

Clostridium Difficile (C. diff)
Phenotype Algorithm Pseudo Code
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BACKGROUND

Clostridium difficile, also known as "C. diff," is a species of bacteria that causes severe diarrhea and other intestinal disease when competing bacteria in the gut have been wiped out by antibiotics (see Wikipedia entry). In rare cases a C. diff infection can progress to toxic megacolon which can be life-threatening. In a very small percentage of the adult population C. difficile bacteria naturally reside in the gut. Other people accidentally ingest spores of the bacteria while patients in a hospital or nursing home.

We may want to distinguish between hospital- and community-acquired C. diff. Recent literature describes an increase in the incidence of community-acquired C. diff (Leffler and Lamont, *Not So Nosocomial Anymore*, Am J Gastro, Jan. 2012), which may account for up to one-third of c. diff diarrhea.

The EMR phenotype has case definitions that vary depending on the type of evidence, which ranges from lab data to diagnosis codes, medication data, and progress note mentions. Vanderbilt developed the initial algorithm based on labs data from their largely inpatient setting. Group Health/UW developed the original algorithm relying on mentions in progress notes from the outpatient setting.

[Clostridium Difficile on Wikipedia.](#)

ALGORITHM

1. Cases

1.1 Labs (gold standard)

Anyone ≥ 2 years of age with at least one positive inpatient or outpatient C. diff antigen or toxin test (includes positive tests for strain A, strain B, or strains A and B).

This is depicted as path 1.1 on the flow sheet.

1.2. Diagnoses (silver standard)

When a patient's record includes one or more diagnosis codes for C. diff there are three ways that diagnosis code, combined with other information from the chart, may qualify the patient as a case.

1.2.1. Diagnoses and Medications

Anyone ≥ 2 years of age with the following sequence of diagnosis codes and medications:

Within a 90-day period the subject has:

- 1) 1+ days with an inpatient or outpatient diagnosis of C. diff, *followed by*
- 2) 1+ days with a dispensed medication for treating C. diff, *followed by*
- 3) 1+ days with an inpatient or outpatient diagnosis of C. diff.

The diagnosis codes for C. diff are:

008.45*

The medications for treating C. diff are:

Metronidazole
Vancomycin (oral)
Fidaxomicin
Linezolid

This is depicted as path 1.2.1 on the flow sheet.

1.2.2. Diagnoses and Progress Note Mentions

Anyone ≥ 2 years of age with:

At least on diagnosis code for C. diff (see above) and at least one affirmative mention of C. diff infection (unqualified by negation, uncertainty, or historical reference) in progress notes.

C. diff mentions include:

1. difficile colitis
2. diff colitis
3. dif colitis
4. difficile diarrhea
5. diff diarrhea
6. dif diarrhea
7. difficile infection
8. diff infection
9. dif infection
10. difficile enteritis
11. diff enteritis
12. dif enteritis

Note that omission of “clostridium” and its abbreviations from the dictionary entries did not reduce specificity at Group Health and simplified implementation in NLP systems because a commonly used abbreviation for clostridium, the single letter “c,” is difficult to implement in a word search or dictionary look up.

This is depicted as path 1.2.2 on the flow sheet.

1.3. Progress Note Mentions *Only* (silver standard)

Anyone ≥ 2 years of age with:

Two or more encounters, on separate calendar days, with affirmative mentions of C. diff infection (unqualified by negation, uncertainty, or historical reference) in progress notes.

This is depicted as path 1.3 on the flow sheet.

1.4. Final exclusion

Exclude from the set of otherwise eligible cases any subject qualifying through any of the three pathways above (i.e., 1.1, 1.2, or 1.3) if any of the following conditions is met:

- The patient has any diagnosis code for bone marrow **cancer** (see Appendix C) in the **2-year** period prior to the c-diff index date **OR** the 7 days following the c-diff index date **OR**
- The patient received cancer **chemotherapy** (see Appendix D) in the **180** day period prior to the c-diff index date **OR** the 7 days following the c-diff index date

2. Controls

The desired ratio of controls to cases when combining data from all sites is 2:1.

There are also avenues by which a subject may qualify as a control for this phenotype.

2.1 Exposure to Class 1 (high risk) or Class 2 (moderate risk) Antibiotics and Hospitalization

Anyone ≥ 2 years of age who:

- 1) has no known test for C. diff (see 1.1), AND
- 2) has no diagnosis codes for C. diff (see 1.2.1), AND
- 3) has at least one hospital admission with a prior exposure to antibiotics (see next), and
- 4) has been exposed to a class 2 (moderate risk for C. diff) or class 1 (high risk for C. diff) antibiotic 7-62 days before the hospital admission.
- 5) has not had chemotherapy or evidence of bone marrow cancer for the **180** day period prior to the c-diff index date **OR** the 7 days following their index date. (These are the 'exclusionary criteria' in the Appendix A flowchart)

Class 1 and Class 2 antibiotics are listed in Appendix B.

The rationale for not using negative C diff. antigen/toxin testing as a definition for controls is as follows. Lab tests are only ~60-70% sensitive. This means that a single test does not rule out the disease. Further, requiring multiple negative tests did not seem like a viable strategy for identifying controls because such a pattern of testing may signal a concern that the disease exists but is not being detected by the lab test.

Matching of cases and controls by age and race will be handled analytically after genotyping (needs discussion).

2.2. Exposure to Class 1 (high risk) or Class 2 (moderate risk) Antibiotics and No Mentions of C. Diff. in Progress Notes

Anyone ≥ 2 years of age who:

- 1) has no known test for C. diff (see 1.1), and
- 2) has no diagnosis codes for C. diff (see 1.2.1), and
- 3) has been exposed to a class 2 (moderate risk for C. diff) or class 3 (high risk for C. diff) antibiotic, and
- 4) has continuous enrollment for 5 or more years following this antibiotic exposure, and
- 5) has no mentions in progress notes of C. diff (ever).
- 6) has not had chemotherapy or evidence of bone marrow cancer for the **180** day period prior to the c-diff index date **OR** the 7 days following their index date. (These are the 'exclusionary criteria' in the Appendix A flowchart)

3. Index Dates

Patient-specific index date for **cases** is the date of the first known positive lab test, diagnosis code, or mention in progress notes, whichever comes first. These may appear earlier in the patient record than the test, code, or mention that *qualified* the patient as a case, on grounds that once the patient qualifies earlier evidence of the same disease is considered evidence of the phenotype.

Patient-specific index date for **controls** is the date of earliest qualifying hospital admission if qualified by the hospital admission criteria, or the earliest date of exposure to a class 2 or class 3 antibiotic followed by 5 years of continuous enrollment if qualified by the progress note criteria.

4. Covariates

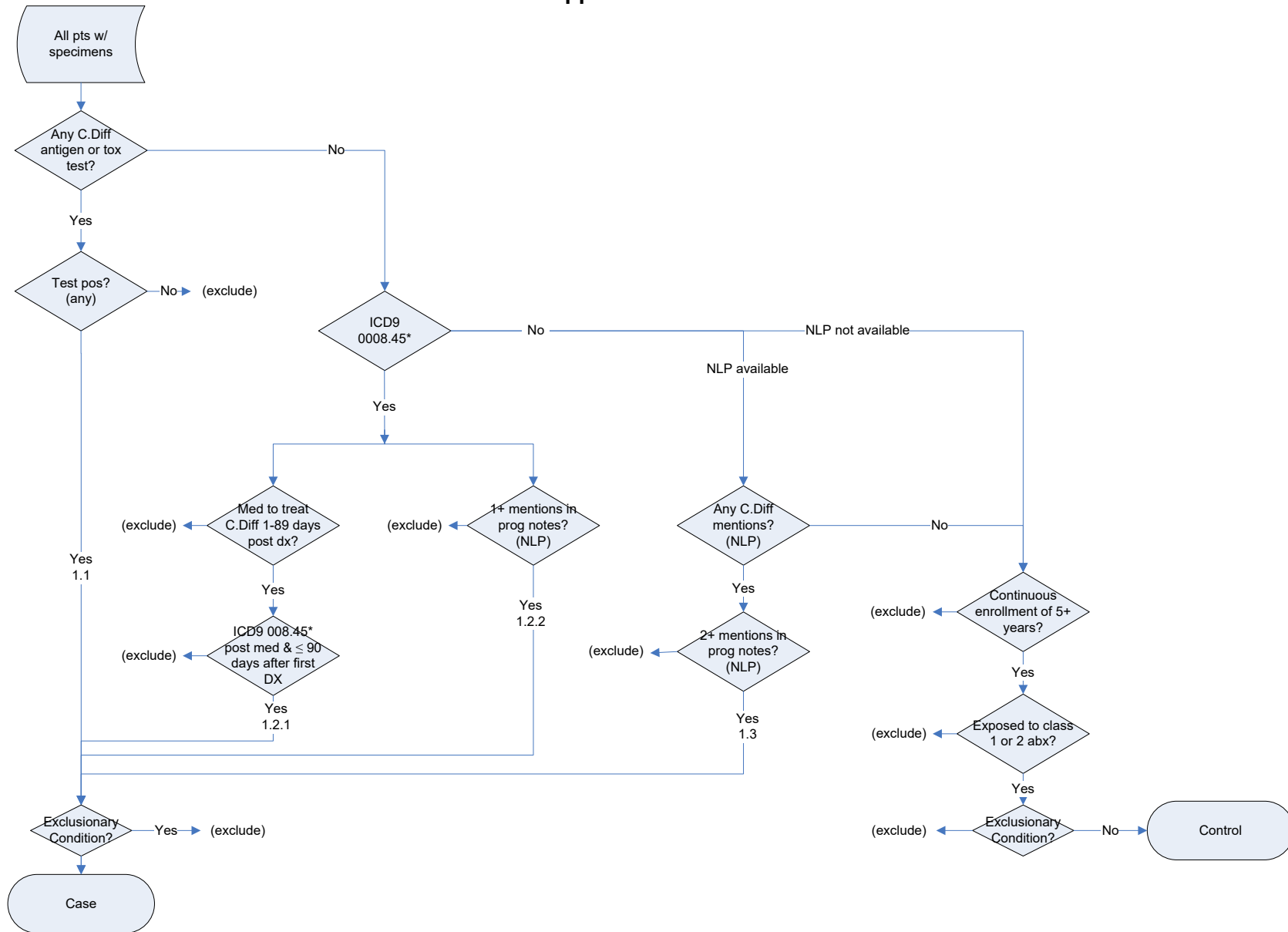
The following covariates will be collected for both cases and controls.

- Basic demographic info
 - BMI, Weight, Height
 - Genetic Gender/Ancestry
- Nursing home status
 - Time -90d to index date
 - Structured data on SNF residence, or
 - Text search for generic or proper names of area nursing homes, esp. within Social Work/case management notes, e.g.:
 - Generic names:
 - NH
 - NSH
 - nursing home
 - SNF
 - skilled nursing facility
 - Hospice
 - NHC

- Proper names such as:
 - Cumberland Manor,
 - Ida Culver House,
 - etc.
- Chemotherapy (Yes/No) – outside of exclusionary time range
 - Exclusionary Time: -180d to index date + 7 days
 - Chemotherapy procedures: any inpatient or outpatient chemotherapy
- Diabetes Mellitus
 - Time: Ever
 - either modify T2D algorithmn to include all DM OR use any 2 of these: [ICD9 250.*]; [DM meds including insulin]; [A1c> 6.5 OR Glucose > 200]]
- HIV
 - Time: Ever
 - ICD9 042
- Cancer
 - Time: Time 0 (date of Subject's first record) to index_date + 7 days
 - ICD9 140-172.99, and 174-209.99
- Transplant medications
 - Time: Time 0 (date of Subject's first record) to index_date + 7 days
 - cellcept, munoloc, mycophenylate mofetil
 - tacrolimus,fk-506,fk5,k506,tacarolimus,tacrolimus hydrate,fujimycin,lcp-tacro,prograf,protopic
 - cyclosporine,ciclosporin,cyclosporin,cyclosporin a,engraf,neoral,restasis,restasis,sandimmune,sangcya
 - azothioprine,azathioprin,azathioprine sodium,azatioprin,azamun,azanin,azasan,ccucol,imuran,imurek,imurel,muran
- Corticosteroid Meds
 - Time: -21 Days to index_date
 - Corticosteroid Medications: Cortisone (Cortisone and Cortisone Acetate), Hydrocortisone (Hydrocortisone, Hydrocortisone Sodium Phosphate, Hydrocortisone Sodium Succinate, Hydrocortisone Acetate, Hydrocortisone Cypionate), Prednisone, Prednisolone (Prednisolone and Prednisolone Sodium Phosphate), Methylprednisolone (Methylprednisolone, Methylprednisolone Sodium Succinate, Methylprednisolone Acetate), Triamcinolone (Triamcinolone, Triamcinolone Acetonide, Triamcinolone Diacetate, Triamcinolone Hexacetonide), Dexamethasone (Dexamethasone, Dexamethasone Acetate, Dexamethasone Sodium Phosphate), Betamethasone (Betamethasone, Betamethasone Sodium Phosphate, Betamethasone Acetate)
 - Exclude if strength/dose includes a “%”
 - {[Route must be (IV, IM, or PO)] OR [have a dose/strength (“MG|milligram|miligram”)]} AND[Route not like intranasal|topical|inhaled]
 - Anti-TNF agents:
- Anti-TNF medications
 - Time: -21 Days to index_date
 - infliximab
 - remicade
 - adalimumab
 - humira
 - certolizumab
 - cimzia

- golimumab
 - simponi
 - etanercept
 - enbrel
- Antibiotic exposure
 - Time: -62d to -7d prior to index date
 - Classified by risk of developed CDiff following (1=high risk, 2=mod risk, 3=low risk)
- PPI (proton pump inhibitor) medications outside of exclusionary time
 - Exclusionary Time: -21d to index date
 - omeprazole
 - esomeprazole
 - lansoprazole
 - dexlansoprasole
 - pantoprazole
 - rabeprazole
 - Prevacid
 - Nexium,
 - Dexilant
 - Prilosec
 - Zegerid
 - Protonix
 - Aciphex
 - Vimovo

Appendix A: Flowchart



Appendix B: Class 1 (high risk) and Class 2 (moderate risk)

Drug Name	RISKCAT
amox	2 Moderate Risk
amoxicillin	2 Moderate Risk
amoxicillin-clavulanate	2 Moderate Risk
amoxil	2 Moderate Risk
ampicillin	2 Moderate Risk
AMPICILLIN / MEROPENEM	2 Moderate Risk
AMPICILLIN SODIUM	2 Moderate Risk
ampicillin-sulbactam	2 Moderate Risk
ancef	2 Moderate Risk
augmentin	2 Moderate Risk
AVALOX	1 High Risk
avelox	1 High Risk
azactam	2 Moderate Risk
azithromycin	2 Moderate Risk
azithromycin : zithromax	2 Moderate Risk
aztreonam	2 Moderate Risk
biaxin	2 Moderate Risk
BIAXIN / PENICILLIN	2 Moderate Risk
BIAXIN XL	2 Moderate Risk
BICILLIN	2 Moderate Risk
ceclor	2 Moderate Risk
cedax	1 High Risk
cefaclor	2 Moderate Risk
CEFADROXIL	2 Moderate Risk
cefazolin	2 Moderate Risk
CEFAZOLIN / CLINDAMYCIN	1 High Risk
cefdinir	1 High Risk
CEFDINIR : OMNICEF	1 High Risk
cefepime	1 High Risk
cefixime	1 High Risk
CEFOTAN	2 Moderate Risk
cefotaxime	1 High Risk
cefotetan	2 Moderate Risk
cefoxitin	1 High Risk
cefpodoxime	1 High Risk
CEFPROZIL	2 Moderate Risk
ceftazidime	1 High Risk
ceftin	2 Moderate Risk

ceftriaxone	1	High Risk
ceftriaxone w/lidocaine	1	High Risk
cefuroxime	2	Moderate Risk
cefuroxime : ceftin	2	Moderate Risk
cefuroxime axetil	2	Moderate Risk
cefuroxime axetil (ceftin)	2	Moderate Risk
cefzil	2	Moderate Risk
cephalexin	2	Moderate Risk
CEPHALEXIN (KEFLEX)	2	Moderate Risk
CEPHALEXIN HCL	2	Moderate Risk
CEPHALOTHIN	2	Moderate Risk
cipro	1	High Risk
CIPRO / LEVOFLOXACIN	1	High Risk
CIPRO XR	1	High Risk
CIPROFLAXACIN	1	High Risk
ciprofloxacin	1	High Risk
ciprofloxacin : cipro	1	High Risk
CIPROFLOXACIN (CIPRO)	1	High Risk
CIPROFLOXIN	1	High Risk
claforan	2	Moderate Risk
clarithromycin	2	Moderate Risk
CLARITHROMYCIN (GENERIC)	2	Moderate Risk
CLARITHROMYCIN / AMIKACIN	2	Moderate Risk
CLAVULANATE (AUGMENTIN)	1	High Risk
cleocin	1	High Risk
cleocin t	1	High Risk
clindamycin	1	High Risk
clindamycin : cleocin	1	High Risk
clindamycin hcl	1	High Risk
CLINDAMYCIN HCL (CLEOCIN)	1	High Risk
CLINDAMYCIN PHOSPHATE	1	High Risk
dicloxacillin	2	Moderate Risk
e-mycin	2	Moderate Risk
ees	2	Moderate Risk
ertapenem	2	Moderate Risk
ERYTHROCIN	2	Moderate Risk
erythromycin	2	Moderate Risk
erythromycin base	2	Moderate Risk
ERYTHROMYCIN ETHYLSUCCINATE	2	Moderate Risk
ERYTHROMYCIN LACTOBIONATE	2	Moderate Risk
erythromycin stearate	2	Moderate Risk
floxacillin	2	Moderate Risk
floxin	1	High Risk

fortaz	1	High Risk
imipenem	2	Moderate Risk
imipenem / cilastatin	2	Moderate Risk
imipenem-cilastatin	2	Moderate Risk
imipenem-cilastatin injection	2	Moderate Risk
invanz	2	Moderate Risk
keflex	2	Moderate Risk
kefzol	2	Moderate Risk
KETEK	2	Moderate Risk
levaquin	1	High Risk
levaquin / ibuprofen	1	High Risk
levaquin leva-pak	1	High Risk
levofloxacin	1	High Risk
levofloxacin : levaquin	1	High Risk
LORABID	2	Moderate Risk
maxipime	1	High Risk
MEFOXIN	1	High Risk
MERONEM	2	Moderate Risk
meropenem	2	Moderate Risk
MEROPENEM : MERREM	2	Moderate Risk
merrem	2	Moderate Risk
methicillin	2	Moderate Risk
moxifloxacin	1	High Risk
nafcillin	2	Moderate Risk
omnicef	1	High Risk
oxacillin	2	Moderate Risk
pen vk	2	Moderate Risk
PEN-VEE K	2	Moderate Risk
PEN-VK	2	Moderate Risk
penicillin	2	Moderate Risk
PENICILLIN G	2	Moderate Risk
PENICILLIN G BENZATHINE	2	Moderate Risk
PENICILLIN G POTASSIUM	2	Moderate Risk
penicillin v potassium	2	Moderate Risk
penicillins	2	Moderate Risk
piperacillin	2	Moderate Risk
piperacillin / tazobactam	2	Moderate Risk
piperacillin-tazobactam	2	Moderate Risk
piperacillin-tazobactam inj	2	Moderate Risk
primaxin	2	Moderate Risk
rocephin	1	High Risk
suprax	2	Moderate Risk
tequin	1	High Risk

ticar	2	Moderate Risk
ticarcillin	2	Moderate Risk
ticarcillin / clavulanate	2	Moderate Risk
timentin	2	Moderate Risk
trimox / amox	2	Moderate Risk
TROVAFLOXACIN	1	High Risk
TROVAN	1	High Risk
ULTRACEF	2	Moderate Risk
unasyn	2	Moderate Risk
vanc / cefepime	1	High Risk
VANC / DORIPENEM	2	Moderate Risk
vanc / rocephin	1	High Risk
vanc / zosyn	2	Moderate Risk
VANCOMYCIN / CEFOTAXIME	1	High Risk
vancomycin / doripenem	2	Moderate Risk
vancomycin / ertapenem	2	Moderate Risk
vantin	1	High Risk
ZARTAN	2	Moderate Risk
zinacef	2	Moderate Risk
zithromax	2	Moderate Risk
ZITHROMAX (ZPAK)	2	Moderate Risk
zithromax / rocephin	1	High Risk
zithromax z-pak	2	Moderate Risk
zosyn	2	Moderate Risk
zosyn / cipro	1	High Risk
zosyn / nsaid	2	Moderate Risk
ZPACK	2	Moderate Risk
zpak	2	Moderate Risk

Appendix C: ICD Codes for Bone Marrow Cancers Used at Northwestern U.

Description	ICD-9 code
LYMPHOMA LIKE REACTION	785.6BT
LYMPHOMA	M9590/3
Burkitt's tumor or lymphoma	200.2
Burkitt's tumor or lymphoma, unspecified site, extranodal and solid organ sites	200.20
Burkitt's tumor or lymphoma of lymph nodes of head, face, and neck	200.21
Burkitt's tumor or lymphoma of intrathoracic lymph nodes	200.22
Burkitt's tumor or lymphoma of intra-abdominal lymph nodes	200.23
Burkitt's tumor or lymphoma of lymph nodes of axilla and upper limb	200.24
Burkitt's tumor or lymphoma of lymph nodes of inguinal region and lower limb	200.25
Burkitt's tumor or lymphoma of intrapelvic lymph nodes	200.26
Burkitt's tumor or lymphoma of lymph nodes of multiple sites	200.28
Marginal zone lymphoma	200.3
Marginal zone lymphoma, unspecified site, extranodal and solid organ sites	200.30
Marginal zone lymphoma, lymph nodes of head, face, and neck	200.31
Marginal zone lymphoma, intrathoracic lymph nodes	200.32
Marginal zone lymphoma, intra-abdominal lymph nodes	200.33
Marginal zone lymphoma, lymph nodes of axilla and upper limb	200.34
Marginal zone lymphoma, lymph nodes of inguinal region and lower limb	200.35
Marginal zone lymphoma, intrapelvic lymph nodes	200.36
Marginal zone lymphoma, spleen	200.37
Marginal zone lymphoma, lymph nodes of multiple sites	200.38
Mantle cell lymphoma	200.4
Mantle cell lymphoma, unspecified site, extranodal and solid organ sites	200.40
Mantle cell lymphoma, lymph nodes of head, face, and neck	200.41
Mantle cell lymphoma, intrathoracic lymph nodes	200.42
Mantle cell lymphoma, intra-abdominal lymph nodes	200.43
Mantle cell lymphoma, lymph nodes of axilla and upper limb	200.44
Mantle cell lymphoma, lymph nodes of inguinal region and lower limb	200.45
Mantle cell lymphoma, intrapelvic lymph nodes	200.46
Mantle cell lymphoma, spleen	200.47
Mantle cell lymphoma, lymph nodes of multiple sites	200.48
Primary central nervous system lymphoma, unspecified site, extranodal and solid organ sites	200.50
Primary central nervous system lymphoma, lymph nodes of head, face, and neck	200.51
Primary central nervous system lymphoma, intrapelvic lymph nodes	200.56
Anaplastic large cell lymphoma	200.6
Anaplastic large cell lymphoma, unspecified site, extranodal and solid organ	200.60

sites	
Anaplastic large cell lymphoma, lymph nodes of head, face, and neck	200.61
Anaplastic large cell lymphoma, intrathoracic lymph nodes	200.62
Anaplastic large cell lymphoma, intra-abdominal lymph nodes	200.63
Anaplastic large cell lymphoma, lymph nodes of axilla and upper limb	200.64
Anaplastic large cell lymphoma, lymph nodes of inguinal region and lower limb	200.65
Anaplastic large cell lymphoma, intrapelvic lymph nodes	200.66
Anaplastic large cell lymphoma, lymph nodes of multiple sites	200.68
Large cell lymphoma	200.7
Large cell lymphoma, unspecified site, extranodal and solid organ sites	200.70
Large cell lymphoma, lymph nodes of head, face, and neck	200.71
Large cell lymphoma, intrathoracic lymph nodes	200.72
Large cell lymphoma, intra-abdominal lymph nodes	200.73
Large cell lymphoma, lymph nodes of axilla and upper limb	200.74
Large cell lymphoma, lymph nodes of inguinal region and lower limb	200.75
Large cell lymphoma, intrapelvic lymph nodes	200.76
Large cell lymphoma, spleen	200.77
Large cell lymphoma, lymph nodes of multiple sites	200.78
Nodular lymphoma	202.0
Nodular lymphoma, unspecified site, extranodal and solid organ sites	202.00
Nodular lymphoma of lymph nodes of head, face, and neck	202.01
Nodular lymphoma of intrathoracic lymph nodes	202.02
Nodular lymphoma of intra-abdominal lymph nodes	202.03
Nodular lymphoma of lymph nodes of axilla and upper limb	202.04
Nodular lymphoma of lymph nodes of inguinal region and lower limb	202.05
Nodular lymphoma of intrapelvic lymph nodes	202.06
Nodular lymphoma of spleen	202.07
Nodular lymphoma of lymph nodes of multiple sites	202.08
Peripheral T cell lymphoma, unspecified site, extranodal and solid organ sites	202.70
Peripheral T cell lymphoma, lymph nodes of head, face, and neck	202.71
Peripheral T cell lymphoma, intrathoracic lymph nodes	202.72
Peripheral T cell lymphoma, intra-abdominal lymph nodes	202.73
Peripheral T cell lymphoma, lymph nodes of axilla and upper limb	202.74
Peripheral T cell lymphoma, lymph nodes of inguinal region and lower limb	202.75
Peripheral T cell lymphoma, spleen	202.77
Peripheral T cell lymphoma, lymph nodes of multiple sites	202.78
Other malignant lymphomas	202.8
Other malignant lymphomas, unspecified site, extranodal and solid organ sites	202.80
Other malignant lymphomas of lymph nodes of head, face, and neck	202.81
Other malignant lymphomas of intrathoracic lymph nodes	202.82
Other malignant lymphomas of intra-abdominal lymph nodes	202.83

Other malignant lymphomas of lymph nodes of axilla and upper limb	202.84
Other malignant lymphomas of lymph nodes of inguinal region and lower limb	202.85
Other malignant lymphomas of intrapelvic lymph nodes	202.86
Other malignant lymphomas of spleen	202.87
Other malignant lymphomas of lymph nodes of multiple sites	202.88
Acute myeloid leukemia	205.0
Acute myeloid leukemia in remission	205.01
Acute myeloid leukemia, in relapse	205.02
Acute myeloid leukemia, without mention of having achieved remission	205.00
Chronic myeloid leukemia	205.1
Chronic myeloid leukemia in remission	205.11
Chronic myeloid leukemia, in relapse	205.12
Chronic myeloid leukemia, without mention of having achieved remission	205.10
Multiple myeloma	203.0
Multiple myeloma in remission	203.01
Multiple myeloma, in relapse	203.02
Multiple myeloma, without mention of having achieved remission	203.00
Myelodysplastic syndrome with 5q deletion	238.74
Myelodysplastic syndrome, unspecified	238.75
High grade myelodysplastic syndrome lesions	238.73
Low grade myelodysplastic syndrome lesions	238.72
Plasma cell leukemia	203.1
Plasma cell leukemia in remission	203.11
Plasma cell leukemia, in relapse	203.12
Plasma cell leukemia, without mention of having achieved remission	203.10
Subacute myeloid leukemia in remission	205.21
Subacute myeloid leukemia, in relapse	205.22
Subacute myeloid leukemia, without mention of having achieved remission	205.20

Appendix D: Cancer Chemotherapy

Procedure codes for cancer chemotherapy used at Group Health are listed below.

pxcode	code_type	code_desc
C8953	H	CHEMOTHERAPY ADMIN IV, P
C8954	H	CHEMO ADMIN IV, INFUS UP
C8955	H	CHEMO ADMN IV, INFUS EA
G0355	H	CHEMO SQ/IM NONHORMONL A
G0359	H	CHEMO IV INFUS,UP TO 1 H
G0360	H	CHEMO ADMIN IV INFUS, EA
G0361	H	INIT PROLNG CHEMO INFUS
G8371	H	CHEMO DOC NOT RECV STG I
G8372	H	CHEMO DOC RECV STAGE III
G8373	H	CHEMO PLAN DOC PRIOR CHE
G8374	H	CHEMO PLAN NOT DOC PRIOR
G9021	H	CHEMO ASSESS NV LEVL 1:
G9022	H	CHEMO ASSESS NV LEVL 2:
G9023	H	CHEMO ASSESS NV LEVL 3:
G9024	H	CHEMO ASSESS NV LEVL 4:
G9025	H	CHEMO ASSESS PAIN LVL 1:
G9026	H	CHEMO ASSESS PAIN LVL 2:
G9027	H	CHEMO ASSESS PAIN LVL 3:
G9028	H	CHEMO ASSESS PAIN LVL 4:
G9029	H	CHEMO ASSESS FATIGUE 1:
G9030	H	CHEMO ASSESS FATIGUE LVL
G9031	H	CHEMO ASSESS FATIGUE 3:
G9032	H	CHEMO ASSESS FATIGUE LVL
J8510	H	BULSULFAN ORAL 2 MG\t\tCHE
J8515	H	CABERGOLINE ORAL 0.25 MG
J8520	H	CAPECITABINE ORAL 150 MG
J8521	H	CAPECITABINE ORAL 500 MG
J8530	H	CYCLOPHOSPHAMIDE ORAL 25
J8540	H	DEXAMETHASONE ORAL 0.25
J8560	H	ETOPOSIDE ORAL 50 MG\t\tCH
J8565	H	GEFITINIB ORAL 250 MG\t\tC
J8600	H	MELPHALAN ORAL 2 MG\t\tCHE
J8610	H	METHOTREXATE ORAL 2.5 MG
J8650	H	NABILONE ORAL 1 MG\t\tCHEM
J8700	H	TEMOZOLOMIDE ORAL 5 MG\t\t
J8999	H	PRSC DRUG ORAL CHEMOTHAP
J9000	H	DOXORUBICIN HCL 10 MG\t\tC
J9001	H	DOXORUBICIN HYDROCHLORID-
J9010	H	DOXORUBICIN HCL\t\tCHEMO
J9015	H	ALDESLEUKIN PER SINGLE U
J9017	H	ARSENIC TRIOXIDE 1MG\t\tCH
J9020	H	ASPARAGINASE 10000 UNITS
J9025	H	INJECTION AZACITIDINE 1

J9027	H	INJECTION CLOFARABINE 1
J9031	H	BCG LIVE PER INSTILLATIO
J9035	H	INJECTION BEVACIZUMAB 10
J9040	H	BLEOMYCIN SULFATE 15 UNI
J9041	H	INJECTION BORTEZOMIB 0.1
J9045	H	CARBOPLATIN 50 MG\t\tCHEMO
J9050	H	CARMUSTINE 100 MG\t\tCHEMO
J9055	H	INJECTION CETUXIMAB 10 M
J9060	H	CISPLATIN POWDER/SOLUTIO
J9062	H	CISPLATIN 50 MG\t\tCHEMO
J9065	H	INJECTION CLADRIBINE PER
J9070	H	CYCLOPHOSPHAMIDE 100 MG\t
J9080	H	CYCLOPHOSPHAMIDE 200 MG\t
J9090	H	CYCLOPHOSPHAMIDE 500 MG\t
J9091	H	CYCLOPHOSPHAMIDE 1 G\t\tCH
J9092	H	CYCLOPHOSPHAMIDE 2 G\t\tCH
J9093	H	CYCLOPHOSPHAMIDE LYOPHIL
J9094	H	CYCLOPHOSPHAMIDE LYOPHIL
J9095	H	CYCLOPHOSPHAMIDE LYOPHIL
J9096	H	CYCLOPHOSPHAMIDE LYOPHIL
J9097	H	CYCLOPHOSPHAMIDE LYOPHIL
J9098	H	CYTARABINE LIPOSOME 10 M
J9100	H	CYTARABINE 100 MG\t\tCHEMO
J9110	H	CYTARABINE 500 MG\t\tCHEMO
J9120	H	DACTINOMYCIN 0.5 MG\t\tCHE
J9130	H	DACARBAZINE 100 MG\t\tCHEM
J9140	H	DACARBAZINE 200 MG\t\tCHEM
J9150	H	DAUNORUBICIN HCL 10 MG\t\t
J9151	H	DAUNORUBICIN CITRATE LIP
J9160	H	DENILEUKIN DIFTITOX 300
J9165	H	DIETHYLSTILBESTROL DIPHO
J9170	H	DOCETAXEL 20 MG\t\tCHEMO
J9175	H	INJECTION ELLIOTTS B SOL
J9178	H	INJECTION EPIRUBICIN HCL
J9180	H	EPIRUBICIN HYDROCHLORIDE
J9181	H	ETOPOSIDE 10 MG\t\tCHEMO
J9182	H	ETOPOSIDE 100 MG\t\tCHEMO
J9185	H	FLUDARABINE PHOSPHATE 50
J9190	H	FLUOROURACIL 500 MG\t\tCHE
J9200	H	FLOXURIDINE 500 MG\t\tCHEM
J9201	H	GEMCITABINE HCL 200 MG\t\t
J9202	H	GOSERELIN ACETATE IMPLAN
J9206	H	IRINOTECAN 20 MG\t\tCHEMO
J9208	H	IFOSFAMIDE PER 1 G\t\tCHEM
J9209	H	MESNA 200 MGJ9210 H
J9211	H	IDARUBICIN HCL 5 MGJ9212
J9213	H	INTRFERON ALFA-2A RECOMB
J9214	H	INTRFERON ALFA-2B RECOMB

J9215	H	INTERFERON ALFA-N3 25000
J9216	H	INTERFERON GAMMA-1B 3 MI
J9217	H	LEUPROLIDE ACETATE 7.5 M
J9218	H	LEUPROLIDE ACETATE PER 1
J9219	H	LEUPROLIDE ACETATE IMPLA
J9225	H	HISTRELIN IMPLANT VANTAS
J9226	H	HISTRELIN IMPL SUPPRELIN
J9230	H	MECHLORETHAMINE HCL 10 M
J9240	H	MEDROXYPROGETERONE\texttt{CHEM
J9245	H	INJECTION MELPHALAN HCL
J9250	H	METHOTREXATE SODIUM 5 MG
J9260	H	METHOTREXATE SODIUM 50 M
J9261	H	INJECTION NELARABINE 50
J9263	H	INJECTION OXALIPLATIN 0.
J9264	H	INJ PACLITAXEL PROTBND P
J9265	H	PACLITAXEL 30 MG\texttt{CHEMO
J9266	H	PEGASPARGASE PER SINGLE
J9268	H	PENTOSTATIN PER 10 MG\texttt{C
J9270	H	PLICAMYCIN 2.5 MG\texttt{CHEMO
J9280	H	MITOMYCIN 5 MG\texttt{CHEMO
J9290	H	MITOMYCIN 20 MG\texttt{CHEMO
J9291	H	MITOMYCIN 40 MG\texttt{CHEMO
J9293	H	INJECTION MITOXANTRONE H
J9295	H	POLYESTRADIOL PHOSPHATE\texttt{t
J9300	H	GEMTUZUMAB OZOGAMICIN 5M
J9303	H	INJECTION PANITUMUMAB 10
J9305	H	INJECTION PEMETREXED 10
J9310	H	RITUXIMAB 100 MG\texttt{CHEMO
J9320	H	STREPTOZOCIN 1 GM\texttt{CHEMO
J9340	H	THIOTEPA 15 M\texttt{CHEMO
J9350	H	TOPOTECAN 4 MG\texttt{CHEMO
J9355	H	TRASTUZUMAB 10 MG\texttt{CHEMO
J9357	H	VALRUBICIN INTRAVESICAL
J9360	H	VINBLASTINE SULFATE 1 MG
J9370	H	VINCRISTINE SULFATE 1 MG
J9375	H	VINCRISTINE SULFATE 2 MG
J9380	H	VINCRISTINE SULFATE 5 MG
J9390	H	VINORELBINE TARTRATE PER
J9395	H	INJECTION FULVESTRANT 25
J9600	H	PORFIMER SODIUM 75 MG\texttt{C
J9999	H	NOT OTHWISE CLASS ANTINE
Q0081	H	INFUS TX OTH THAN CHEMO
Q0083	H	CHEMO ADMIN NOT INFUS TE
Q0084	H	CHEMO ADMIN INFUS TECH O
Q0085	H	CHEMO ADMIN INFUS&OTH TE
S5019	H	CHEMOTHERAPY ADMIN\texttt{CHEM
S5020	H	CHEMOTHERAPY ADMIN\texttt{CHEM
S9329	H	HIT CHEMOTHERAPY INFUSIO

S9330	H	HIT CONT CHEMOTHAPY INFU
S9331	H	HIT INTERMIT CHEMOTHAPY
0.1	I	IMPLANT CHEMO AGENT\
331	U	RAD THERAPEUTIC CHEMO IN
332	U	RAD THERAPEUTIC CHEMO OR
335	U	RAD THERAPEUTIC CHEMO IV
4621B	G	10 QUART CHEMOTHERAPY WA
61517	C	IMPLT BRAIN CHEMOTX ADD-
96400	C	CHEMOTHERAPY, SC/IM\
96401	C	CHEMO, ANTI-NEOPL, SQ/IM
96402	C	CHEMO HORMON ANTINEOPL S
96405	C	CHEMO INTRALESIONAL, UP\
96406	C	CHEMO INTRALESIONAL OVER
96408	C	CHEMOTHERAPY, PUSH TECHN
96409	C	CHEMO, IV PUSH, SNGL DRU
96410	C	CHEMOTHERAPY,INFUSION ME
96411	C	CHEMO, IV PUSH, ADDL DRU
96412	C	CHEMO, INFUSE METHOD ADD
96413	C	CHEMO, IV INFUSION, 1 HR
96414	C	CHEMO, INFUSE METHOD ADD
96415	C	CHEMO, IV INFUSION, ADDL
96416	C	CHEMO PROLONG INFUSE W/P
96417	C	CHEMO IV INFUS EACH ADDL
96420	C	CHEMO, IA, PUSH TECHNIQUE
96422	C	CHEMO IA INFUSION UP TO\
96423	C	CHEMO IA INFUSE EACH ADD
96425	C	CHEMOTHERAPY,INFUSION ME
96440	C	CHEMOTHERAPY, INTRACAVIT
96445	C	CHEMOTHERAPY, INTRACAVIT
96450	C	CHEMOTHERAPY, INTO CNS\
96500	C	CHEMO INJECTION\
96501	C	CHEMO INJECTION\
96504	C	CHEMO INJECTION\
96505	C	CHEMO INJECTION\
96508	C	CHEMO INJECTION\
96509	C	CHEMO INJECTION\
96510	C	CHEMO INJECTION\
96511	C	CHEMO INJECTION\
96512	C	CHEMO INJECTION\
96524	C	CHEMO INJECTION\
96526	C	CHEMO INJECTION\
96535	C	CHEMO INJECTION\
96538	C	CHEMO INJECTION\
96540	C	CHEMO INJECTION\
96542	C	CHEMOTHERAPY INJECTION\
96545	C	PROVIDE CHEMOTHERAPY AGE
96549	C	CHEMOTHERAPY, UNSPECIFIE
96910	C	PHOTOCHEMOTHERAPY WITH U

96912	C	PHOTOCHEMOTHERAPY WITH U
96913	C	PHOTOCHEMOTHERAPY, UV-A\t
99.25	I	INJECT CA CHEMO AGENT\t\tC
99555	C	HOME INFUSE, CHEMOTHERAP

Appendix E: Proton-Pump Inhibitors

To identify proton-pump inhibitors (PPIs) during the 21 day period prior to the c-diff infection index date, Group Health included all medications where the drug class description included the term “proton pump inhibitor.” This is an efficient approach to identifying all PPIs, specific instances of which may vary across institutions.

VU list of PPIs (brand and generic):

omeprazole

esomeprazole

lansoprazole

dexlansoprasole

pantoprazole

rabeprazole

Prevacid

Nexium,

Dexilant

Prilosec

Zegerid

Protonix

Aciphex

Vimovo