RXNORM:75917 | Interferon beta-1a | FALSE |
| ITF-beta | RXNORM:792493 | 0.5 ml interferon beta-1a 24000000 unt/ml prefilled syringe | FALSE |
| ITF-beta | RXNORM:792497 | 0.5 ml interferon beta-1a 12000000 unt/ml prefilled syringe | FALSE |
| ITF-beta | RXNORM:795748 | 0.2 ml interferon beta-1a 0.044 mg/ml prefilled syringe [rebif] | FALSE |
| ITF-beta | RXNORM:795749 | {6 (0.2 ml interferon beta-1a 0.044 mg/ml prefilled syringe [rebif]) / 6 (0.5 ml interferon beta-1a 0.044 mg/ml prefilled syringe [rebif]) } pack [rebif titration] | FALSE |
| ITF-beta | RXNORM:860244 | Interferon beta-1b 0.25 mg/ml injectable solution [Extavia] | FALSE |
| ITF-beta | CQ3025 | Injection, Interferon Beta-1A, 11 MCG for Intramuscular use | TRUE |
| ITF-beta | CQ3025 | Injection, Interferon Beta-1A, 11 MCG for Intramuscular use | TRUE |
| ITF-beta | CJ1825 | Injection, Interferon Beta-1A, 33 Mcg | TRUE |
| ITF-beta | CJ1825 | Injection, Interferon Beta-1A, 33 Mcg | TRUE |

## References