

Intravenous immunoglobulin contains a broad repertoire of anticarbohydrate antibodies that is not restricted to the IgG₂ subclass

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Background: Specificities for carbohydrate IgG antibodies, thought to be predominantly of the IgG₂ subclass, have never been broadly examined in healthy human subjects.

Objective: To examine commercial intravenous immunoglobulin (IVIG) preparations for their ability to recognize a wide range of glycans and to determine the contribution of IgG₂ to the binding pattern observed.

Methods: We used a glycan microarray to evaluate IVIG preparations and a control mix of similar proportions of human myeloma IgG₁ and IgG₂ for binding to 377 glycans, courtesy of the Consortium for Functional Glycomics Core H (Merck & Co, Inc, Whitehouse Station, NJ). Glycans recognized were categorized using public databases for their likely cellular sources. IgG₂ was depleted from IVIG by using immunoaffinity chromatography, and depletion was confirmed by using nephelometry and surface plasmon resonance.

Results: Nearly half of the glycans bound IgG. Some of the glycans with the greatest antibody binding can be found in structures of human pathogenic bacteria (eg, *Streptococcus pneumoniae*, *Mycobacterium tuberculosis*, *Vibrio cholera*) and nonpathogenic bacteria, including LPS and lipoteichoic acid, capsular polysaccharides, and exopolysaccharides.

Surprisingly, depletion of IgG₂ had only a modest effect on anticarbohydrate recognition patterns compared with the starting IVIG preparation. Little to no binding activity was detected to human endogenous glycans, including tumor-associated antigens.

Conclusions: This novel, comprehensive analysis provides evidence that IVIG contains a much wider range than

previously appreciated of anticarbohydrate IgG antibodies, including those recognizing both pathogenic and non-pathogen-associated prokaryotic glycans. (*J Allergy Clin Immunol* ■■■■;■■■:■■■-■■■.)

Key words: IgG subclasses, γ -globulin, anticarbohydrate antibodies, glycans, IgG₂, glycan microarray

Production of immunoglobulins by plasma cells defines the net effect of an antigen-specific humoral response. This process results in the production of IgG, IgA, and IgE antibodies, which themselves are the end result of immunoglobulin class switching and gene rearrangements.¹ Implicit in this paradigm is that the major epitopes recognized by the vast majority of immunoglobulins are those from proteins. However, antibodies can be produced against nonprotein antigens. Examples include the generation of carbohydrate-specific antibodies after immunization with carbohydrate vaccines such as Pneumovax; anti-DNA antibodies in SLE; antibodies to blood group carbohydrate antigens; and antibody responses to glycolipids, including LPS and lipoteichoic acid (LTA).² The vast majority of these antibodies are of the IgG class, and current paradigms suggest that IgG₁ and IgG₃ subclasses represent the bulk of protective antiprotein antibodies, in part because of their ability to activate complement more efficiently. In contrast, the IgG₂ subclass is believed to be more commonly associated with anticarbohydrate immune responses.³⁻⁷ A broad and comprehensive analysis of this concept, however, is lacking.

In 2001, the National Institute of General Medical Sciences funded the Consortium for Functional Glycomics (CFG; <http://www.functionalglycomics.org>) to facilitate new discoveries in the field of glycobiology. Among the technologies created was the development of a glycan microarray in which now over 300 human and nonhuman glycans have been immobilized on a testing surface to facilitate high-throughput screening of lectins, antibodies, and other structures for their carbohydrate ligands (<http://www.functionalglycomics.org/static/consortium/resources/resourcecoreh.shtml>). Numerous publications have demonstrated the utility of this technology in facilitating the discovery of candidate ligands for known or unknown glycan binding structures, as well as for screening a variety of existing antibodies and human serum samples for the presence of anti-glycan binding activity.⁸

In the current article, the CFG glycan microarray was used to test preparations of human pooled intravenous immunoglobulin (IVIG) for its antiglycan binding activity. The main hypothesis to be tested was whether normal human IgG contains a limited spectrum of anticarbohydrate antibodies that are predominantly IgG₂.

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Abbreviations used

BCSDB: Bacterial Carbohydrate Structure Database

CFG: Consortium for Functional Glycomics

CPS: Capsular polysaccharide

GD2: Ganglioside GalNAc β (1-4)[NeuAc(α 2-8)NeuAc(α 2-3)]
Gal β (1-4)Glc β (1-1')-ceramideGD3: Ganglioside NeuAc(α 2-8)NeuAc(α 2-3)
Gal β (1-4)Glc β (1-1')-ceramideGM1: Ganglioside Gal β (1-4)GalNAc β (1-4)[NeuAc(α 2-3)]
Gal β (1-4)Glc β (1-1')-ceramideGM2: Ganglioside GalNAc β (1-4)[NeuAc(α 2-3)]
Gal β (1-4)Glc β (1-1')-ceramide

IVIG: Intravenous immunoglobulin

LTA: Lipoteichoic acid

sLe^x: Sialyl Lewis XsTn: Sialyl Tn (Thomsen-Friedenreich precursor) antigen:
Neu5Ac(α 2-6)GalNAc α -O-Ser/Thr

su: Sulfated

METHODS**Reagents**

The commercially available IVIG preparations used in this study were Sandoglobulin and Privigen (kindly provided by CSL Behring, Bern, Switzerland) and Gamunex (purchased from Talecris, Research Triangle Park, NC). Sandoglobulin and Privigen (IgG content $\geq 98\%$) contain $\leq 2\%$ and $\leq 0.0021\%$ IgA, respectively, and only traces of IgM, IgD, and IgE (as reported by CSL Behring). The IgG subclass composition of Sandoglobulin was analyzed by nephelometry (Quest Diagnostics, Baltimore, Md) and contained mainly IgG₁ (61%) and IgG₂ (32%), with small amounts of IgG₃ (5%) and IgG₄ (2%). Privigen contained 66% IgG₁, 29% IgG₂, 3% IgG₃, and 3% IgG₄ (as reported by CSL Behring). To remove the stabilizing sucrose component of Sandoglobulin, this IVIG preparation was dialyzed as previously described.⁹

A control IgG preparation was made by mixing 2 monoclonal human myeloma proteins, IgG₁, λ (67%) and IgG₂, κ (33%), purchased from Sigma-Aldrich (St Louis, Mo), yielding a κ/λ ratio of 0.5, well within the range found in normal serum (0.26-1.65).

Glycan array analysis

The glycan microarrays from the CFG (<http://www.functionalglycomics.org/static/consortium/resources/resourcecoreh11.shtml>) are prepared from amine functionalized glycan structures covalently coupled in microarrays to N-hydroxysuccinimide-derivatized microscope slides as previously described.¹⁰ IVIG preparations and mixed human myeloma IgG₁ and IgG₂ were analyzed for binding to version 3.1 of the printed array (377 glycan targets).

IgG₂ depletion of IVIG

Purified murine monoclonal antihuman IgG₂ Fd (part of the Ig heavy chain consisting of the two amino-terminal domains, namely V_HC_H1) (HP6014; Hybridoma Reagent Laboratory, Baltimore, Md)¹¹ was coupled to cyanogen bromide-activated Sepharose 4B-CL (Sigma-Aldrich) at 1 mg/mL packed beads and blocked with 1 mol/L ethanolamine. The antihuman IgG₂-Sepharose (20 mL 50% vol/vol) was packed into a Biorad glass (BioRad Laboratories, Inc, Hercules, Calif) column and washed with 20 bed volumes of PBS, and the IVIG (Sandoglobulin) was applied to the column and recycled 5 times. The final eluate was collected, and the column was then washed with PBS until no protein was detected in the eluate at OD 280 with an online monitor (Pharmacia-LKB Uvicord SD, Uppsala, Sweden). The bound human IgG₂ fraction was eluted from the anti-IgG₂ affinity column with 10 mmol/L NaOH. The protein peak,

once completely eluted based on online OD monitoring, was immediately neutralized to pH 7.4.

Immunochemical characterization of the original and IgG₂-depleted IVIG

The IgG₂-adsorbed IVIG that passed through the anti-IgG₂ affinity column was initially analyzed for IgG₁, IgG₂, IgG₃, and IgG₄ by nephelometry (CSL Behring) using Binding Site Reagents (San Diego, Calif) and the CRM (certified reference material) 470 serums standard. The levels of IgG subclass protein measured by nephelometry in the IgG₂-depleted fraction were as follows: IgG₁, 14 mg/dL; IgG₂, <17 mg/dL; IgG₃, 2 mg/dL; and IgG₄, 0.4 mg/dL. Because the analytical sensitivity of the IgG₂ nephelometric assay was insufficient to demonstrate effective removal of IgG₂, we performed an alternative assay by using surface plasmon resonance on the Biacore 3000 instrument (General Electric, Piscataway, NJ). The following purified mAbs were coupled to separate flow cells on a carboxymethyl cellulose chip by using 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride-N-hydroxysuccinimide chemistry: HP6019 (murine antihuman IgG₁, IgG₃, and IgG₄ Fc exclusion antibody that does not bind human IgG₂), HP6043 (murine antihuman IgG₁, IgG₂, IgG₃, and IgG₄ Fc that is pan reactive with all 4 human IgG subclasses), and HP6014 (antihuman IgG₂ Fd). The levels of the IgG subclass protein in the original Sandoglobulin and IgG₂-depleted IVIG eluate were analyzed by measuring the level of binding to each of the antibodies in each of the flow cells in separate runs. The level of resonance units measured were analyzed with BIA simulation software (General Electric) to compute the relative quantity of IgG₂ or IgG_{1,3,4} protein binding to the anti-IgG₂ and anti-IgG_{1,3,4}, respectively.

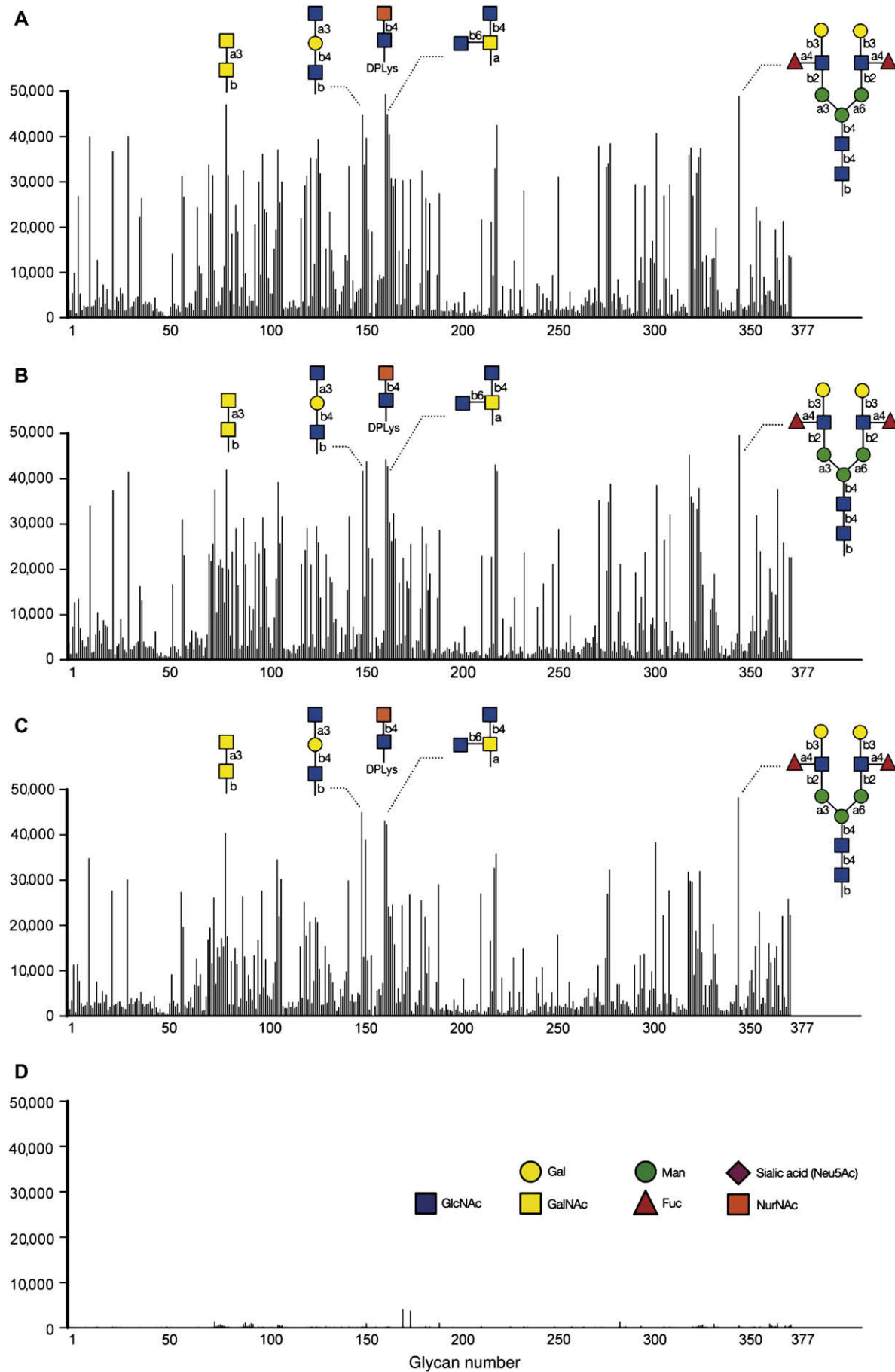
Glycan analysis using the Bacterial Carbohydrate Structure Database

For an analysis of glycans recognized by IVIG, the online Bacterial Carbohydrate Structure Database (BCSDB) was consulted (<http://www.glyco.ac.ru/bcsdb/start.shtml>). For the top 100 glycans binding to IVIG, glycan names were entered as terms to search for expression of these glycans in bacteria. The top 20 glycans for which registries were found were grouped according to expression by pathogenic versus nonpathogenic, by gram-positive versus gram-negative bacteria, and according to the presence in LPS, lipooligosaccharides, and LTA; capsular polysaccharide (CPS); and endopolysaccharide.

RESULTS

In cooperation with the CFG, IVIG was analyzed for the presence of anticarbohydrate antibodies by using a glycan microarray containing 377 glycan structures. To broaden the analysis, preparations of IVIG tested included Sandoglobulin (donors from the United States and Europe), Privigen (donors from Germany), and Gamunex preparation (donors from the United States). These IVIG preparations contained all 4 IgG subclasses but were mainly composed of the antibody subclasses IgG₁ and IgG₂ as measured by their respective manufacturers. Thus, a 2:1 mix of human myeloma-derived IgG₁ and IgG₂ protein (IgG control mix) was also concurrently analyzed to determine levels of background nonspecific binding.

On the basis of results of pilot experiments that involved testing a range of dilutions of IVIG (data not shown), a concentration of 180 μ g/mL IVIG was determined to be optimal for screening in the CFG glycan microarray. At this concentration, reproducible glycan-binding patterns were achieved with minimal background (Fig 1). Sandoglobulin and Privigen each bound to 181 (48%) and Gamunex to 172 (46%) of the 377 glycans of the microarray at a level above background, defined as the level of the highest



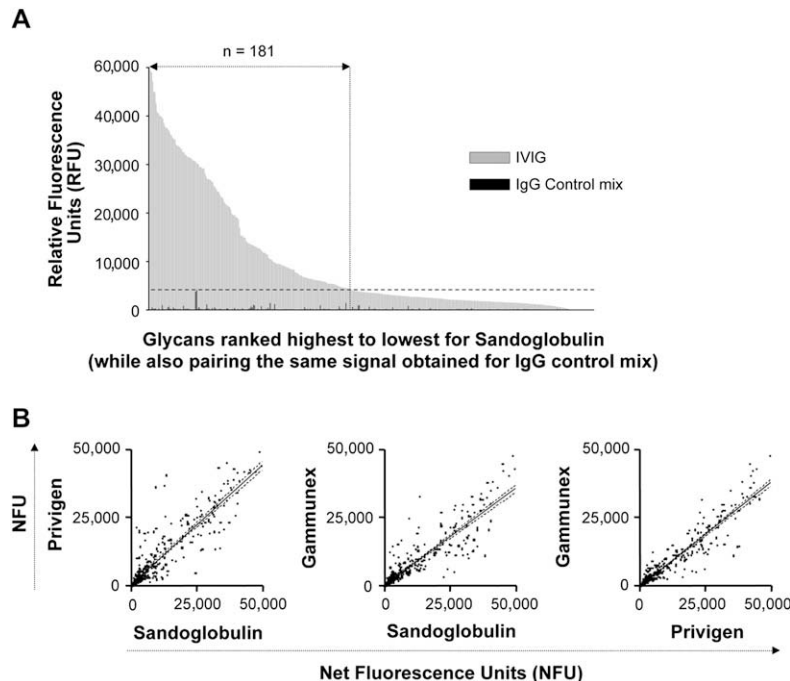


FIG 2. Different commercial IVIG preparations derived from different donor populations recognize similar patterns of glycans. **A**, Glycan-binding patterns of the Sandoglobulin IVIG as measured by relative fluorescence units and ranked in descending order of signal (gray bars) paired with the results of the control IgG mix (black bars). Binding of IVIG to 181 glycans (48%) was above background, as defined by the highest signal of the control IgG mix (dotted horizontal line). **B**, Comparison of glycan binding activities of Sandoglobulin, Privigen, and Gammunex. Values are indicated as net fluorescence units (NFU) as calculated by subtraction of the corresponding glycan binding value for the IgG control mix. The majority of glycans were recognized with comparable binding intensity by the 3 IVIG preparations (r^2 from left to right: 0.82, 0.81, and 0.88).

binding signal obtained by using the IgG myeloma control mix (Fig 1; Fig 2, A). The maximal values of relative fluorescence were similar for all 3 IVIG preparations (maximal value of relative fluorescence for Sandoglobulin, 49,379; for Privigen, 49,710; for Gammunex, 48,348). Among the various specifically recognized glycans, the levels of IVIG binding varied considerably. In contrast, binding of the IgG myeloma control was low for all 377 glycans on the microarray (Fig 1), suggesting that the anticarbohydrate binding activity of IVIG is a result of the presence of specific antiglycan antibodies and not nonspecific binding.

Because all 3 IVIG preparations produced the same relative level of binding to the glycan microarray (46% to 48% of glycans recognized; see previous paragraph), it was important to determine whether the glycan recognition patterns were similar. As shown in Fig 1 and Fig 2, B, the glycan recognition patterns of Sandoglobulin, Privigen, and Gammunex were similar, and for the majority of glycans, there was only a minor variation in signal intensity produced by the 3 IVIG preparations. Table I shows results for the top 20 glycans bound by IVIG. A comprehensive list showing binding intensities of all 3 IVIG

preparations to each of the 377 glycans is provided in supplementary material to this manuscript (see this article's Table E1 in the Online Repository at www.jacionline.org). All raw data are also presented on the CFG website at <http://www.functionalglycomics.org/glycomics/publicdata/selectedScreens.jsp>.

Long-standing doctrine suggests that among human IgG subclasses, IgG₂ most commonly binds to carbohydrate epitopes.^{12,13} To assess globally the contribution of IgG₂ to glycan binding, a preparation of Sandoglobulin was depleted of IgG₂ by affinity chromatography for testing on the glycan microarray. The depletion efficacy was analyzed by nephelometry and surface plasmon resonance to determine the IgG₂ content of the various fractions, including the starting IVIG material, IgG₂-depleted IVIG, and eluates from the anti-IgG₂ affinity column. These fractions were tested for binding to antihuman IgG₂ mAb antibody clone HP6014 and antihuman IgG₁/IgG₃/IgG₄ clone HP6019, 2 well characterized antibodies covalently immobilized on a carboxymethyl cellulose-coated Biacore chip (General Electric). In addition, monoclonal human IgG₁ and IgG₂ antibodies were used as positive and negative specificity controls, respectively.

FIG 1. IVIG contains many different anticarbohydrate IgG antibodies. A total of 377 glycans were screened for binding of IgG by using commercial IVIG brands Sandoglobulin (A), Privigen (B), and Gammunex (C) or a control mix of human myeloma (D; containing IgG₁ and IgG₂ in a 2:1 proportion, similar to IVIG). Glycan binding for each was tested at 180 μ g/mL. As examples, the carbohydrate structures of several of the top IVIG bound glycans are shown.

TABLE I. Top 20 glycans bound by antibodies contained in IVIG

Chart no.	Masterlist name	Relative fluorescence units				
		Sandoglobulin (mean)	Privigen (mean)	Gammunex (mean)	Average	SEM
156	GlcNAc β 1-2Gal β 1-3GalNAc α	38,808	42,989	37,997	39,931	2187
154	GlcNAc α 1-3Gal β 1-4GlcNAc β	44,652	41,549	44,768	43,656	1491
24	GlcNAc β 1-3(GlcNAc β 1-4)(GlcNAc β 1-6)GlcNAc	36,572	37,350	27,618	33,846	4416
166	GlcNAc β 1-4MDPLys $\dagger$	49,248	44,222	42,953	45,475	2718
167	GlcNAc β 1-4(GlcNAc β 1-6)GalNAc α	44,791	42,589	42,158	43,179	1153
168	GlcNAc β 1-4Gal β 1-4GlcNAc β	40,247	30,117	23,867	31,410	6749
102	Gal α 1-3Gal β 1-3GlcNAc β	36,030	31,401	27,631	31,687	3435
110	Gal α 1-4GlcNAc β	36,518	38,687	33,955	36,387	1934
147	Gal β 1-4GlcNAc β 1-3Gal β 1-4Glc β	33,402	31,560	29,834	31,599	1457
83	GalNAc α 1-3GalNAc β	46,913	41,898	40,319	43,043	2812
324	NeuAc(9Ac) α 2-3Gal β 1-3GlcNAc β	35,989	45,272	31,884	37,715	5600
223	Neu5Ac α 2-3Gal β 1-3GlcNAc β *	33,050	43,183	32,744	36,326	4851
224	Neu5Ac α 2-3Gal β 1-3GlcNAc β *	42,560	41,737	35,903	40,067	2963
283	Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-3Gal β 1-3GlcNAc β	38,558	38,927	32,376	36,620	3005
282	Neu5Ac α 2-3Gal β 1-3GlcNAc β 1-3Gal β 1-3GlcNAc β	34,023	34,962	27,041	32,008	3534
325	NeuAc α 2-6Gal β 1-4GlcNAc β 1-3Gal β 1-3GlcNAc β	37,472	36,108	29,887	34,489	3301
12	α -L-Rha	39,964	34,151	34,807	36,308	2599
32	[su]3Gal β 1-3GlcNAc β	40,124	41,628	30,224	37,326	5059
307	HOOC(CH ₃)CH-3-O-GlcNAc β 1-4GlcNAc β ‡	40,792	38,600	38,355	39,249	1096
350	Gal β 1-3(Fuc α 1-4)GlcNAc β 1-2Man α 1-3[Gal β 1-3(Fuc α 1-4)GlcNAc β 1-2Man α 1-6]Man β 1-4GlcNAc β 1-4GlcNAc β	48,478	49,208	47,846	48,511	557

Results for each of the 377 glycans on the array and for 3 different IVIG preparations (Sandoglobulin, Privigen, Gammunex) are shown. The complete list is provided as an Online Supplement, Table E1.

*Glycans 223 and 224 differ only by a single carbon in the linkage to the array.

†A fragment of peptidoglycan containing GlcNAc β 1-4MurAc coupled to the array through a lysine.

‡MurAc β 1-4GlcNAc β (disaccharide of peptidoglycan).

Fig 3, A, depicts the surface plasmon resonance association curves obtained with each of the fractions at 100 μ g/mL to anti-IgG₂ mAb immobilized on the chip flow cell. Total IVIG and affinity-purified IgG₂ fractions demonstrated a high level of binding that was similar to the IgG₂ myeloma isotype control. In contrast, IgG₂-depleted IVIG and the IgG₁ myeloma control demonstrated no evidence of binding with the anti-IgG₂ antibody. These data indicated that the IgG₂ protein had been removed from this IVIG fraction. Analogous reciprocal binding patterns were obtained on the flow cell containing the anti-IgG₁/IgG₃/IgG₄ antibody. From these data for binding levels, the percentages of IgG₂ and IgG₁/IgG₃/IgG₄ were computed in each of the fractions (Fig 3, B) and demonstrate that >99% of the IgG₂ had been removed from the anti-IgG₂ affinity column-adsorbed IVIG fraction.

The glycan binding properties of total and IgG₂-depleted IVIG were next evaluated by using the glycan microarray (Fig 4). For this analysis, we arbitrarily defined IgG₂ subclass predominance as IgG₂-depleted IVIG signal intensities <33.3% of total IVIG signals and non-IgG₂ predominance as response levels >66.7%. Although a broad range of glycans were still recognized by IgG₂-depleted IVIG, binding was completely lost for some glycans, suggesting that these structures are exclusively recognized by IgG₂ antibodies. For example, among 45 of the top 100 glycans recognized, binding of IgG₂-depleted IVIG was below 33.3% of the signal intensity of nondepleted IVIG. This indicated that for these glycans, recognition was mainly a result of antiglycan antibodies of the IgG₂ subclass. In contrast, 22 of the top 100 glycans bound by the IgG₂-depleted IVIG were still above 66.7% of the

signal strength compared with unadsorbed IVIG, revealing that non-IgG₂ antibodies play a major role in their recognition. A summary of the results for all 377 glycans is presented as supplementary material (see this article's Table E2 in the Online Repository at www.jacionline.org). These data strongly suggest that human immune responses toward glycans are not exclusively a function of IgG₂ and that the IgG subclass antibodies generated from anticarbohydrate responses may be dependent on the type of glycan.

Given the pattern of glycans bound by IVIG, the identity of these glycans and their biological source and function were explored. The top ranked IVIG binding glycans were elucidated for their occurrence in bacteria by using the BCSDB. Among the top 100 glycans recognized by IVIG, 39 had entries in the BCSDB. Results of the BCSDB analysis for the top 20 of these sugars are presented in Table II. Most of the highly recognized glycans represent determinants found in bacteria. They are not limited to 1 class of bacteria but instead represent a broad cross-section of species. Besides bacterial commensals, such as *Bacteroides* spp and *Lactobacillus*, these included glycans found in important pathogens such as *Bacillus anthracis*, *Mycobacteria*, *Vibrio cholerae*, *Neisseria meningitidis*, *Haemophilus influenzae*, *Helicobacter pylori*, *Pseudomonas aeruginosa*, *Streptococcus pneumoniae*, *Escherichia coli*, *Shigella*, and *Salmonella* spp. Bacterial glycans recognized by IVIG were not restricted to 1 species but rather were a part of a variety of structural and secreted molecules such as bacterial cell wall components like LPS, lipooligosaccharides, and LTA; CPS; and even secreted endopolysaccharide.

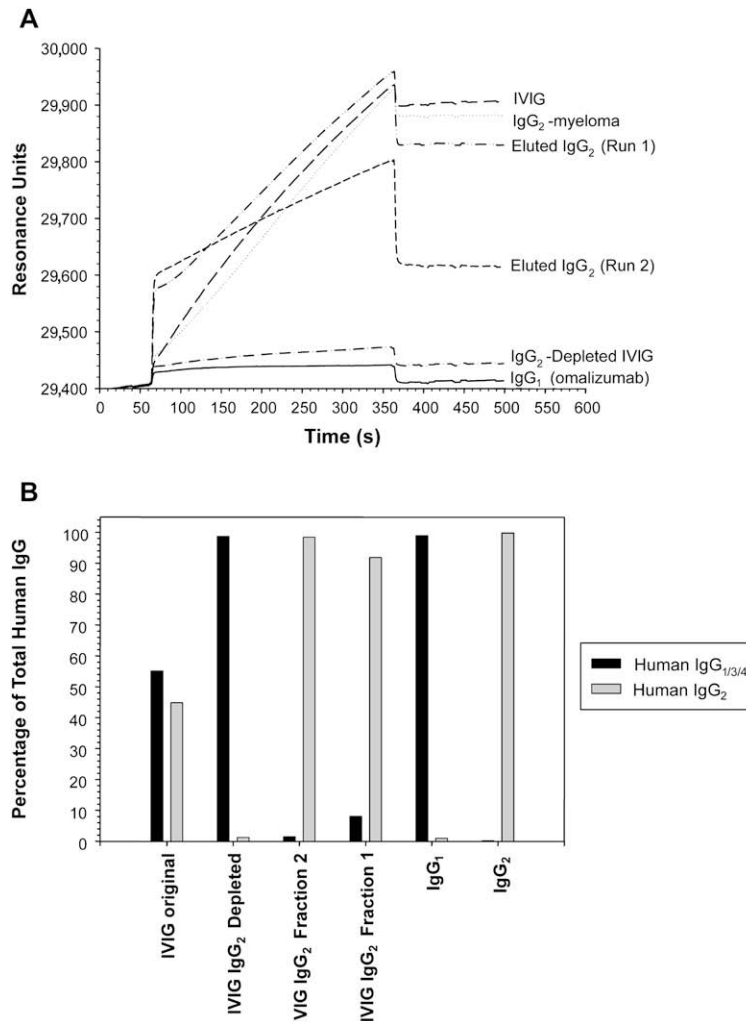


FIG 3. Analysis of IgG₂ depletion from IVIG: evaluation of IVIG fractions before and after IgG₂ adsorption by surface plasmon resonance. **A**, Binding of IVIG fractions after immunoaffinity IgG₂ depletion. **B**, The proportion of IgG₂ versus IgG₁/IgG₃/IgG₄ for the various fractions.

Comparing data from the untreated and IgG₂-depleted IVIGs, it becomes apparent that the IgG₂ subclass contribution to the top 20 binding bacterial glycan antibodies was quite variable (see Table II). Using an arbitrarily defined IgG₂ subclass predominance of IgG₂-depleted IVIG signal intensities <33.3% of total IVIG signals, only 3 of the top 20 IVIG bound glycans were recognized predominantly by IgG₂ antibodies. Ten of the top 20 glycans were recognized predominantly by non-IgG₂ antibodies, and 7 glycans were recognized by both IgG₂ and non-IgG₂ antibodies. Bacterial capsular structures are thought to be recognized principally by IgG₂ antibodies,⁷ but our BCSDB analysis revealed that many of the top 20 glycans bound by non-IgG₂ antibodies are present in capsular polysaccharides. These results indicate that more than a third of the glycans on the microarray bound by IgG antibodies in the IVIG are present in a variety of bacterial components and products of both commensals and pathogens. Furthermore, the bacterial glycan recognition in IVIG is not restricted to the IgG₂ subclass but involves an even higher proportion of non-IgG₂ antiglycan antibodies.

Endogenous human glycans (eg, blood group antigens, selectin ligands) have important biological functions in health and disease, and binding by IVIG to these glycans may have important modulatory effects. Certain biologically important glycans for which IVIG binding has been assessed by using the glycan microarray are depicted in Fig 5. As expected, IVIG contained antibodies to blood group antigens H (core), A, and B, but not the P/E-selectin ligand sialyl Lewis x (sLe^x), the Siglec-8 ligand 6(Gal)-sulfated(su)-sLe^x, the L-selectin ligand 6(GlcNAc)-su-sLe^x, or the ganglioside NeuAc(α2-8)NeuAc(α2-3)Galβ(1-4)Glcβ(1-1')-ceramide (GD3). Cancer cells frequently display altered glycosylation patterns. Glycans that have been associated with cancer and were represented on the microarray but were not recognized by IVIG included sialyl Lewis a, sialyl Tn (Thomsen-Friedenreich precursor) antigen: Neu5Ac<(α2-6)GalNAcα-O-Ser/Thr (sTn), Lewis y, polysialic acid, and the gangliosides GalNAcβ(1-4)[NeuAc(α2-8)NeuAc(α2-3)]Galβ(1-4)Glcβ(1-1')-ceramide (GD2), GD3, fucosyl ganglioside Galβ(1-4)GalNAcβ(1-4)[NeuAc(α2-3)]Galβ(1-4)Glcβ(1-1')-ceramide (GM1), and ganglioside GalNAcβ

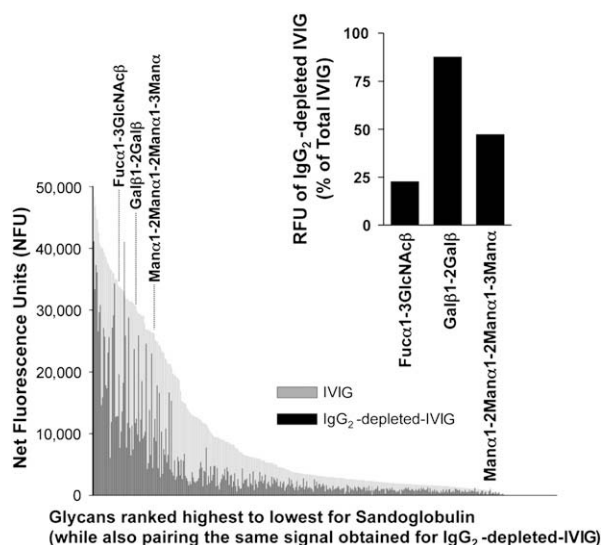


FIG 4. IgG₂ dependence of glycan recognition by IVIG. Glycans bound by IgG antibodies in the original and IgG₂-depleted Sandoglobulin are ranked from highest to lowest binding. Signal intensities for IVIG binding to the 377 glycans were expressed as net fluorescence units after subtraction of the IgG control mix signal for each respective glycan. Depending on the carbohydrate structure, IgG₂ depletion had different effects on glycan recognition by IVIG. For instance, binding to the 3 bacterial glycans Fucα1-3GlcNAcβ, Galβ1-2Galβ, and Manα1-2Manα1-2Manα1-3Manα were largely IgG₂-dependent, independent, or mixed, respectively (inset). RFU, Relative fluorescence units.

(1-4)[NeuAc(α2-3)]Galβ(1-4)Glcβ(1-1')-ceramide (GM2; see Fig 5). Taken together, these data demonstrate that IVIG contained antibodies to blood group antigens but not to endogenous human cancer or inflammation-associated glycans, which therefore appear to be relatively nonimmunogenic or at least are not represented often enough to be detected among normal healthy donors.

DISCUSSION

Intravenous immunoglobulin preparations contain mostly IgG from thousands of donors with only trace amounts of IgM or IgA. They represent the immunologic antibody repertoire of the donor population that has evolved predominantly after T-cell-dependent immunoglobulin isotype class-switching. Most carbohydrate structures are considered to be T-cell-independent antigens.^{2,14} The present data show that IVIG contains abundant antiglycan antibodies that are capable of binding to a broad range of carbohydrate structures. Furthermore, a greater than expected proportion of non-IgG₂ antibodies in IVIG displayed antiglycan binding activity because depletion of IgG₂ from the IVIG reduced or eliminated binding to only about half of glycans (45% of the top 100 recognized glycans), suggesting that many carbohydrate-specific IgG antibody responses can be of IgG₂, non-IgG₂, or mixed subclass distribution. Why certain glycans do not elicit a preferential IgG₂ response cannot be determined from the present experiments. However, from an immunogenicity standpoint, their IgG subclass suggests that these antiglycan antibodies occurred as a result of isotype class-switching with the help of T cells. Conversion of glycans into T-cell-dependent antigens may occur if the specific glycan

is coupled to a carrier (glycoconjugates) and in this form presented by antigen-presenting cells to T cells. Also, glycolipids are presented to T cells by CD1 molecules (CD1a, CD1b, CD1c, and CD1d).

The immense structural diversity of bacterial glycans, their variable levels of expression, and the presence in both bacterial pathogens and commensals at various host sites likely all contribute to both short-term and long-term host-bacterial interactions with stimulation of the host's immune system and subsequent antibody production. The current analysis identified a number of carbohydrates that are immunogenic, and many are found in both pathogenic and nonpathogenic bacteria. The bacterial constituents containing these glycans included structural molecules such as the cell wall components LPS, lipooligosaccharides, and LTA or CPS, and secreted bacterial products such as endopolysaccharide. Although in the current study we focused on the identification of IVIG binding to bacterial glycans, the results contain information on glycans that are expressed in other nonbacterial microorganisms, such as glycan 196, which represents a mannose structure often found in fungi.

Why certain glycans are more immunogenic than others cannot be ascertained by the current analysis, and ultimately the eliciting source of all of the observed IgG₂ and non-IgG₂ anti-carbohydrate responses cannot be determined. Nevertheless, these data might help identify T-cell-dependent glycan antigens that could be of major importance in carbohydrate vaccine development. Indeed, at the September 2007 meeting held at the National Institutes of Health entitled "Carbohydrate Moieties as Vaccine Candidates" for vaccine development, the "need to understand the unique differences in the degree of immunogenicity among and between types of carbohydrates including the immune responses to glycolipids" was postulated.² Thus, the results of the current study regarding the recognition of glycans by IgG in IVIG may be of future aid in the development of carbohydrate-based vaccines.

Finally, among 3 different IVIG preparations, the glycan binding patterns were similar in their recognition patterns of many presumed exogenous glycans, yet little IVIG binding was detected to endogenous human cancer or inflammation-associated glycans (eg, ligands of lectins, Siglecs). The absence of naturally occurring antibodies to sialosides and other glycan structures of potential human origin was expected and suggests that IVIG should not interfere with receptor-ligand interactions of biologically important human lectins. For instance, our data suggest that IVIG treatment would not inhibit sLe^x-selectin-mediated leukocyte emigration into inflamed tissue or tumor-cell migration to distant tissues.¹⁵ Altered glycosylation patterns of cancer cells might give rise to anticarbohydrate antibodies that could be used as serologic tumor markers.^{15,16} Our glycan microarray included many well known tumor-associated glycans, including gangliosides. The healthy blood donors who contributed to the pooled IVIG do not appear to produce significant levels of antibodies against these gangliosides, suggesting that the appearance and detection of such antibodies in a patient might be diagnostically useful. Therefore, the data presented here set the stage for future investigations into the diagnostic utility of measuring antiglycan antibodies in various disease states, and point to the potential use of novel carbohydrate-based vaccines to enhance pathogen and cancer immunity.

TABLE II. The top 20 Glycans Bound by Antibodies in IVIg Recognizing Bacterial Carbohydrate Structures that are Listed in the Bacterial Carbohydrate Structure Data Base (BCSDB; <http://www.glyco.ac.ru/bcsdb/start.shtml>).

Glycan #	Glycan Name	LPS / LOS		LTA		CPS				EPS				Other				Predominant Ab Isotype	
		gram -		gram +		gram +		gram -		gram +		gram -		gram +		gram -			
		Comm./		Comm./		Comm./		Comm./		Comm./		Comm./		Comm./		Comm./			
		Pathogen	Environ.	Pathogen	Environ.	Pathogen	Environ.	Pathogen	Environ.	Pathogen	Environ.	Pathogen	Environ.	Pathogen	Environ.	Pathogen	Environ.	Non-IgG ₂	IgG ₂
166	¹ GlcNAcβ1-4MD P-Lys												+	+				+	
83	GalNAcα1- 3GalNAcβ (Forssman (Fs) disaccharide)	+		+		+								+				+	
224	Neu5Acα2-3Galβ 1-3GlcNAcβ					+												+	
32	[su]3Galβ1- 3GlcNAcβ									+									
12	α-L-Rha	+	+			+	+	+	+	+		+	+	+	+	+	+	+	
102	Galα1-3Galβ 1-3GlcNAcβ														+			+	
147	Galβ1-4GlcNAcβ 1-3Galβ1-4Glcβ	+				+										+			
112	Galβ1-2Galβ	+			+					+								+	
92	Galα1-2Galβ	+				+		+										+	
130	Galβ1-3GlcNAcβ 1-3Galβ1-4Glcβ		+			+													
131	Galβ1-3GlcNAcβ	+	+			+		+		+									
256	Neu5Gcα2-3Galβ 1-3GlcNAcβ					+	+											+	
74	Fucα1-3GlcNAcβ	+					+											+	
171	GlcNAcβ1-4GlcNA cβ1-4GlcNAcβ		+							+	+								
187	Manα1-2Manα 1-2Manα1-3Manα	+	+																
179	Glcβ1-6Glcβ (Gentiobiose)	+			+	+			+	+		+		+				+	
111	Galα1-6Glcβ (Melibiose)	+					+			+		+						+	
77	GalNAcα1-3(Fucα1- 2)Galβ1- 3GlcNAcβ	+																+	
100	Galα1-3GalNAcβ	+	+			+												+	
84	GalNAcα1-3Galβ	+								+									

¹A fragment of peptidoglycan containing GlcNAcβ1-4MurAc coupled to the array through a lysine.IgG₂ subclass distribution of binding antibody is based on data of IgG₂-depletion experiments as described. IgG₂ predominance was defined as IgG₂-depleted-IVIg signal intensity of total IVIg < 33.3 %, and > 66.6 % for non-IgG₂ predominance. *CPS*, Capsular polysaccharides; *EPS*, exopolysaccharides; *LPS*, lipopolysaccharides; *LOS*, lipooligosaccharides; *LTA*, lipoteichoic acid; *Comm.*, commensal; *Environ.*, environmental; *Ab*, antibody

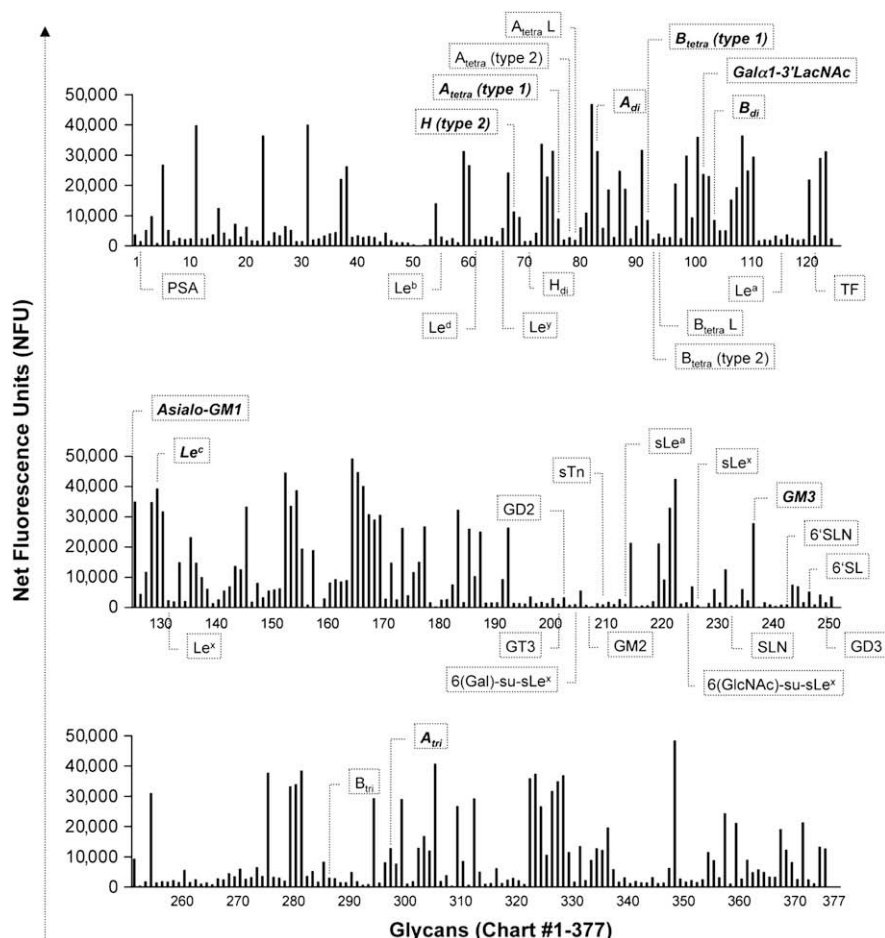


FIG 5. Recognition of known autologous glycans by IVIG. IVIG contained antibodies to blood group antigens H, A, and B. Notably absent, however, were antibodies to selectin ligands, Siglec ligands, and cancer-associated glycans, such as sLe^x, sialyl Lewis a (sLe^a), 6(Gal)-su-sLe^x, 6(GlcNAc)-su-sLe^x, polysialic acid (PSA), sTn, Lewis y (Le^y), and the gangliosides GD2, GD3, fucosyl GM1, and GM2. The detailed structures of each of the glycans mentioned in this figure can be found in Table E2.

Clinical implications: IVIG, and presumably sera from normal individuals, contains many types of IgG antibodies (both IgG₂ and others) recognizing carbohydrate structures. This suggests that normal immunity involves making IgG responses to many different naturally occurring foreign glycans.

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TABLE E1. Comprehensive list of glycans bound by antibodies contained in IVIG arranged in decreasing order of average binding activity

Glycan no.	Masterlist name	Net fluorescence units			Average	SEM
		Sandoglobulin (mean)	Privigen (mean)	Gammunex (mean)		
350	Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-3[Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	48,478	49,208	47,846	48,511	557
166	GlcNAcβ1-4MDPLys	49,248	44,222	42,953	45,475	2,718
154	GlcNAcα1-3Galβ1-4GlcNAcβ	44,652	41,549	44,768	43,656	1,491
167	GlcNAcβ1-4(GlcNAcβ1-6)GalNAcα	44,791	42,589	42,158	43,179	1,153
83	GalNAcα1-3GalNAcβ	46,913	41,898	40,319	43,043	2,812
224	Neu5Acα2-3Galβ1-3GlcNAcβ	42,560	41,737	35,903	40,067	2,963
156	GlcNAcβ1-2Galβ1-3GalNAcα	38,808	42,989	37,997	39,931	2,187
307	HOOC(CH ₃)CH-3-O-GlcNAcβ1-4GlcNAcβ	40,792	38,600	38,355	39,249	1,096
324	NeuAc(9Ac)α2-3Galβ1-3GlcNAcβ	35,989	45,272	31,884	37,715	5,600
32	[3OSO ₃]Galβ1-3GlcNAcβ	40,124	41,628	30,224	37,326	5,059
283	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-3GlcNAcβ	38,558	38,927	32,376	36,620	3,005
110	Galα1-4GlcNAcβ	36,518	38,687	33,955	36,387	1,934
223	Neu5Acα2-3Galβ1-3GlcNAcβ	33,050	43,183	32,744	36,326	4,851
12	α-L-Rha	39,964	34,151	34,807	36,308	2,599
325	NeuAcα2-6Galβ1-4GlcNAcβ1-3Galβ1-3GlcNAcβ	37,472	36,108	29,887	34,489	3,301
24	GlcNAcβ1-3(GlcNAcβ1-4)(GlcNAcβ1-6)GlcNAc	36,572	37,350	27,618	33,846	4,416
282	Neu5Acα2-3Galβ1-3GlcNAcβ1-3Galβ1-3GlcNAcβ	34,023	34,962	27,041	32,008	3,534
102	Galα1-3Galβ1-3GlcNAcβ	36,030	31,401	27,631	31,687	3,435
147	Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ	33,402	31,560	29,834	31,599	1,457
168	GlcNAcβ1-4Galβ1-4GlcNAcβ	40,247	30,117	23,867	31,410	6,749
330	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	36,997	23,339	31,538	30,625	5,613
326	NeuAcα2-3Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-3(Fucα1-4)GlcNAcβ	26,759	34,551	29,454	30,254	3,231
112	Galβ1-2Galβ	29,555	31,210	29,785	30,183	732
60	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ	31,378	31,050	27,471	29,966	1,769
314	Neu5Acα2-3Galβ1-3(Neu5Acα2-6)GalNAc	29,349	32,104	27,618	29,690	1,847
92	Galα1-2Galβ	31,726	30,595	25,703	29,341	2,614
185	KDNα2-3Galβ1-3GlcNAcβ	32,382	29,392	25,441	29,072	2,843
329	GalNAcβ1-3Galα1-4Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ	34,991	37,472	14,474	28,979	10,307
376	Galβ1-3GalNAcα1-3(Fucα1-2)Galβ1-4Glc	13,363	40,566	32,866	28,931	11,449
170	(GlcNAcβ1-4)5b	29,129	32,423	24,646	28,733	3,187
130	Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ	34,955	29,369	21,665	28,663	5,448
131	Galβ1-3GlcNAcβ	39,342	25,809	20,597	28,583	7,900
277	Galβ1-3GlcNAcβ1-3Galβ1-3GlcNAcβ	37,810	35,276	11,170	28,086	12,006
328	Galα1-4Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ	31,838	33,168	18,568	27,858	6,591
194	Manα1-3(Manα1-2Manα1-2Manα1-6)Manα	26,448	27,688	28,050	27,395	686
169	(GlcNAcβ1-4)6β	30,873	26,284	22,040	26,399	3,607
124	Galβ1-3GalNAcβ	29,160	24,257	25,195	26,204	2,125
125	Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ	31,300	28,983	17,682	25,988	5,949
256	Neu5Gcα2-3Galβ1-3GlcNAcβ	31,100	28,913	17,952	25,988	5,752
127	Galβ1-3GalNAcβ1-4Galβ1-4Glcβ	35,084	20,892	20,632	25,536	6,752
311	Manα1-2Manα1-2Manα1-3(Manα1-2Manα1-6(Manα1-3)Manα1-6)Manα	26,808	26,338	22,089	25,078	2,122
74	Fucα1-3GlcNAcβ	33,770	23,433	16,967	24,723	6,920
171	GlcNAcβ1-4GlcNAcβ1-4GlcNAcβ	30,720	26,831	15,792	24,448	6,323
187	Manα1-2Manα1-2Manα1-3Manα	26,125	25,392	21,591	24,369	1,987
179	Glcβ1-6Glcβ	26,884	21,931	23,116	23,977	2,112
359	Galα1-3Galβ1-4GlcNAcβ1-2Manα1-3(Galα1-3Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	24,413	31,937	15,408	23,919	6,757
111	Galα1-6Glcβ	24,995	25,206	21,506	23,902	1,697
216	NeuAcα2-3Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	21,409	22,766	26,819	23,664	2,298
77	GalNAcα1-3(Fucα1-2)Galβ1-3GlcNAcβ	9,082	36,214	24,788	23,361	11,123
100	Galα1-3GalNAcβ	29,928	23,406	16,703	23,346	5,399
61	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ	26,736	23,073	19,680	23,163	2,881
373	NeuAcα2-6Galβ1-4GlcNAcβ1-3GalNAc	21,412	25,932	22,067	23,137	1,994
88	GalNAcβ1-3Galα1-4Galβ1-4GlcNAcβ	24,887	29,061	15,054	23,000	5,872
84	GalNAcα1-3Galβ	31,365	19,860	17,466	22,897	6,067
76	Fucβ1-3GlcNAcβ	31,433	25,568	11,632	22,877	8,305
361	Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-3[Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4(Fucα1-6)GlcNAcβ	21,225	23,809	22,905	22,646	1,071
301	GlcAβ1-3GlcNAcβ	29,120	23,794	13,719	22,211	6,386
238	Neu5Acα2-3Galβ1-4Glcβ	27,934	23,476	14,828	22,079	5,441

(Continued)

TABLE E1. (Continued)

Glycan no.	Masterlist name	Net fluorescence units			Average	SEM
		Sandoglobulin (mean)	Privigen (mean)	Gammunex (mean)		
281	Galβ1-4GlcNAcβ1-3Galβ1-3GlcNAcβ	33,291	19,662	12,849	21,934	8,498
175	Glcα1-4Glcβ	26,356	18,555	20,467	21,793	3,320
75	Fucα1-4GlcNAcβ	23,005	21,896	19,506	21,469	1,460
370	Galα1-3(Fucα1-2)Galβ1-3GlcNAcβ1-2Manα1-3[Galα1-3(Fucα1-2)Galβ1-3GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	12,385	36,752	14,414	21,184	11,040
221	NeuAcα2-3Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ	21,246	22,866	16,631	20,248	2,642
155	GlcNAcα1-6Galβ1-4GlcNAcβ	33,685	13,839	12,972	20,165	9,566
98	Galα1-3(Galα1-4)Galβ1-4GlcNAcβ	20,681	26,053	13,406	20,047	5,183
377	Galβ1-3GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAc	12,796	25,606	21,643	20,015	5,355
296	Galβ1-4GlcNAcα1-6Galβ1-4GlcNAcβ	29,426	19,294	11,202	19,974	7,455
189	Manα1-2Manα1-3Manα	25,116	18,888	15,074	19,693	4,139
122	Galβ1-3(Neu5Acα2-6)GlcNAcβ1-4Galβ1-4Glcβ	21,990	21,160	15,407	19,519	2,927
157	GlcNAcβ1-3(GlcNAcβ1-6)GalNAcα	19,539	24,797	12,352	18,896	5,101
132	Galβ1-3GlcNAcβ	31,808	13,650	10,351	18,603	9,434
86	GalNAcβ1-3GalNAcα	18,678	24,027	12,152	18,286	4,856
159	GlcNAcβ1-3GalNAcα	19,058	22,395	13,387	18,280	3,718
103	Galα1-3Galβ1-4GlcNAcβ	23,866	24,511	6,231	18,203	8,469
135	Galβ1-4(Fucα1-3)GlcNAcβ1-4Galβ1-4(Fucα1-3)GlcNAcβ	15,021	23,121	15,231	17,791	3,770
137	Galβ1-4[6OSO3]Glcβ	23,310	18,185	11,319	17,605	4,913
104	Galα1-3Galβ1-4Glcβ	23,150	16,200	12,463	17,271	4,428
6	α-D-Gal	26,853	13,523	11,431	17,269	6,831
337	GlcNAcα1-4Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	12,310	18,151	19,468	16,643	3,111
109	Galα1-4Galβ1-4Glcβ	19,474	18,078	11,976	16,509	3,256
89	GalNAcβ1-4(Fucα1-3)GlcNAcβ	18,867	16,367	11,424	15,553	3,093
369	GalNAcα1-3(Fucα1-2)Galβ1-3GlcNAcβ1-2Manα1-3[GalNAcα1-3(Fucα1-2)Galβ1-3GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	19,196	14,050	12,527	15,257	2,853
39	[4OSO3]Galβ1-4GlcNAcβ	26,373	13,148	5,314	14,945	8,691
338	GlcNAcα1-4Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	19,770	10,531	13,624	14,642	3,840
81	GalNAcα1-3(Fucα1-2)Galβ1-4Glcβ	6,202	19,778	16,697	14,226	5,811
38	[4OSO3][6OSO3]Galβ1-4GlcNAcβ	22,190	16,198	3,342	13,910	7,863
178	Glcβ1-4Glcβ	15,165	15,689	10,835	13,896	2,175
68	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAc	24,321	4,748	12,573	13,881	8,044
138	Galβ1-4[6OSO3]Glcβ	14,889	17,033	9,595	13,839	3,126
331	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	11,643	15,977	13,399	13,673	1,780
93	Galα1-3(Fucα1-2)Galβ1-3GlcNAcβ	8,646	19,897	12,044	13,529	4,712
55	Fucα1-2Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ	14,149	16,733	9,168	13,350	3,140
366	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-2Manα1-3[GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	5,075	19,306	15,228	13,203	5,984
233	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	12,698	13,876	13,013	13,196	498
299	GalNAcα1-3(Fucα1-2)Galβ	12,994	13,575	12,981	13,183	277
177	Glcα1-6Glcα1-6Glcβ	11,756	17,401	9,830	12,996	3,212
82	GalNAcα1-3(Fucα1-2)Galβ	11,048	12,318	14,986	12,784	1,641
173	GlcNAcβ1-6GalNAcα	14,837	16,987	6,257	12,694	4,635
146	Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ	12,648	15,516	9,845	12,670	2,315
79	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ	2,941	20,308	14,568	12,606	7,225
305	GlcNAcβ1-4GlcNAcβ	16,920	9,306	9,821	12,016	3,474
253	Neu5Acβ2-6Galβ1-4GlcNAcβ	9,416	21,221	5,265	11,967	6,759
80	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ	2,058	21,456	12,380	11,964	7,925
188	Manα1-2Manα1-3(Manα1-2Manα1-6)Manα	10,393	15,421	9,406	11,740	2,634
336	GlcNAcα1-4Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ	12,889	13,461	7,948	11,433	2,475
4	Galβ1-3GlcNAcβ1-2Manα1-3(Galβ1-3GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	9,892	12,672	11,226	11,263	1,135
248	Neu5Acα2-6Galβ1-4Glcβ	5,328	16,867	10,742	10,979	4,714
108	Galα1-4Galβ1-4GlcNAcβ	15,332	9,421	7,257	10,670	3,413
193	Manα1-3(Manα1-6)Manα	9,456	13,707	7,565	10,243	2,568
16	β-D-Gal	12,620	10,415	7,455	10,163	2,116
367	Galα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-2Manα1-3[Galα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	3,489	14,425	11,303	9,739	4,600

(Continued)

TABLE E1. (Continued)

Glycan no.	Masterlist name	Net fluorescence units			Average	SEM
		Sandoglobulin (mean)	Privigen (mean)	Gammunex (mean)		
357	Fucα1-2Galβ1-4GlcNAcβ1-2Manα1-3(Fucα1-2Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	8,927	9,778	10,051	9,585	478
288	Galα1-3(Fucα1-2)Galβ	3,161	19,838	5,689	9,563	7,339
327	NeuAcα2-6Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	10,690	8,523	9,023	9,412	926
245	Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	7,588	11,787	8,610	9,328	1,788
145	Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	13,800	5,514	7,798	9,038	3,494
335	GlcNAcα1-4Galβ1-3GlcNAcβ	9,021	11,171	6,656	8,949	1,844
304	GlcNAcβ1-3Man	13,033	7,900	5,724	8,886	3,064
287	6-H2PO3Glcβ	8,447	10,586	6,980	8,671	1,480
139	Galβ1-4GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ	10,147	8,161	7,369	8,559	1,169
356	Fucα1-2Galβ1-3GlcNAcβ1-2Manα1-3(Fucα1-2Galβ1-3GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	11,592	6,167	7,711	8,490	2,282
306	GlcNAcβ1-4GlcNAcβ	12,077	6,827	6,090	8,332	2,666
184	GlcAβ1-6Galβ	7,680	11,471	5,752	8,301	2,376
227	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	7,029	9,128	8,425	8,194	872
333	GlcNAcα1-4Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	13,563	4,220	6,632	8,138	3,960
95	Galα1-3(Fucα1-2)Galβ1-4GlcNAc	4,155	11,362	8,407	7,975	2,958
70	Fucα1-2Galβ1-4GlcNAcβ	9,656	4,665	9,164	7,828	2,246
165	GlcNAcβ1-3Galβ1-4Glcβ	9,165	6,501	7,283	7,650	1,118
365	Galβ1-4GlcNAcβ1-2(Galβ1-4GlcNAcβ1-4)Manα1-3[Galβ1-4GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAc	5,864	8,875	8,209	7,650	1,291
262	Neu5Gcα	5,683	9,767	7,429	7,626	1,673
129	Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ	11,814	2,792	7,730	7,445	3,689
312	Manα1-2Manα1-2Manα1-3(Manα1-2Manα1-6(Manα1-2Manα1-3)Manα1-6)Manα	8,684	8,451	4,993	7,376	1,688
19	β-GalNAc	7,363	8,807	5,593	7,254	1,314
101	Galα1-3Galβ1-4(Fucα1-3)GlcNAcβ	9,474	7,287	4,785	7,182	1,915
207	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ	5,679	7,421	8,295	7,132	1,087
298	GalNAcα	8,236	8,138	4,835	7,070	1,581
69	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	11,388	3,262	6,505	7,052	3,340
300	GalNAcβ1-3Galβ	7,780	6,683	6,203	6,889	660
339	GlcNAcα1-4Galβ1-3GalNAc	6,001	7,522	6,922	6,815	625
105	Galα1-3Galβ	8,682	7,147	4,565	6,798	1,699
149	Galβ1-4GlcNAcβ1-6GalNAcα	8,236	7,244	4,786	6,755	1,450
7	α-D-Glc	5,338	7,006	7,712	6,685	996
371	Fucα1-2Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-3[Fucα1-2Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	8,333	4,839	6,716	6,629	1,428
78	GalNAcα1-3(Fucα1-2)Galβ1-4(Fucα1-3)GlcNAcβ	2,163	10,278	6,813	6,418	3,325
349	Galβ1-3GlcNAcβ1-2Manα1-3(Galβ1-3GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4(Fucα1-6)GlcNAcβ	6,425	5,927	6,868	6,407	385
275	Galβ1-3-(Neu5Acα2-3Galβ1-4GlcNAcβ1-6)GalNAc	6,575	7,502	5,070	6,382	1,002
67	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ	5,942	6,116	6,874	6,311	405
28	[3OSO3]Galβ1-4(6OSO3)Glcβ	6,581	9,042	3,120	6,248	2,429
143	Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	5,653	7,078	5,910	6,214	620
231	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4GlcNAcβ	6,195	7,135	5,276	6,202	759
140	Galβ1-4GalNAcβ1-3(Fucα1-2)Galβ1-4GlcNAcβ	6,233	9,005	3,346	6,195	2,311
21	β-GlcNAc	6,391	7,356	4,814	6,187	1,048
222	NeuAcα2-3Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ	9,321	3,554	5,538	6,138	2,392
363	Neu5Acα2-6GlcNAcβ1-4GlcNAcβ1-4GlcNAc	9,059	5,177	4,099	6,112	2,130
163	GlcNAcβ1-3Galβ1-4GlcNAcβ	9,461	2,470	5,924	5,952	2,854
152	Galβ1-4Glcβ	6,044	5,858	5,109	5,670	404
162	GlcNAcβ1-3Galβ1-4GlcNAcβ	8,266	3,093	5,639	5,666	2,112
164	GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	8,626	3,778	4,531	5,645	2,130
153	Galβ1-4Glcβ	6,405	5,604	4,723	5,577	687
315	Neu5Acα2-3Galβ1-3GalNAc	5,111	6,367	4,784	5,421	682
97	Galα1-3(Fucα1-2)Galβ	2,993	10,457	2,762	5,404	3,575
3	Neu5Gcb2-6Galβ1-4GlcNAc	5,339	7,251	3,390	5,327	1,576
272	Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-3(Fucα1-4)GlcNAcβ	6,095	3,704	6,071	5,290	1,122
46	[6OSO3]GlcNAcβ	4,517	6,329	4,449	5,099	871

(Continued)

TABLE E1. (Continued)

Glycan no.	Masterlist name	Net fluorescence units			Average	SEM
		Sandoglobulin (mean)	Privigen (mean)	Gammunex (mean)		
246	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-3Gal β 1-4GlcNAc β	7,079	2,965	5,121	5,055	1,680
176	Glc α 1-4Glc α	4,156	5,442	4,900	4,833	527
236	Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-3Gal β 1-4GlcNAc β	6,168	2,900	5,430	4,833	1,399
73	Fuc α 1-2Gal β	4,400	5,609	4,365	4,791	579
358	Fuc α 1-2Gal β 1-4(Fuc α 1-3)GlcNAc β 1-2Man α 1-3[Fuc α 1-2Gal β 1-4(Fuc α 1-3)GlcNAc β 1-2Man α 1-6]Man β 1-4GlcNAc β 1-4GlcNAc β	3,250	6,116	4,983	4,783	1,179
318	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-3(GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	6,299	3,984	3,955	4,746	1,098
364	Fuc α 1-2Gal β 1-3GlcNAc β 1-3[Gal β 1-4(Fuc α 1-3)GlcNAc β 1-6]Gal β 1-4GlcNAc β	4,987	6,423	2,823	4,744	1,480
151	Gal β 1-4GlcNAc β	5,656	5,459	3,076	4,730	1,172
20	β -GlcNAc	3,160	7,785	3,093	4,679	2,196
85	GalNAc α 1-4(Fuc α 1-2)Gal β 1-4GlcNAc β	6,023	5,387	2,577	4,662	1,497
65	Fuc α 1-2Gal β 1-4(Fuc α 1-3)GlcNAc β 1-3Gal β 1-4(Fuc α 1-3)GlcNAc β 1-3Gal β 1-4(Fuc α 1-3)GlcNAc	3,106	6,480	4,150	4,579	1,411
17	β -D-Glc	4,481	6,406	2,830	4,572	1,461
91	GalNAc β 1-4GlcNAc β	6,692	3,156	3,754	4,534	1,545
270	Fuc α 1-2-(6OSO $_3$)-Gal β 1-4Glc	4,596	4,816	4,089	4,500	305
96	Gal α 1-3(Fuc α 1-2)Gal β 1-4Glc β	2,851	5,593	5,052	4,499	1,186
144	Gal β 1-4GlcNAc β 1-3Gal β 1-4GlcNAc β 1-3Gal β 1-4GlcNAc β	7,055	1,677	4,333	4,355	2,196
106	Gal α 1-4(Fuc α 1-2)Gal β 1-4GlcNAc β	5,288	3,555	4,166	4,336	718
128	Gal β 1-3Gal β	4,580	5,525	2,746	4,284	1,154
37	[3OSO $_3$]Gal β	4,653	4,090	3,881	4,208	326
285	[3OSO $_3$][4OSO $_3$]Gal β 1-4GlcNAc β	5,305	4,016	3,196	4,172	868
15	β -Neu5Ac	3,858	5,537	2,982	4,126	1,060
29	[3OSO $_3$]Gal β 1-4(6OSO $_3$)Glc β	5,359	4,894	2,077	4,110	1,450
292	Gal β 1-3Gal β 1-4GlcNAc β	5,016	3,794	3,165	3,992	769
271	Fuc α 1-2-Gal β 1-4[6OSO $_3$]Glc	3,611	3,961	4,249	3,940	261
276	Gal β 1-3GalNAc	3,715	3,747	4,166	3,876	206
107	Gal α 1-4Gal β 1-4GlcNAc β	5,285	2,602	3,628	3,839	1,105
123	Gal β 1-3GalNAc α	3,573	3,563	4,077	3,738	240
36	[3OSO $_3$]Gal β 1-4GlcNAc β	4,226	3,773	3,153	3,717	440
202	Neu5Ac α 2-8Neu5Ac α 2-8Neu5Ac α 2-3(GalNAc β 1-4)Gal β 1-4Glc β	3,239	4,040	3,686	3,655	328
355	KDN α 2-3Gal β 1-3GalNAc α	2,681	3,677	4,345	3,568	684
11	α -L-Fuc	2,526	5,053	3,089	3,556	1,083
1	Neu5Ac α 2-8Neu5Ac β	3,864	3,749	3,032	3,548	368
274	Gal β 1-3(GlcNAc β 1-6)GalNAc	3,333	5,088	2,217	3,546	1,182
64	Fuc α 1-2Gal β 1-4(Fuc α 1-3)GlcNAc β 1-3Gal β 1-4(Fuc α 1-3)GlcNAc β	3,312	3,981	3,198	3,497	346
346	Gal β 1-4GlcNAc β 1-2Man α 1-3(Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	3,340	4,017	3,060	3,472	402
136	Gal β 1-4(Fuc α 1-3)GlcNAc β 1-4Gal β 1-4(Fuc α 1-3)GlcNAc β 1-4Gal β 1-4(Fuc α 1-3)GlcNAc β	2,246	5,211	2,958	3,471	1,264
374	NeuAc α 2-3[Fuc α 1-3]Gal β 1-4GlcNAc β 1-3GalNAc	2,591	3,861	3,792	3,414	583
118	Gal β 1-3(Gal β 1-4GlcNAc β 1-6)GalNAc α	3,844	3,273	3,059	3,392	331
250	Neu5Ac α 2-8Neu5Ac α	4,342	2,799	3,020	3,387	681
362	Neu5Ac α 2-6GlcNAc β 1-4GlcNAc	2,867	4,527	2,737	3,377	815
27	[3OSO $_3$]Gal β 1-4Glc β	3,591	3,512	3,009	3,370	258
182	GlcAb	2,643	4,299	3,113	3,352	697
26	[3OSO $_3$][6OSO $_3$]Gal β 1-4GlcNAc β	4,529	2,924	2,586	3,346	847
161	GlcNAc β 1-3Gal β 1-3GalNAc α	3,053	4,818	2,126	3,332	1,117
40	6-H $_2$ PO $_3$ Man α	3,069	4,101	2,725	3,298	585
204	Neu5Ac α 2-8Neu5Ac α 2-3(GalNAc β 1-4)Gal β 1-4Glc β	3,411	3,854	2,411	3,226	604
321	Gal β 1-3(Neu5Ac α 2-6)GalNAc α	3,073	3,963	2,553	3,196	582
56	Fuc α 1-2Gal β 1-3(Fuc α 1-4)GlcNAc β	3,157	2,999	3,425	3,194	176
183	GlcA β 1-3Gal β	2,842	4,200	2,442	3,161	753
174	GlcNAc β 1-6Gal β 1-4GlcNAc β	2,811	3,565	3,090	3,155	311
150	Gal β 1-4GlcNAc β	3,446	2,823	3,101	3,123	255
172	GlcNAc β 1-6(Gal β 1-3)GalNAc α	2,970	3,369	2,942	3,094	195
35	[3OSO $_3$]Gal β 1-4GlcNAc β	3,470	3,068	2,602	3,047	355
126	Gal β 1-3GalNAc β 1-4(Neu5Ac α 2-3)Gal β 1-4Glc β	2,606	2,848	3,676	3,043	458
290	Gal β 1-3GalNAc α	1,644	3,982	3,468	3,031	1,003
44	[6OSO $_3$]Gal β 1-4[6OSO $_3$]Glc β	2,969	2,920	3,192	3,027	118
264	[3OSO $_3$]Gal β 1-4(Fuc α 1-3)Glc	2,634	3,159	3,272	3,021	278
198	Man β 1-4GlcNAc β	3,741	2,736	2,576	3,018	516

(Continued)

TABLE E1. (Continued)

Glycan no.	Masterlist name	Net fluorescence units			Average	SEM
		Sandoglobulin (mean)	Privigen (mean)	Gammunex (mean)		
284	[3OSO3]Galβ1-4[6OSO3]GlcNAcβ	3,691	2,042	3,317	3,017	706
43	[6OSO3]Galβ1-4GlcNAcβ	3,377	2,884	2,752	3,005	269
309	Manα1-6Manβ	3,982	2,406	2,585	2,991	705
260	Neu5Gcα2-6GalNAcα	2,398	3,880	2,679	2,986	642
8	α-D-Man	1,735	4,259	2,924	2,973	1,031
278	Galβ1-4[Fucα1-3][6OSO3]GlcNAc	3,409	2,451	3,042	2,967	395
18	β-D-Man	2,362	3,594	2,918	2,958	504
289	Galα1-3GalNAcα	3,022	3,187	2,602	2,937	246
121	Galβ1-3(Neu5Acβ2-6)GalNAcα	2,372	3,120	3,276	2,923	394
34	[3OSO3]Galβ1-4[6OSO3]GlcNAcβ	2,515	2,277	3,950	2,914	739
41	[6OSO3]Galβ1-4Glcβ	3,552	2,901	2,207	2,886	549
252	Neu5Acβ2-6GalNAcα	3,720	2,745	2,128	2,865	655
348	Galβ1-4GlcNAcβ1-2Manα1-3(Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4(Fucα1-6)GlcNAcβ	1,531	3,778	3,196	2,835	952
116	Galβ1-3(Fucα1-4)GlcNAc	3,476	1,969	3,042	2,829	633
42	[6OSO3]Galβ1-4Glcβ	3,008	2,691	2,646	2,782	161
351	(6SO3)GlcNAcβ1-3Gal β1-4GlcNAcβ	2,867	3,316	2,084	2,756	509
94	Galα1-3(Fucα1-2)Galβ1-4(Fucα1-3)GlcNAcβ	2,349	2,781	3,030	2,720	281
62	Fucα1-2Galβ1-3GlcNAcβ	2,337	3,256	2,461	2,685	407
87	GalNAcβ1-3(Fucα1-2)Galβ	2,990	2,485	2,543	2,673	225
9	α-GalNAc	2,729	2,969	2,204	2,634	319
273	Galβ1-3-(Galβ1-4GlcNAcβ1-6)GalNAc	2,815	2,841	2,196	2,618	298
54	Fucα1-2Galβ1-3GalNAcβ1-3Gala	2,370	2,657	2,734	2,587	157
58	Fucα1-2Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ	2,650	2,309	2,781	2,580	199
148	Galβ1-4GlcNAcβ1-6(Galβ1-3)GalNAcα	1,989	2,339	3,357	2,562	580
341	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAc	3,315	3,113	1,208	2,546	949
133	Galβ1-4(Fucα1-3)GlcNAcβ	2,516	2,618	2,447	2,527	71
10	α-L-Fuc	2,297	2,902	2,295	2,498	286
214	Neu5Acα2-3Galβ1-3(6OSO3)GlcNAc	2,840	1,941	2,690	2,490	394
279	Galβ1-4[Fucα1-3][6OSO3]Glc	3,141	1,959	2,328	2,476	494
268	Fucα1-2Galβ1-4[6OSO3]GlcNAc	2,907	2,349	2,145	2,467	322
33	[3OSO3]Galβ1-4(Fucα1-3)GlcNAcβ	2,156	2,425	2,684	2,422	216
269	Fucα1-2[6OSO3]Galβ1-4[6OSO3]Glc	2,549	2,790	1,923	2,421	366
353	KDNα2-6Galβ1-4GlcNAc	2,378	2,021	2,832	2,410	332
134	Galβ1-4(Fucα1-3)GlcNAcβ	2,088	2,492	2,566	2,382	210
90	GalNAcβ1-4GlcNAcβ	2,540	2,482	2,089	2,371	200
334	GlcNAcα1-4Galβ1-4GlcNAcβ	2,364	2,635	1,972	2,324	272
220	Neu5Acα2-3Galβ	2,176	2,731	1,945	2,284	330
368	Galα1-3Galβ1-4(Fucα1-3)GlcNAcβ1-2Manα1-3[Galα1-3Galβ1-4(Fucα1-3)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	3,453	1,552	1,818	2,274	841
120	Galβ1-3(Neu5Acα2-6)GalNAcα	2,116	2,432	2,185	2,244	136
99	Galα1-3GalNAcα	2,630	2,463	1,625	2,239	440
313	Neu5Acα2-3Galβ1-3(Neu5Acα2-3Galβ1-4GlcNAcβ1-6)GalNAc	788	3,018	2,890	2,232	1,022
255	Neu5Gcα2-3Galβ1-3(Fucα1-4)GlcNAcβ	1,947	2,456	2,240	2,214	209
113	Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	1,878	2,548	2,215	2,214	274
186	KDNα2-3Galβ1-4GlcNAcβ	1,902	2,229	2,479	2,203	236
13	α-Neu5Ac	2,558	1,654	2,374	2,195	390
63	Fucα1-2Galβ1-3GlcNAcβ	2,201	2,475	1,822	2,166	268
142	Galβ1-4GlcNAcβ1-3GalNAcα	2,814	1,659	1,947	2,140	491
237	Neu5Acα2-3Galβ1-4Glcβ	2,440	1,893	2,073	2,135	228
258	Neu5Gcα2-3Galβ1-4GlcNAcβ	2,007	2,443	1,953	2,134	220
291	Galβ1-3(Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-6)GalNAc	1,660	2,357	2,351	2,123	327
280	Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-3(Fucα1-4)GlcNAcβ	2,149	1,811	2,401	2,120	242
247	Neu5Acα2-6Galβ1-4Glcβ	1,867	2,219	2,203	2,096	162
293	Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	2,036	2,073	2,162	2,090	53
308	Manα1-3(Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	2,074	2,150	2,029	2,084	50
23	(Galβ1-4GlcNAcβ)2-3,6-GalNAcα	1,794	2,341	2,117	2,084	224
347	GlcNAcβ1-2Manα1-3(GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4(Fucα1-6)GlcNAcβ	1,384	2,196	2,573	2,051	496

(Continued)

TABLE E1. (Continued)

Glycan no.	Masterlist name	Net fluorescence units			Average	SEM
		Sandoglobulin (mean)	Privigen (mean)	Gammunex (mean)		
319	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,412	2,589	2,147	2,049	485
14	α -Neu5Ac	2,615	1,768	1,696	2,026	417
249	Neu5Ac α 2-6Gal β	1,107	2,416	2,504	2,009	639
114	Gal β 1-3(Fuc α 1-4)GlcNAc β 1-3Gal β 1-4GlcNAc β	2,226	2,098	1,687	2,004	230
332	(Neu5Ac α 2-3-Gal β 1-3)((Neu5Ac α 2-3-Gal β 1-4(Fuc α 1-3))GlcNAc β 1-6)GalNAc	1,857	1,850	2,301	2,003	211
257	Neu5Gc α 2-3Gal β 1-4(Fuc α 1-3)GlcNAc β	1,581	2,091	2,335	2,002	314
259	Neu5Gc α 2-3Gal β 1-4Glc β	1,846	2,120	2,026	1,998	114
115	Gal β 1-3(Fuc α 1-4)GlcNAc	2,023	2,274	1,691	1,996	239
72	Fuc α 1-2Gal β 1-4Glc β	1,779	2,767	1,399	1,982	577
30	[3OSO3]Gal β 1-3(Fuc α 1-4)GlcNAc β	1,649	2,252	1,979	1,960	247
66	Fuc α 1-2Gal β 1-4(Fuc α 1-3)GlcNAc β	1,680	2,268	1,818	1,922	251
372	NeuAc α 2-3Gal β 1-4GlcNAc β 1-3GalNAc	2,744	1,760	1,259	1,921	617
119	Gal β 1-3(GlcNAc β 1-6)GalNAc α	2,624	1,377	1,759	1,920	522
303	GlcNAc β 1-2Man α 1-3(GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,992	1,976	1,777	1,915	97
232	Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-3Gal β 1-4(Fuc α 1-3)GlcNAc	1,704	2,064	1,916	1,895	148
117	Gal β 1-3(Fuc α 1-4)GlcNAc β	2,293	1,446	1,922	1,887	346
45	NeuAc α 2-3[6OSO3]Gal β 1-4GlcNAc β	1,520	2,469	1,632	1,874	423
57	Fuc α 1-2Gal β 1-3GalNAc α	1,878	1,588	2,155	1,874	231
190	Man α 1-6(Man α 1-2Man α 1-3)Man α 1-6(Man α 2Man α 1-3)Man β 1-4GlcNAc β 1-4GlcNAc β	1,628	2,180	1,812	1,873	230
343	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-3Man β 1-4GlcNAc β 1-4GlcNAc	2,060	2,470	1,088	1,873	579
180	G-ol	1,779	2,686	1,124	1,863	641
22	β -GlcN(Gc)	1,925	2,295	1,295	1,838	413
297	Gal β 1-4GlcNAc β 1-6Gal β 1-4GlcNAc β	1,514	1,962	2,016	1,831	225
25	[3OSO3][6OSO3]Gal β 1-4[6OSO3]GlcNAc β	1,710	1,320	2,437	1,822	463
354	KDN α 2-3Gal β 1-4Glc	1,719	1,960	1,787	1,822	101
320	Fuc α 1-2Gal β 1-3GalNAc α	2,493	1,539	1,374	1,802	493
192	Man α 1-2Man α 1-2Man α 1-3(Man α 1-2Man α 1-3(Man α 1-2Man α 1-6)Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,819	2,482	1,102	1,801	564
261	Neu5Gc α 2-6Gal β 1-4GlcNAc β	1,761	1,732	1,904	1,799	75
263	[3OSO3]Gal β 1-4(Fuc α 1-3)(6OSO3)Glc	1,725	2,171	1,494	1,797	281
199	Fuc α 1-3(Gal β 1-4)GlcNAc β 1-2Man α 1-3(Fuc α 1-3(Gal β 1-4)GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,499	2,424	1,451	1,791	448
322	Gal β 1-4GlcNAc β 1-3GalNAc	2,278	1,441	1,651	1,790	356
375	GalNAc β 1-4GlcNAc β 1-2Man α 1-6(GalNAc β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc	1,287	2,045	2,005	1,779	348
266	[3OSO3]Gal β 1-4[Fuc α 1-3]GlcNAc	1,599	1,755	1,872	1,742	112
47	9NAcNeu5Ac α	1,962	1,411	1,827	1,733	235
286	[6OSO3]Gal β 1-4[6OSO3]GlcNAc β	1,892	1,725	1,542	1,720	143
196	Man α 1-6(Man α 1-3)Man α 1-6(Man α 1-3)Man β 1-4GlcNAc β 1-4GlcNAc β	1,508	1,775	1,823	1,702	139
340	Man α 1-3(Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc	1,840	1,499	1,741	1,693	143
212	Neu5Ac α 2-3GalNAc α	1,939	1,763	1,378	1,693	234
203	Neu5Ac α 2-8Neu5Ac α 2-8Neu5Ac α 2-3Gal β 1-4Glc β	1,285	2,238	1,551	1,691	402
352	KDN α 2-3Gal β 1-4(Fuc α 1-3)GlcNAc	1,875	1,781	1,274	1,643	264
31	[3OSO3]Gal β 1-3GalNAc α	1,659	1,674	1,581	1,638	41
200	Neu5Ac α 2-3Gal β 1-3GalNAc α	1,934	1,586	1,288	1,603	264
191	Man α 1-2Man α 1-6(Man α 1-3)Man α 1-6(Man α 2Man α 2Man α 1-3)Man β 1-4GlcNAc β 1-4GlcNAc β	1,759	1,483	1,530	1,591	121
210	NeuAc α 2-3(NeuAc α 2-3Gal β 1-3GalNAc β 1-4)Gal β 1-4Glc β	1,527	1,777	1,390	1,565	160
197	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,410	1,995	1,244	1,550	322
240	Neu5Ac α 2-6GalNAc α	1,811	1,276	1,505	1,531	219
2	Neu5Ac α 2-8Neu5Ac α 2-8Neu5Ac β	1,646	1,327	1,583	1,519	138
49	Man α 1-3(Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,336	1,569	1,524	1,476	101
195	Man α 1-6(Man α 1-3)Man α 1-6(Man α 2Man α 1-3)Man β 1-4GlcNAc β 1-4GlcNAc β	1,591	1,337	1,475	1,468	104
213	Neu5Ac α 2-3GalNAc β 1-4GlcNAc β	1,137	2,002	1,248	1,462	384
230	Neu5Ac α 2-3Gal β 1-4(Fuc α 1-3)GlcNAc β 1-3Gal β	1,590	1,594	1,195	1,460	187

(Continued)

TABLE E1. (Continued)

Glycan no.	Masterlist name	Net fluorescence units			Average	SEM
		Sandoglobulin (mean)	Privigen (mean)	Gammunex (mean)		
201	Neu5Ac α 2-8Neu5Ac α 2-8Neu5Ac α 2-3(GalNAc β 1-4)Gal β 1-4Glc β	1,516	1,813	978	1,436	346
141	Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,532	1,444	1,197	1,391	142
251	Neu5Ac α 2-8Neu5Ac α 2-3Gal β 1-4Glc β	1,781	1,415	941	1,379	344
323	NeuAc(9Ac) α 2-3Gal β 1-4GlcNAc β	1,119	1,456	1,507	1,361	172
265	[3OSO $_3$]Gal β 1-4[Fuc α 1-3][6OSO $_3$]GlcNAc	1,228	1,366	1,458	1,351	94
360	Man α 1-3(Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,262	1,290	1,477	1,343	96
208	Neu5Ac α 2-3(GalNAc β 1-4)Gal β 1-4GlcNAc β	923	1,663	1,417	1,335	308
158	GlcNAc β 1-3(GlcNAc β 1-6)Gal β 1-4GlcNAc β	1,058	1,534	1,391	1,328	199
244	Neu5Ac α 2-6Gal β 1-4GlcNAc β	1,101	1,724	1,154	1,326	282
302	GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,244	1,636	1,090	1,323	230
243	Neu5Ac α 2-6Gal β 1-4GlcNAc β	990	1,473	1,420	1,294	216
344	Gal β 1-4GlcNAc β 1-2Man α 1-3Man β 1-4GlcNAc β 1-4GlcNAc	1,610	854	1,397	1,287	318
235	Neu5Ac α 2-3Gal β 1-4GlcNAc β	972	1,447	1,425	1,282	219
317	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-3(Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,371	1,731	740	1,281	409
345	Gal β 1-4GlcNAc β 1-2Man α 1-6Man β 1-4GlcNAc β 1-4GlcNAc	1,606	1,029	1,099	1,244	257
342	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6Man β 1-4GlcNAc β 1-4GlcNAc	1,394	1,140	1,187	1,240	110
71	Fuc α 1-2Gal β 1-4GlcNAc β	1,658	863	1,196	1,239	326
267	Fuc α 1-2[6OSO $_3$]Gal β 1-4GlcNAc	967	1,231	1,517	1,238	225
225	Neu5Ac α 2-3Gal β 1-4[6OSO $_3$]GlcNAc β	1,403	797	1,423	1,208	291
5	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,050	1,525	933	1,169	256
226	Neu5Ac α 2-3Gal β 1-4(Fuc α 1-3)(6OSO $_3$)GlcNAc β	1,780	879	841	1,167	434
211	Neu5Ac α 2-3(Neu5Ac α 2-6)GalNAc α	1,107	1,415	968	1,164	187
205	Neu5Ac α 2-8Neu5Ac α 2-8Neu5Ac α	945	1,444	1,098	1,162	208
218	Neu5Ac α 2-3Gal β 1-3[6OSO $_3$]GalNAc α	736	1,358	1,159	1,084	260
206	Neu5Ac α 2-3(6-O-Su)Gal β 1-4(Fuc α 1-3)GlcNAc β	1,170	1,344	713	1,076	266
215	Neu5Ac α 2-3Gal β 1-3(Fuc α 1-4)GlcNAc β	1,328	971	854	1,051	202
294	Gal β 1-4GlcNAc β 1-3(Gal β 1-4GlcNAc β 1-6)Gal β 1-4GlcNAc	792	1,036	1,322	1,050	217
316	Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,133	1,058	908	1,033	93
234	Neu5Ac α 2-3Gal β 1-4GlcNAc β	808	1,292	971	1,024	201
219	Neu5Ac α 2-3Gal β 1-3(Neu5Ac α 2-6)GalNAc α	839	1,132	1,026	999	121
310	Man α 1-6(Man α 1-3)Man α 1-6(Man α 1-3)Man β	514	1,198	1,225	979	329
242	Neu5Ac α 2-6Gal β 1-4[6OSO $_3$]GlcNAc β	627	1,281	963	957	267
48	9NAcNeu5Ac α 2-6Gal β 1-4GlcNAc β	1,256	770	828	952	217
59	Fuc α 1-2Gal β 1-3GalNAc β 1-4(Neu5Ac α 2-3)Gal β 1-4Glc β	1,262	709	789	920	244
50	GlcNAc β 1-2Man α 1-3(GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,138	611	765	838	221
209	Neu5Ac α 2-3(GalNAc β 1-4)Gal β 1-4Glc β	426	1,039	1,004	823	281
51	Gal β 1-4GlcNAc β 1-2Man α 1-3(Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	508	1,031	865	801	218
295	Gal β 1-4GlcNAc β 1-3(GlcNAc β 1-6)Gal β 1-4GlcNAc	1,055	684	585	775	202
241	Neu5Ac α 2-6GalNAc β 1-4GlcNAc β	1,113	562	599	758	251
228	Neu5Ac α 2-3Gal β 1-4(Fuc α 1-3)GlcNAc β	893	620	671	728	118
229	Neu5Ac α 2-3Gal β 1-4(Fuc α 1-3)GlcNAc β	-27	1,186	786	648	505
53	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	454	741	490	562	128
254	Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	530	361	480	457	71
181	GlcA α	413	359	521	431	67
217	Neu5Ac α 2-3Gal β 1-3(Neu5Ac α 2-3Gal β 1-4)GlcNAc β	578	337	321	412	117
52	Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-6Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	94	643	268	335	229
239	Gal β 1-4GlcNAc β 1-2Man α 1-3(Fuc α 1-3)(Gal β 1-4)GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	340	2	212	185	139
160	GlcNAc β 1-3Gal β	-48	-12	-25	-28	15

Results for each of the 377 glycans on the array and for 3 different IVIG preparations (Sandoglobulin, Privigen, Gammunex) are shown. Specific binding (net fluorescence units) was calculated by subtraction of unspecific relative fluorescence unit values of control preparations (IgG control mix).

TABLE E2. Antiglycan activity of Sandoglobulin versus IgG₂-depleted Sandoglobulin and comprehensive list of glycans bound by antibodies contained in IVIG

Glycan no.	Masterlist name	Total IVIG (NFU)	IgG ₂ -depleted IVIG (NFU)	IgG ₂ -depleted IVIG (% of total)	Predominant Ab isotype		
					Non-IgG ₂	IgG ₂	Mixed
1	Neu5Acα2-8Neu5Acβ	3,864	2,531	65.5			
2	Neu5Acα2-8Neu5Acα2-8Neu5Acβ	1,646	810	49.2			
3	Neu5Gcβ2-6Galβ1-4GlcNAc	5,339	1,930	36.2			
4	Galβ1-3GlcNAcβ1-2Manα1-3(Galβ1-3GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	9,892	3,299	33.3			
5	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,050	250	23.8			
6	α-D-Gal	26,853	4,254	15.8		+	
7	α-D-Glc	5,338	2,266	42.5			
8	α-D-Man	1,735	1,236	71.2			
9	α-GalNAc	2,729	603	22.1			
10	α-L-Fuc	2,297	842	36.6			
11	α-L-Fuc	2,526	1,169	46.3			
12	α-L-Rha	39,964	27,102	67.8	+		
13	α-Neu5Ac	2,558	710	27.7			
14	α-Neu5Ac	2,615	827	31.6			
15	β-Neu5Ac	3,858	1,862	48.3			
16	β-D-Gal	12,620	2,776	22.0		+	
17	β-D-Glc	4,481	2,277	50.8			
18	β-D-Man	2,362	822	34.8			
19	β-GalNAc	7,363	1,474	20.0			
20	β-GlcNAc	3,160	1,830	57.9			
21	β-GlcNAc	6,391	1,402	21.9			
22	β-GlcN(Gc)	1,925	249	12.9			
23	(Galβ1-4GlcNAcβ)2-3,6-GalNAcα	1,794	728	40.6			
24	GlcNAcβ1-3(GlcNAcβ1-4)(GlcNAcβ1-6)GlcNAc	36,572	11,879	32.5		+	
25	[3OSO3][6OSO3]Galβ1-4[6OSO3]GlcNAcβ	1,710	891	52.1			
26	[3OSO3][6OSO3]Galβ1-4GlcNAcβ	4,529	1,254	27.7			
27	[3OSO3]Galβ1-4Glcβ	3,591	1,691	47.1			
28	[3OSO3]Galβ1-4(6OSO3)Glcβ	6,581	2,490	37.8			
29	[3OSO3]Galβ1-4(6OSO3)Glcβ	5,359	1,071	20.0			
30	[3OSO3]Galβ1-3(Fucα1-4)GlcNAcβ	1,649	474	28.7			
31	[3OSO3]Galβ1-3GalNAcα	1,659	551	33.2			
32	[3OSO3]Galβ1-3GlcNAcβ	40,124	15,873	39.6			+
33	[3OSO3]Galβ1-4(Fucα1-3)GlcNAcβ	2,156	1,025	47.6			
34	[3OSO3]Galβ1-4[6OSO3]GlcNAcβ	2,515	1,014	40.3			
35	[3OSO3]Galβ1-4GlcNAcβ	3,470	1,438	41.4			
36	[3OSO3]Galβ1-4GlcNAcβ	4,226	1,652	39.1			
37	[3OSO3]Galβ	4,653	1,473	31.7			
38	[4OSO3][6OSO3]Galβ1-4GlcNAcβ	22,190	10,811	48.7			+
39	[4OSO3]Galβ1-4GlcNAcβ	26,373	4,468	16.9		+	
40	6-H2PO3Manα	3,069	629	20.5			
41	[6OSO3]Galβ1-4Glcβ	3,552	1,285	36.2			
42	[6OSO3]Galβ1-4Glcβ	3,008	932	31.0			
43	[6OSO3]Galβ1-4GlcNAcβ	3,377	1,154	34.2			
44	[6OSO3]Galβ1-4[6OSO3]Glcβ	2,969	1,570	52.9			
45	NeuAcα2-3[6OSO3]Galβ1-4GlcNAcβ	1,520	692	45.5			
46	[6OSO3]GlcNAcβ	4,517	1,936	42.9			
47	9NAcNeu5Acα	1,962	505	25.7			
48	9NAcNeu5Acα2-6Galβ1-4GlcNAcβ	1,256	496	39.5			
49	Manα1-3(Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,336	851	63.7			
50	GlcNAcβ1-2Manα1-3(GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,138	560	49.3			
51	Galβ1-4GlcNAcβ1-2Manα1-3(Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	508	260	51.1			
52	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	94	297	315.4			

(Continued)

TABLE E2. (Continued)

Glycan no.	Masterlist name	Total IVIG (NFU)	IgG ₂ - depleted IVIG (NFU)	IgG ₂ - depleted IVIG (% of total)	Predominant Ab isotype		
					Non- IgG ₂	IgG ₂	Mixed
53	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	454	269	59.2			
54	Fucα1-2Galβ1-3GalNAcβ1-3Gala	2,370	1,527	64.4			
55	Fucα1-2Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ	14,149	2,363	16.7		+	
56	Fucα1-2Galβ1-3(Fucα1-4)GlcNAcβ	3,157	1,307	41.4			
57	Fucα1-2Galβ1-3GalNAcα	1,878	1,102	58.7			
58	Fucα1-2Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ	2,650	1,528	57.6			
59	Fucα1-2Galβ1-3GalNAcβ1-4(Neu5Acα2-3)Galβ1-4Glcβ	1,262	685	54.2			
60	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ	31,378	6,487	20.7		+	
61	Fucα1-2Galβ1-3GlcNAcβ1-3Galβ1-4Glcβ	26,736	6,530	24.4		+	
62	Fucα1-2Galβ1-3GlcNAcβ	2,337	784	33.6			
63	Fucα1-2Galβ1-3GlcNAcβ	2,201	731	33.2			
64	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	3,312	1,528	46.1			
65	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAc	3,106	1,914	61.6			
66	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ	1,680	954	56.8			
67	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ	5,942	3,808	64.1			
68	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAc	24,321	2,957	12.2		+	
69	Fucα1-2Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	11,388	1,715	15.1			
70	Fucα1-2Galβ1-4GlcNAcβ	9,656	4,780	49.5			
71	Fucα1-2Galβ1-4GlcNAcβ	1,658	1,142	68.9			
72	Fucα1-2Galβ1-4Glcβ	1,779	726	40.8			
73	Fucα1-2Galβ	4,400	763	17.3			
74	Fucα1-3GlcNAcβ	33,770	7,688	22.8		+	
75	Fucα1-4GlcNAcβ	23,005	6,548	28.5		+	
76	Fucβ1-3GlcNAcβ	31,433	10,905	34.7			+
77	GalNAcα1-3(Fucα1-2)Galβ1-3GlcNAcβ	9,082	2,665	29.3			
78	GalNAcα1-3(Fucα1-2)Galβ1-4(Fucα1-3)GlcNAcβ	2,163	1,040	48.1			
79	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ	2,941	950	32.3			
80	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ	2,058	1,137	55.2			
81	GalNAcα1-3(Fucα1-2)Galβ1-4Glcβ	6,202	1,673	27.0			
82	GalNAcα1-3(Fucα1-2)Galβ	11,048	3,143	28.5			
83	GalNAcα1-3GalNAcβ	46,913	37,305	79.5	+		
84	GalNAcα1-3Galβ	31,365	11,290	36.0			+
85	GalNAcα1-4(Fucα1-2)Galβ1-4GlcNAcβ	6,023	1,277	21.2			
86	GalNAcβ1-3GalNAcα	18,678	3,262	17.5		+	
87	GalNAcβ1-3(Fucα1-2)Galβ	2,990	1,084	36.3			
88	GalNAcβ1-3Galα1-4Galβ1-4GlcNAcβ	24,887	4,387	17.6		+	
89	GalNAcβ1-4(Fucα1-3)GlcNAcβ	18,867	5,555	29.4		+	
90	GalNAcβ1-4GlcNAcβ	2,540	1,300	51.2			
91	GalNAcβ1-4GlcNAcβ	6,692	1,944	29.1			
92	Galα1-2Galβ	31,726	28,790	90.7	+		
93	Galα1-3(Fucα1-2)Galβ1-3GlcNAcβ	8,646	3,898	45.1			
94	Galα1-3(Fucα1-2)Galβ1-4(Fucα1-3)GlcNAcβ	2,349	1,446	61.6			
95	Galα1-3(Fucα1-2)Galβ1-4GlcNAc	4,155	2,833	68.2			
96	Galα1-3(Fucα1-2)Galβ1-4Glcβ	2,851	1,474	51.7			
97	Galα1-3(Fucα1-2)Galβ	2,993	1,240	41.4			
98	Galα1-3(Galα1-4)Galβ1-4GlcNAcβ	20,681	3,732	18.0		+	
99	Galα1-3GalNAcα	2,630	904	34.4			
100	Galα1-3GalNAcβ	29,928	9,861	32.9		+	
101	Galα1-3Galβ1-4(Fucα1-3)GlcNAcβ	9,474	4,764	50.3			
102	Galα1-3Galβ1-3GlcNAcβ	36,030	29,176	81.0	+		
103	Galα1-3Galβ1-4GlcNAcβ	23,866	10,322	43.2			+
104	Galα1-3Galβ1-4Glcβ	23,150	7,498	32.4		+	
105	Galα1-3Galβ	8,682	4,540	52.3			
106	Galα1-4(Fucα1-2)Galβ1-4GlcNAcβ	5,288	3,023	57.2			
107	Galα1-4Galβ1-4GlcNAcβ	5,285	1,834	34.7			
108	Galα1-4Galβ1-4GlcNAcβ	15,332	2,634	17.2		+	
109	Galα1-4Galβ1-4Glcβ	19,474	2,544	13.1		+	

(Continued)

TABLE E2. (Continued)

Glycan no.	Masterlist name	Total IVIG (NFU)	IgG ₂ -depleted IVIG (NFU)	IgG ₂ -depleted IVIG (% of total)	Predominant Ab isotype		
					Non-IgG ₂	IgG ₂	Mixed
110	Gal α 1-4GlcNAc β	36,518	27,158	74.4	+		
111	Gal α 1-6Glc β	24,995	17,819	71.3	+		
112	Gal β 1-2Gal β	29,555	25,915	87.7	+		
113	Gal β 1-3(Fuc α 1-4)GlcNAc β 1-3Gal β 1-4(Fuc α 1-3)GlcNAc β	1,878	958	51.0			
114	Gal β 1-3(Fuc α 1-4)GlcNAc β 1-3Gal β 1-4GlcNAc β	2,226	771	34.6			
115	Gal β 1-3(Fuc α 1-4)GlcNAc	2,023	1,270	62.8			
116	Gal β 1-3(Fuc α 1-4)GlcNAc	3,476	965	27.8			
117	Gal β 1-3(Fuc α 1-4)GlcNAc β	2,293	1,036	45.2			
118	Gal β 1-3(Gal β 1-4GlcNAc β 1-6)GalNAc α	3,844	1,225	31.9			
119	Gal β 1-3(GlcNAc β 1-6)GalNAc α	2,624	1,090	41.5			
120	Gal β 1-3(Neu5Ac α 2-6)GalNAc α	2,116	296	14.0			
121	Gal β 1-3(Neu5Ac β 2-6)GalNAc α	2,372	774	32.6			
122	Gal β 1-3(Neu5Ac α 2-6)GlcNAc β 1-4Gal β 1-4Glc β	21,990	5,317	24.2		+	
123	Gal β 1-3GalNAc α	3,573	1,245	34.8			
124	Gal β 1-3GalNAc β	29,160	18,525	63.5			+
125	Gal β 1-3GalNAc β 1-3Gal α 1-4Gal β 1-4Glc β	31,300	7,432	23.7		+	
126	Gal β 1-3GalNAc β 1-4(Neu5Ac α 2-3)Gal β 1-4Glc β	2,606	1,410	54.1			
127	Gal β 1-3GalNAc β 1-4Gal β 1-4Glc β	35,084	12,683	36.1			+
128	Gal β 1-3Gal β	4,580	2,275	49.7			
129	Gal β 1-3GlcNAc β 1-3Gal β 1-4GlcNAc β	11,814	1,478	12.5		+	
130	Gal β 1-3GlcNAc β 1-3Gal β 1-4Glc β	34,955	12,792	36.6			+
131	Gal β 1-3GlcNAc β	39,342	25,694	65.3			+
132	Gal β 1-3GlcNAc β	31,808	11,720	36.8			+
133	Gal β 1-4(Fuc α 1-3)GlcNAc β	2,516	921	36.6			
134	Gal β 1-4(Fuc α 1-3)GlcNAc β	2,088	1,169	56.0			
135	Gal β 1-4(Fuc α 1-3)GlcNAc β 1-4Gal β 1-4(Fuc α 1-3)GlcNAc β	15,021	6,729	44.8			+
136	Gal β 1-4(Fuc α 1-3)GlcNAc β 1-4Gal β 1-4(Fuc α 1-3)GlcNAc β 1-4Gal β 1-4(Fuc α 1-3)GlcNAc β	2,246	1,482	66.0			
137	Gal β 1-4[6OSO ₃]Glc β	23,310	3,488	15.0		+	
138	Gal β 1-4[6OSO ₃]Glc β	14,889	3,184	21.4		+	
139	Gal β 1-4GalNAc α 1-3(Fuc α 1-2)Gal β 1-4GlcNAc β	10,147	2,413	23.8			
140	Gal β 1-4GalNAc β 1-3(Fuc α 1-2)Gal β 1-4GlcNAc β	6,233	1,949	31.3			
141	Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-2Man α 1-3(Neu5Ac α 2-3Gal β 1-4GlcNAc β 1-2Man α 1-6)Man β 1-4GlcNAc β 1-4GlcNAc β	1,532	485	31.6			
142	Gal β 1-4GlcNAc β 1-3GalNAc α	2,814	1,096	38.9			
143	Gal β 1-4GlcNAc β 1-3Gal β 1-4(Fuc α 1-3)GlcNAc β 1-3Gal β 1-4(Fuc α 1-3)GlcNAc β	5,653	3,384	59.9			
144	Gal β 1-4GlcNAc β 1-3Gal β 1-4GlcNAc β 1-3Gal β 1-4GlcNAc β	7,055	1,127	16.0			
145	Gal β 1-4GlcNAc β 1-3Gal β 1-4GlcNAc β	13,800	1,655	12.0		+	
146	Gal β 1-4GlcNAc β 1-3Gal β 1-4Glc β	12,648	2,361	18.7		+	
147	Gal β 1-4GlcNAc β 1-3Gal β 1-4Glc β	33,402	13,584	40.7			+
148	Gal β 1-4GlcNAc β 1-6(Gal β 1-3)GalNAc α	1,989	773	38.8			
149	Gal β 1-4GlcNAc β 1-6GalNAc α	8,236	3,588	43.6			
150	Gal β 1-4GlcNAc β	3,446	1,142	33.1			
151	Gal β 1-4GlcNAc β	5,656	2,413	42.7			
152	Gal β 1-4Glc β	6,044	1,834	30.4			
153	Gal β 1-4Glc β	6,405	1,467	22.9			
154	GlcNAc α 1-3Gal β 1-4GlcNAc β	44,652	26,586	59.5			+
155	GlcNAc α 1-6Gal β 1-4GlcNAc β	33,685	10,320	30.6		+	
156	GlcNAc β 1-2Gal β 1-3GalNAc α	38,808	17,824	45.9			+
157	GlcNAc β 1-3(GlcNAc β 1-6)GalNAc α	19,539	5,665	29.0		+	
158	GlcNAc β 1-3(GlcNAc β 1-6)Gal β 1-4GlcNAc β	1,058	531	50.1			
159	GlcNAc β 1-3GalNAc α	19,058	6,255	32.8		+	
160	GlcNAc β 1-3Gal β	-48	7	-14.7			
161	GlcNAc β 1-3Gal β 1-3GalNAc α	3,053	1,669	54.7			
162	GlcNAc β 1-3Gal β 1-4GlcNAc β	8,266	1,338	16.2			
163	GlcNAc β 1-3Gal β 1-4GlcNAc β	9,461	1,470	15.5			
164	GlcNAc β 1-3Gal β 1-4GlcNAc β 1-3Gal β 1-4GlcNAc β	8,626	1,683	19.5			
165	GlcNAc β 1-3Gal β 1-4Glc β	9,165	2,124	23.2			

(Continued)

TABLE E2. (Continued)

Glycan no.	Masterlist name	Total IVIG (NFU)	IgG ₂ -depleted IVIG (NFU)	IgG ₂ -depleted IVIG (% of total)	Predominant Ab isotype		
					Non-IgG ₂	IgG ₂	Mixed
166	GlcNAcβ1-4MDPLys	49,248	41,151	83.6	+		
167	GlcNAcβ1-4(GlcNAcβ1-6)GalNAcα	44,791	36,101	80.6	+		
168	GlcNAcβ1-4Galβ1-4GlcNAcβ	40,247	14,602	36.3			+
169	(GlcNAcβ1-4)6b	30,873	11,725	38.0			+
170	(GlcNAcβ1-4)5b	29,129	9,192	31.6		+	
171	GlcNAcβ1-4GlcNAcβ1-4GlcNAcβ	30,720	12,432	40.5			+
172	GlcNAcβ1-6(Galβ1-3)GalNAcα	2,970	735	24.7			
173	GlcNAcβ1-6GalNAcα	14,837	2,794	18.8		+	
174	GlcNAcβ1-6Galβ1-4GlcNAcβ	2,811	1,260	44.8			
175	Glcα1-4Glcβ	26,356	9,350	35.5			+
176	Glcα1-4Glcα	4,156	1,816	43.7			
177	Glcα1-6Glcα1-6Glcβ	11,756	3,999	34.0			
178	Glcβ1-4Glcβ	15,165	5,615	37.0			+
179	Glcβ1-6Glcβ	26,884	24,570	91.4	+		
180	G-ol	1,779	878	49.4			
181	GlcAa	413	141	34.1			
182	GlcAb	2,643	454	17.2			
183	GlcAβ1-3Galβ	2,842	1,045	36.8			
184	GlcAβ1-6Galβ	7,680	613	8.0			
185	KDNα2-3Galβ1-3GlcNAcβ	32,382	25,866	79.9	+		
186	KDNα2-3Galβ1-4GlcNAcβ	1,902	955	50.2			
187	Manα1-2Manα1-2Manα1-3Manα	26,125	12,368	47.3			+
188	Manα1-2Manα1-3(Manα1-2Manα1-6)Manα	10,393	4,736	45.6			
189	Manα1-2Manα1-3Manα	25,116	8,760	34.9			+
190	Manα1-6(Manα1-2Manα1-3)Manα1-6(Manα2Manα1-3)Manβ1-4 GlcNAcβ1-4GlcNAcβ	1,628	965	59.3			
191	Manα1-2Manα1-6(Manα1-3)Manα1-6(Manα2Manα2Manα1-3) Manβ1-4GlcNAcβ1-4GlcNAcβ	1,759	725	41.2			
192	Manα1-2Manα1-2Manα1-3(Manα1-2Manα1-3(Manα1-2Manα1-6) Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,819	997	54.8			
193	Manα1-3(Manα1-6)Manα	9,456	4,474	47.3			
194	Manα1-3(Manα1-2Manα1-2Manα1-6)Manα	26,448	22,987	86.9	+		
195	Manα1-6(Manα1-3)Manα1-6(Manα2Manα1-3)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,591	476	29.9			
196	Manα1-6(Manα1-3)Manα1-6(Manα1-3)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,508	903	59.9			
197	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-3Galβ1-4Glc NAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,410	538	38.2			
198	Manβ1-4GlcNAcβ	3,741	825	22.0			
199	Fucα1-3(Galβ1-4)GlcNAcβ1-2Manα1-3(Fucα1-3(Galβ1-4) GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,499	1,001	66.8			
200	Neu5Acα2-3Galβ1-3GalNAcα	1,934	911	47.1			
201	NeuAcα2-8NeuAcα2-8NeuAcα2-8NeuAcα2-3(GalNAcβ1-4)Galβ1-4Glcβ	1,516	954	62.9			
202	Neu5Acα2-8Neu5Acα2-8Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ	3,239	1,149	35.5			
203	Neu5Acα2-8Neu5Acα2-8Neu5Acα2-3Galβ1-4Glcβ	1,285	457	35.6			
204	Neu5Acα2-8Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ	3,411	1,360	39.9			
205	Neu5Acα2-8Neu5Acα2-8Neu5Acα	945	173	18.3			
206	Neu5Acα2-3(6-O-Su)Galβ1-4(Fucα1-3)GlcNAcβ	1,170	559	47.8			
207	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ	5,679	1,969	34.7			
208	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4GlcNAcβ	923	481	52.1			
209	Neu5Acα2-3(GalNAcβ1-4)Galβ1-4Glcβ	426	502	117.9			
210	NeuAcα2-3(NeuAcα2-3Galβ1-3GalNAcβ1-4)Galβ1-4Glcβ	1,527	506	33.2			
211	Neu5Acα2-3(Neu5Acα2-6)GalNAcα	1,107	634	57.3			
212	Neu5Acα2-3GalNAcα	1,939	584	30.1			
213	Neu5Acα2-3GalNAcβ1-4GlcNAcβ	1,137	864	76.0			
214	Neu5Acα2-3Galβ1-3(6OSO3)GlcNAc	2,840	865	30.4			
215	Neu5Acα2-3Galβ1-3(Fucα1-4)GlcNAcβ	1,328	780	58.7			
216	NeuAcα2-3Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	21,409	16,658	77.8	+		
217	Neu5Acα2-3Galβ1-3(Neu5Acα2-3Galβ1-4)GlcNAcβ	578	469	81.1			
218	Neu5Acα2-3Galβ1-3[6OSO3]GalNAcα	736	241	32.8			
219	Neu5Acα2-3Galβ1-3(Neu5Acα2-6)GalNAcα	839	165	19.7			

(Continued)

TABLE E2. (Continued)

Glycan no.	Masterlist name	Total IVIG (NFU)	IgG ₂ -depleted IVIG (NFU)	IgG ₂ -depleted IVIG (% of total)	Predominant Ab isotype		
					Non-IgG ₂	IgG ₂	Mixed
220	Neu5Acα2-3Galβ	2,176	1,014	46.6			
221	NeuAcα2-3Galβ1-3GalNAcβ1-3Galα1-4Galβ1-4Glcβ	21,246	4,188	19.7		+	
222	NeuAcα2-3Galβ1-3GlcNAcβ1-3Galβ1-4GlcNAcβ	9,321	958	10.3			
223	Neu5Acα2-3Galβ1-3GlcNAcβ	33,050	41,081	124.3	+		
224	Neu5Acα2-3Galβ1-3GlcNAcβ	42,560	29,626	69.6	+		
225	Neu5Acα2-3Galβ1-4[6OSO3]GlcNAcβ	1,403	754	53.8			
226	Neu5Acα2-3Galβ1-4(Fucα1-3)(6OSO3)GlcNAcβ	1,780	1,006	56.5			
227	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	7,029	4,359	62.0			
228	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ	893	563	63.0			
229	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ	−27	282	−1,026.7			
230	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ	1,590	363	22.9			
231	Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4GlcNAcβ	6,195	3,886	62.7			
232	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAc	1,704	847	49.7			
233	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	12,698	2,293	18.1		+	
234	Neu5Acα2-3Galβ1-4GlcNAcβ	808	197	24.3			
235	Neu5Acα2-3Galβ1-4GlcNAcβ	972	666	68.5			
236	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	6,168	859	13.9			
237	Neu5Acα2-3Galβ1-4Glcβ	2,440	1,285	52.7			
238	Neu5Acα2-3Galβ1-4Glcβ	27,934	10,294	36.8			+
239	Galβ1-4GlcNAcβ1-2Manα1-3(Fucα1-3(Galβ1-4)GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	340	−9	−2.6			
240	Neu5Acα2-6GalNAcα	1,811	1,007	55.6			
241	Neu5Acα2-6GalNAcβ1-4GlcNAcβ	1,113	740	66.5			
242	Neu5Acα2-6Galβ1-4[6OSO3]GlcNAcβ	627	373	59.4			
243	Neu5Acα2-6Galβ1-4GlcNAcβ	990	375	37.9			
244	Neu5Acα2-6Galβ1-4GlcNAcβ	1,101	551	50.0			
245	Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	7,588	2,663	35.1			
246	Neu5Acα2-6Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	7,079	1,069	15.1			
247	Neu5Acα2-6Galβ1-4Glcβ	1,867	1,032	55.3			
248	Neu5Acα2-6Galβ1-4Glcβ	5,328	1,596	30.0			
249	Neu5Acα2-6Galβ	1,107	1,221	110.4			
250	Neu5Acα2-8Neu5Acα	4,342	1,323	30.5			
251	Neu5Acα2-8Neu5Acα2-3Galβ1-4Glcβ	1,781	730	41.0			
252	Neu5Acβ2-6GalNAcα	3,720	1,343	36.1			
253	Neu5Acβ2-6Galβ1-4GlcNAcβ	9,416	1,612	17.1			
254	Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	530	206	38.8			
255	Neu5Gcα2-3Galβ1-3(Fucα1-4)GlcNAcβ	1,947	693	35.6			
256	Neu5Gcα2-3Galβ1-3GlcNAcβ	31,100	23,680	76.1	+		
257	Neu5Gcα2-3Galβ1-4(Fucα1-3)GlcNAcβ	1,581	727	45.9			
258	Neu5Gcα2-3Galβ1-4GlcNAcβ	2,007	827	41.2			
259	Neu5Gcα2-3Galβ1-4Glcβ	1,846	861	46.6			
260	Neu5Gcα2-6GalNAcα	2,398	715	29.8			
261	Neu5Gcα2-6Galβ1-4GlcNAcβ	1,761	1,107	62.8			
262	Neu5Gcα	5,683	3,147	55.4			
263	[3OSO3]Galβ1-4(Fucα1-3)(6OSO3)Glc	1,725	964	55.9			
264	[3OSO3]Galβ1-4(Fucα1-3)Glc	2,634	1,260	47.8			
265	[3OSO3]Galβ1-4[Fucα1-3][6OSO3]GlcNAc	1,228	546	44.4			
266	[3OSO3]Galβ1-4[Fucα1-3]GlcNAc	1,599	593	37.1			
267	Fucα1-2[6OSO3]Galβ1-4GlcNAc	967	768	79.5			
268	Fucα1-2Galβ1-4[6OSO3]GlcNAc	2,907	1,096	37.7			
269	Fucα1-2[6OSO3]Galβ1-4[6OSO3]Glc	2,549	1,442	56.6			
270	Fucα1-2-(6OSO3)-Galβ1-4Glc	4,596	1,471	32.0			
271	Fucα1-2-Galβ1-4[6OSO3]Glc	3,611	1,464	40.6			
272	Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-3(Fucα1-4)GlcNAcβ	6,095	2,493	40.9			
273	Galβ1-3-(Galβ1-4GlcNAcβ1-6)GalNAc	2,815	1,140	40.5			
274	Galβ1-3(GlcNAcβ1-6)GalNAc	3,333	594	17.8			

(Continued)

TABLE E2. (Continued)

Glycan no.	Masterlist name	Total IVIG (NFU)	IgG ₂ -depleted IVIG (NFU)	IgG ₂ -depleted IVIG (% of total)	Predominant Ab isotype		
					Non-IgG ₂	IgG ₂	Mixed
275	Galβ1-3-(Neu5Ac2-3Galβ1-4GlcNAcβ1-6)GalNAc	6,575	2,527	38.4			
276	Galβ1-3GalNAc	3,715	2,326	62.6			
277	Galβ1-3GlcNAcβ1-3Galβ1-3GlcNAcβ	37,810	23,132	61.2			+
278	Galβ1-4[Fucα1-3][6OSO3]GlcNAc	3,409	1,286	37.7			
279	Galβ1-4[Fucα1-3][6OSO3]Glc	3,141	1,592	50.7			
280	Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-3(Fucα1-4)GlcNAcβ	2,149	1,037	48.3			
281	Galβ1-4GlcNAcβ1-3Galβ1-3GlcNAcβ	33,291	18,243	54.8			+
282	Neu5Acα2-3Galβ1-3GlcNAcβ1-3Galβ1-3GlcNAcβ	34,023	19,592	57.6			+
283	Neu5Acα2-3Galβ1-4GlcNAcβ1-3Galβ1-3GlcNAcβ	38,558	17,349	45.0			+
284	[3OSO3]Galβ1-4[6OSO3]GlcNAcβ	3,691	832	22.5			
285	[3OSO3][4OSO3]Galβ1-4GlcNAcβ	5,305	1,372	25.9			
286	[6OSO3]Galβ1-4[6OSO3]GlcNAcβ	1,892	794	42.0			
287	6-H2PO3Glcβ	8,447	3,210	38.0			
288	Galα1-3(Fucα1-2)Galβ	3,161	1,850	58.5			
289	Galα1-3GalNAcα	3,022	1,029	34.0			
290	Galβ1-3GalNAcα	1,644	605	36.8			
291	Galβ1-3(Neu5Acα2-3Galβ1-4(Fucα1-3)GlcNAcβ1-6)GalNAc	1,660	1,274	76.8			
292	Galβ1-3Galβ1-4GlcNAcβ	5,016	2,138	42.6			
293	Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	2,036	896	44.0			
294	Galβ1-4GlcNAcβ1-3(Galβ1-4GlcNAcβ1-6)Galβ1-4GlcNAc	792	664	83.9			
295	Galβ1-4GlcNAcβ1-3(GlcNAcβ1-6)Galβ1-4GlcNAc	1,055	640	60.6			
296	Galβ1-4GlcNAcα1-6Galβ1-4GlcNAcβ	29,426	8,720	29.6			+
297	Galβ1-4GlcNAcβ1-6Galβ1-4GlcNAcβ	1,514	482	31.8			
298	GalNAcα	8,236	2,286	27.8			
299	GalNAcα1-3(Fucα1-2)Galβ	12,994	2,944	22.7			+
300	GalNAcβ1-3Galβ	7,780	1,503	19.3			
301	GlcAβ1-3GlcNAcβ	29,120	9,625	33.1			+
302	GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,244	854	68.7			
303	GlcNAcβ1-2Manα1-3(GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,992	913	45.9			
304	GlcNAcβ1-3Man	13,033	3,757	28.8			+
305	GlcNAcβ1-4GlcNAcβ	16,920	5,771	34.1			+
306	GlcNAcβ1-4GlcNAcβ	12,077	4,508	37.3			+
307	HOOC(CH ₃)CH-3-O-GlcNAcβ1-4GlcNAcβ	40,792	30,834	75.6	+		
308	Manα1-3(Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	2,074	1,037	50.0			
309	Manα1-6Manb	3,982	1,535	38.5			
310	Manα1-6(Manα1-3)Manα1-6(Manα1-3)Manb	514	611	118.7			
311	Manα1-2Manα1-2Manα1-3(Manα1-2Manα1-6(Manα1-3)Manα1-6)Manα	26,808	5,212	19.4			+
312	Manα1-2Manα1-2Manα1-3(Manα1-2Manα1-6(Manα1-2Manα1-3)Manα1-6)Manα	8,684	2,515	29.0			
313	Neu5Acα2-3Galβ1-3(Neu5Acα2-3Galβ1-4GlcNAcβ1-6)GalNAc	788	1,075	136.4			
314	Neu5Acα2-3Galβ1-3(Neu5Acα2-6)GalNAc	29,349	12,292	41.9			+
315	Neu5Acα2-3Galβ1-3GalNAc	5,111	2,844	55.6			
316	Neu5Acα2-3Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,133	547	48.3			
317	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,371	1,012	73.8			
318	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	6,299	3,539	56.2			
319	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,412	530	37.6			
320	Fucα1-2Galβ1-3GalNAcα	2,493	1,346	54.0			
321	Galβ1-3(Neu5Acα2-6)GalNAcα	3,073	1,557	50.7			
322	Galβ1-4GlcNAcβ1-3GalNAc	2,278	1,092	47.9			
323	NeuAc(9Ac)α2-3Galβ1-4GlcNAcβ	1,119	779	69.6			
324	NeuAc(9Ac)α2-3Galβ1-3GlcNAcβ	35,989	34,316	95.4	+		
325	NeuAcα2-6Galβ1-4GlcNAcβ1-3Galβ1-3GlcNAcβ	37,472	25,634	68.4	+		
326	NeuAcα2-3Galβ1-3(Fucα1-4)GlcNAcβ1-3Galβ1-3(Fucα1-4)GlcNAcβ	26,759	13,801	51.6			+

(Continued)

TABLE E2. (Continued)

Glycan no.	Masterlist name	Total IVIG (NFU)	IgG ₂ -depleted IVIG (NFU)	IgG ₂ -depleted IVIG (% of total)	Predominant Ab isotype		
					Non-IgG ₂	IgG ₂	Mixed
327	NeuAcα2-6Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	10,690	2,008	18.8			
328	Galα1-4Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ	31,838	7,738	24.3		+	
329	GalNAcβ1-3Galα1-4Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ	34,991	12,838	36.7			+
330	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	36,997	6,086	16.5		+	
331	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	11,643	3,817	32.8			
332	(Neu5Acα2-3-Galβ1-3)((Neu5Acα2-3-Galβ1-4(Fucα1-3))GlcNAcβ1-6)GalNAc	1,857	1,276	68.7			
333	GlcNAcα1-4Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	13,563	2,228	16.4		+	
334	GlcNAcα1-4Galβ1-4GlcNAcβ	2,364	734	31.0			
335	GlcNAcα1-4Galβ1-3GlcNAcβ	9,021	3,167	35.1			
336	GlcNAcα1-4Galβ1-4GlcNAcβ1-3Galβ1-4Glcβ	12,889	2,286	17.7		+	
337	GlcNAcα1-4Galβ1-4GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ1-3Galβ1-4(Fucα1-3)GlcNAcβ	12,310	5,391	43.8			+
338	GlcNAcα1-4Galβ1-4GlcNAcβ1-3Galβ1-4GlcNAcβ	19,770	3,203	16.2		+	
339	GlcNAcα1-4Galβ1-3GalNAc	6,001	2,246	37.4			
340	Manα1-3(Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAc	1,840	764	41.5			
341	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3(Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAc	3,315	2,620	79.0			
342	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-6Manβ1-4GlcNAcβ1-4GlcNAc	1,394	501	36.0			
343	Neu5Acα2-6Galβ1-4GlcNAcβ1-2Manα1-3Manβ1-4GlcNAcβ1-4GlcNAc	2,060	776	37.7			
344	Galβ1-4GlcNAcβ1-2Manα1-3Manβ1-4GlcNAcβ1-4GlcNAc	1,610	535	33.2			
345	Galβ1-4GlcNAcβ1-2Manα1-6Manβ1-4GlcNAcβ1-4GlcNAc	1,606	813	50.6			
346	Galβ1-4GlcNAcβ1-2Manα1-3(Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	3,340	986	29.5			
347	GlcNAcβ1-2Manα1-3(GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4(Fucα1-6)GlcNAcβ	1,384	1,082	78.2			
348	Galβ1-4GlcNAcβ1-2Manα1-3(Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4(Fucα1-6)GlcNAcβ	1,531	993	64.9			
349	Galβ1-3GlcNAcβ1-2Manα1-3(Galβ1-3GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4(Fucα1-6)GlcNAcβ	6,425	2,707	42.1			
350	Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-3[Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	48,478	33,366	68.8	+		
351	(6SO3)GlcNAcβ1-3Galβ1-4GlcNAcβ	2,867	1,124	39.2			
352	KDNα2-3Galβ1-4(Fucα1-3)GlcNAc	1,875	1,269	67.7			
353	KDNα2-6Galβ1-4GlcNAc	2,378	1,250	52.6			
354	KDNα2-3Galβ1-4Glc	1,719	1,195	69.5			
355	KDNα2-3Galβ1-3GalNAcα	2,681	1,698	63.3			
356	Fucα1-2Galβ1-3GlcNAcβ1-2Manα1-3(Fucα1-2Galβ1-3GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	11,592	7,725	66.6			
357	Fucα1-2Galβ1-4GlcNAcβ1-2Manα1-3(Fucα1-2Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	8,927	4,321	48.4			
358	Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ1-2Manα1-3[Fucα1-2Galβ1-4(Fucα1-3)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	3,250	2,226	68.5			
359	Galα1-3Galβ1-4GlcNAcβ1-2Manα1-3(Galα1-3Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	24,413	16,609	68.0	+		
360	Manα1-3(Galβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAcβ	1,262	652	51.7			
361	Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-3[Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4(Fucα1-6)GlcNAcβ	21,225	15,306	72.1	+		
362	Neu5Acα2-6GlcNAcβ1-4GlcNAc	2,867	1,300	45.3			
363	Neu5Acα2-6GlcNAcβ1-4GlcNAcβ1-4GlcNAc	9,059	3,418	37.7			
364	Fucα1-2Galβ1-3GlcNAcβ1-3[Galβ1-4(Fucα1-3)GlcNAcβ1-6]Galβ1-4Glc	4,987	2,758	55.3			
365	Galβ1-4GlcNAcβ1-2(Galβ1-4GlcNAcβ1-4)Manα1-3[Galβ1-4GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAc	5,864	2,303	39.3			
366	GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-2Manα1-3[GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	5,075	2,473	48.7			
367	Galα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-2Manα1-3[Galα1-3(Fucα1-2)Galβ1-4GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	3,489	2,784	79.8			
368	Galα1-3Galβ1-4(Fucα1-3)GlcNAcβ1-2Manα1-3[Galα1-3Galβ1-4(Fucα1-3)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	3,453	2,292	66.4			

(Continued)

TABLE E2. (Continued)

Glycan no.	Masterlist name	Total IVIG (NFU)	IgG ₂ -depleted IVIG (NFU)	IgG ₂ -depleted IVIG (% of total)	Predominant Ab isotype		
					Non-IgG ₂	IgG ₂	Mixed
369	GalNAcα1-3(Fucα1-2)Galβ1-3GlcNAcβ1-2Manα1-3[GalNAcα1-3(Fucα1-2)Galβ1-3GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	19,196	3,044	15.9		+	
370	Galα1-3(Fucα1-2)Galβ1-3GlcNAcβ1-2Manα1-3[Galα1-3(Fucα1-2)Galβ1-3GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	12,385	4,336	35.0			+
371	Fucα1-2Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-3[Fucα1-2Galβ1-3(Fucα1-4)GlcNAcβ1-2Manα1-6]Manβ1-4GlcNAcβ1-4GlcNAcβ	8,333	3,301	39.6			
372	NeuAcα2-3Galβ1-4GlcNAcβ1-3GalNAc	2,744	250	9.1			
373	NeuAcα2-6Galβ1-4GlcNAcβ1-3GalNAc	21,412	6,551	30.6		+	
374	NeuAcα2-3[Fucα1-3]Galβ1-4GlcNAcβ1-3GalNAc	2,591	1,192	46.0			
375	GalNAcβ1-4GlcNAcβ1-2Manα1-6(GalNAcβ1-4GlcNAcβ1-2Manα1-6)Manβ1-4GlcNAcβ1-4GlcNAc	1,287	876	68.0			
376	Galβ1-3GalNAcα1-3(Fucα1-2)Galβ1-4Glc	13,363	1,793	13.4		+	
377	Galβ1-3GalNAcα1-3(Fucα1-2)Galβ1-4GlcNAc	12,796	2,051	16.0		+	

Results for all 377 glycans on the array are shown. Purity of IgG₂-depleted Sandoglobulin was >99%. Specific binding (net fluorescence units, *NFU*) was calculated by subtraction of unspecific relative fluorescence unit values of control preparations (IgG control mix for Sandoglobulin and IgG₁ myeloma for IgG₂-depleted Sandoglobulin, respectively). Binding of IgG₂-depleted IVIG <33.3% of the signal intensity of nondepleted IVIG was considered predominantly IgG₂; >66.6%, non-IgG₂; and >33.3 and <66.6%, mixed isotype-mediated. Isotype predominance of glycan-recognizing antibodies was indicated for the top 100 glycan signals recognized by total Sandoglobulin, of which 45% were predominantly IgG₂, 22% were non-IgG₂, and 33% were mixed IgG₂ and non-IgG₂.