Project no.: **FP6-2005-LIFESCIHEAL-7-037661**
Project acronym: **GLYFDIS**
Project title: **Glycans in Body Fluids – Potential for Disease Diagnostics**
Instrument: **STREP**
Thematic priority: **LSH-2005-1.2.2-4: Development of new diagnostics**

FINAL ACTIVITY REPORT

Period covered: **From November 1st 2006 to April 30th 2010**
Date of preparation: **June 15th , 2010**
Start date of project: **November 1st , 2006.**
Duration: **42 months**
Project coordinator name): **Angel Porgador**
Project coordinator organisation name: **Ben-Gurion University of the Negev, Beer-Sheva, Israel**

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Publishable Final Activity report

Glycans in Body Fluids – Potential for Disease Diagnostics disease: The GLYFDIS project

(a) Project execution - introduction

GLYFDIS mission is to develop novel integrated diagnostic tools for diagnosis and monitoring of cancerous states based on glycome and peptidome analysis of blood samples. Optimized diagnosis of cancer significantly decreases cancer-associated morbidity and mortality. It relieves economical and mental burden from patients, their families and the entire society. Accurate monitoring of cancerous states following diagnosis can significantly contribute to prognosis determination and on-line evaluation of therapeutic regimens. The long-term objective of GLYFDIS project is to develop methods and to acquire knowledge in the field of diagnosis and monitoring of cancer progression by integrating various technologies of glycome and peptidome analysis in body fluids into one prediction methodology.

To achieve that goal, the GLYFDIS project was constructed as follows: Sera from cancer patients and matching healthy controls were methodologically collected by one partner (the sera collecting partner, RNTB/F). Then, aliquots of the same sera samples were sent to the other four partners that first optimized their technologies and then analyzed the sera in different methodologies (HPLC-based assay of sera glycome – DOGL partner, lectin-based assay of sera glycome – PRC partner, analysis of sera glycosphingolipidome – MUN partner, and sera peptidome – BGU partner). Following these stages of methodologies' optimization and first identification of biomarker patterns based on the training sera, a testing step took place. As before, the sera collecting partner sent aliquots of a new set of sera (testing set) to the four analyzing partners which then assayed it with the optimized technologies. Results were then subjected to a separate analysis (for each of the individual methodologies) and to a combined integrated analysis (by BGU - the coordinating partner) for the purpose of identifying different technologies-based integrated biomarker pattern that could indicate and monitor a cancerous state.

Combined results were subjected to the integrated prediction methodology obtained from the sera for the purpose of better assessment of this prediction methodology.

The main objectives for the entire GLYFDIS project are as follows:

(i) Optimization of different glycome and peptidome analysis methodologies for mixture of sera-derived molecules.

(ii) Identifying cancer-associated glycome and peptidome markers based on training and testing sets of serum samples from stomach and pancreatic cancer patients.

(iii) Generating an integrated metalerner-based prediction protocol employing features from the different analysis methods and its assessment on the entire sera.

Partners and cooperation details:

The Consortium is constituted of 5 partners based in Europe:

Partner no	**Institution**	**Main Investigator** (s)
1	Ben-Gurion University of the Negev (BGU) Coordinating Institute	Angel Porgador, coordinator Email: angel@bgu.ac.il Tel: 972-8-6477283 Fax: 972-8-6472574 Additional investigators: Eitan Rubin Rachel Glicklis-Lichtenstein
2	Procognia Ltd (Israel) (PRC)	Rakefet Rosenfeld, Dorit Landstein
3	NIBRT- The National Institute for Bioprocessing Research & Training (DOGL)	Pauline Rudd, Jonathan Bones
4	Munster University (MUN)	Jasna Peter-Katalinic, Laura Bindila
5,6	RNTech Belgium (RNTB) / RNTech France (RNTF)	Julien Taieb

The GLYFDIS STREP is composed of two innovative SMEs each one of them is a leader in its niche, joint together with leading European universities and research institutions tract from four different European countries to provide Europe and the world with a new innovative cancer diagnostic and tracking method that can save lives and money. The tasks we defined at GLYFDIS to reach our objectives were carried out by the concerted efforts of the different participants with complementary skills and experience. The tasks and goals of GLYFDIS have been reached and this multidisciplinary strategy has established the framework for developing new integrated diagnostic tools and features.

(b) Project objectives and major achievements

The goal of GLYFDIS was to identify different and integrated patterns / alterations of glycans and specific peptides/glycopeptides that are uniquely developed in cancerous state and appear in the blood (serum). To achieve its goal, the GLYFDIS project was designed as follows:

- **The same serum samples (identical aliquots) are to be analyzed by all partners:**

Sera from cancer patients (Stomach and pancreas adenocarcinomas) and matching non-cancer bearing controls were methodologically collected by one partner. Then, aliquots of the same sera samples were sent to the other 4 partners that analyze the sera in different methodologies.

Additions to the original GLYFDIS plan:

(i) Adding of sera from a 2nd source (Asterand company) providing sera from stomach cancer patients and matching controls representing different (environmentally and geographically) regions compared to the sera from Partner 5 (E.g. USA vs. Romania).

(ii) Adding sera from gastritis and pancreatitis representing non-malignant inflammatory illnesses of stomach and pancreas.

Supply of sera was as follows:

(a) RNTech source (partner 5/6), sent to partners 1,2,3,4:

Sera were sent in two major batches:

(i) First batch for the purpose of optimization of the individual technologies listed above followed by analysis of clinical groups for the production of a prediction protocol for each individual methodology.
(ii) Second batch for the purpose of testing and optimizing the prediction protocol and for the generation of a prediction classifier integrating results from the different methodologies
(b) Asterand source (commercial, only stomach and controls) , sent to partners 1,2,3: on e batch

- **Studied methodologies for sera analysis:**

The main approach undertaken by the DOGL partner to achieve his objectives was global and targeted glycosylation analysis of enzymatically released N-glycans from the supplied sera samples to identify cancer associated alterations in the serum glycome. This was done both on whole sera and sera depleted from abundant proteins. Following total N-glycome analysis, differential proteomic and glycoproteomic analysis of the depleted serum to identify differentially expressed cancer associated protein targets and proteins carrying the identified altered glycosylation.

The main approach undertaken by the BGU partner to achieve his objectives was mass-spectrometry peptidome analysis of from the supplied sera samples. This was followed by independent quantitative analysis (clinical-type assays) of some of the disease predicting peptide identified by the mass-spectrometry approach combined with some widely-used clinical parameters to obtain diagnostic score for cancer diagnosis.

The main approach taken by the PRC partner to achieve his objectives was to identify cancer-associated serum global glycosylation pattern based on lectin array binding. Then to identify cancer-associated alterations in glycosylation of specific serum proteins and to develop/optimize computational methods for data analysis of the lectin array chip results.

The main approach undertaken by the MUN partner to achieve his objectives was to extract Glycolipids from sera, develop highthrouput quantitative-like technologies to MS-based analysis of sera-extracted glycolipids and to apply these technologies to the analysis of the clinical sera groups.

Please note that general regularly-used clinical parameters (e.g. CA19-9, CRP) were also employed in the final integrated analysis (see PAR1 and PAR2).

- **Analysis of individual methodologies and integrated results**

A bioinformatics pipeline was developed to analyze the data from the different methodologies, seeking to uncover a combination of markers that together differentiate healthy and diseased samples. The pipeline was based on the Support Vector Machines (SVM) algorithm, coupled with a hybrid algorithm for choosing informative features developed specifically for GLYFDIS (combining the CC/SNR method to reduce the features set until it can be explored exhaustively). Several approaches were tested for integrating the results from different methodologies, including (1) *naïve merging*, in which all the results from all the methodologies are introduced together to the machine learning pipeline, (2) *feature merging*, in which the informative features are identified for each data source separately, and these features are analyzed with the SVM pipeline; and (3) *proper meta-analysis*, in which an SVM model is created for each methodology separately, and the predictions of these models are than used to train a new SVM model.

- **Integrated results and conclusions**

Each individual partner accomplished his mission (please note WP description at section 3 for more details)

<u>As for the integrated analysis (WP7, there is also a more detailed file in the email):</u>

(i) An analysis of the glycoproteomic (JB) and glycoproteomic (AP) results with the Ingenuity Pathway Analaysis (Ingenuity, USA) indicates an overrepresentation of proteins involved in two pathways that are known to be functionally linked to the host response to cancer, namely the acute phase response signaling pathway and the complement system pathway. These enrichments are much stronger when the results of peptidomics and glycoproteomics are combined, with p-values lower by 4-7 orders of magnitudes in the combined dataset. These results show that the different methodologies detect different facets of the same underlying biological processes. They also suggest that acute phase and complement responses contribute to the cancer-specific changes observed in the serum of pancreatic and stomach cancer patients.

(ii) For stomach cancer, a classifier was found with an estimated accuracy of 92% (MCC: 0.81). This classifier was obtained by the naïve merging of the results of the different WPs, and it involves features from the lectine arrays (Gal_Galc_8, SialicAcid_1 and Mannose_3), a feature acquired with MALDI-based serum peptidomics (with m/z=927100E3), a feature derived from Elisa-based analysis of serum peptides (ApoAI/ApoB), and a standard biomarker for inflammantion (G0/G1).

(iii) The combining the data from the different WPs produced a classifier that is more accurate than the models generated with any WP alone. Single-methodology also

identified patterns with predictive powers, but the most accurate single-methodology had an estimated accuracy of 79% (MCC: 0.48).

(iv) For pancreatic cancer a classifier was found with a predicted accuracy of 89%, (MCC: 0.79), using the proper meta analysis approach. The pipeline identified the combination of lectine array and MALDI-based peptidiomic predictions as the most informative features for SVM based classification. Single-methodology also identified patterns with predictive powers, but these did not exceed 87% accuracy (MCC: 0.73).

(v) We conclude that complex patterns can be found in serum biomarkers, involving glycomic, peptidomic as well existing clinical biomarkers, with a high potential to serve as aids in stomach and pancreatic cancer diagnosis, and these patterns have a higher accuracy than existing biomarkers

(vi) We also conclude that multi-feature patterns that combine the results of different methodologies provide more accurate predictions than patterns based on a single methodology.

(c) Project management

The consortium management organization has been implemented as defined in the technical annex of the contract. The project officially started in November 2006 for 36 months, has been extended for 6 months at no cost, in order to finalize data management and analysis of the integrated results. Thus, the project spanned 42 months, from November 1st, 2006 to April 30th, 2010. On may 1st, 2008 a partner SME, RNTB changed to RNTF with no significant impact on the project since these are sister SMEs owned and managed by the same entity. Strategic directions for the scientific activities, the implementation of the work plan, as well as financial issues were discussed regularly during sessions of the steering committee and reports were sent to each partner. Four GLYFDIS meetings had been taking place during the consortium period.

(d) Impact of the project

Estimated deaths worldwide in 2007 for stomach cancer were 511,549 for males (2nd causing death for cancers in male) and 288,681 for female. Estimated deaths worldwide in 2007 for pancreatic cancer were 137,206 for male and 122,185 for female. It is clear that there is an urgent need to identify novel tumor markers and protocols for the

improvement of personal care treatment for patients and population. It is also clear that the dream of one biomarker good for cancer monitoring is impractical and an array of biomarkers and imaging technologies should be the goal to obtain for accurate and specific diagnostics and monitoring of specific cancerous state. Therefore, GLYFDIS individual and integrated successful results on stomach and pancreas cancer monitoring are expected to eventually have a clear impact on the health of the European population and associated countries, by enforcing the concept of personalized cancer care through providing novel individual and integrated features to determine cancerous state for stomach and pancreas cancer patients and possibly be to be further extrapolated for other cancers.

GLYFDIS results advanced basic-clinical European scientific excellence. The project-induced results and intellectual property are expected to be efficiently implemented to the clinic. Further developed commercially exploitable products will promote European industrial production. Successful clinical and commercial implementation of GLYFDIS results will have multiple medical and social benefits to European countries, as it will promote the cure of stomach and pancreas cancer patients and reduce their suffer. This also bears effects on social and economical aspects, as hospitalization time and costs will be possibly reduced and the economical loss induced by the inability of patients to work will be reduced.

(e) Logo, Website, Photos

Logo:

Website:

www.glyfdis.org

Photo:

2. Final Plan for Using and disseminating the knowledge

Four GLYFDIS meetings took place and 121 actions of dissemination were performed during the entire GLYFDIS period, including oral presentations and posters in national and international conferences and meetings (academic and industrial) as well as some press release (see Annex 2 below for details). Three patents were issues with the purpose of commercial exploitation; a shared patent is planned.

Total of fourteen scientific papers were published and three are currently submitted. These papers describe (i) the technological advances stemmed from GLYFDIS work, (ii) studies in which these technological aspects were implemented, and (iii) results stemming from the direct analysis within GLYFDIS. Of course, the GLYFDIS grant was acknowledged accordingly. Moreover, at least eight additional manuscripts are in preparation for submission that describe some of GLYFDIS results and the integrated results.

Section 1: Exploitable knowledge and its use

Exploitable Knowledge (description)	**Exploitable product(s) or measure(s)**	**Sector(s)** of application	**Timetable for commercial use**	**Patents or other IPR protection**	**Owner & Other Partner(s) involved**
Chip-based diagnostics	platform for high throughput glycoanalysis of serum samples for cancer diagnostics	Diagnostics		Provisional patent application 7/9/2009	(PRC) Procognia.
Diagnostic score	Set of clinical assays for diagnosis of Stomach cancer	Diagnostics		Provisional patent application 2009	BGU
HPLC-based diagnostics	Glycosylation-based markers for cancer diagnotics	Diagnostics		US patent application, 2007	DOGL (NIBRT)

Section 2: Dissemination of knowledge

GLYFDIS meetings:
(1) 7-9 December 2006, Dead Sea, Israel
(2) 2-3 April 2008, Paris, France
(3) 13-14 September 2009, Eilat, Israel
(4) 26-27-April 2010, Dublin, Ireland

Other Dissemination Actions

DATE	**TYPE**	**TYPE OF AUDIENCE**	**COUNTRIES ADDRESSED**	**SIZE OF AUDIENCE**	**PARTNER INVOLVED**
16-Nov-2006	Annual conference by Ernst & Young	General.	International Mix.	200	Procognia

28-Nov-2006	Birbeck College Conference.	Academic.	International Mix.	200	DOGL Prof. P.M. Rudd
28-Nov-2006	Euroscicon, ICL.	Academic.	International Mix.	100	DOGL Prof. P.M. Rudd
30-Nov-2006	FP7 and Health Research	Academic.	Israel	50	BGU
December 2006	Glycobiology conference LA	Academic	International	200	BGU Michal Perlmutter
04-Dec-2006	European Antibodies Congress.	Pharmaceutical Industry.	International Mix.	150	DOGL Prof. P.M. Rudd
14-Dec-2006	UCD Winter Festival of Research.	General.	Domestic – Ireland.	100	DOGL Prof. P.M. Rudd
15-Dec-2006	ERC St. Vincents University Hospital, Dublin.	Medics.	Domestic – Ireland.	30	DOGL Prof. P.M. Rudd
10-Jan-2007	Norwegian School of Veterinary Science.	Vets.	Norway.	60	DOGL Prof. P.M. Rudd
13-Jan-2007	National University of Ireland, Galway.	General.	Domestic – Ireland.	50	DOGL Prof. P.M. Rudd
21-Jan-2007	Gordon Conference on Cancer Biomarkers.	Cancer Research.	USA.	100	DOGL Prof. P.M. Rudd
22-Feb-2007	3rd Glycan Forum.	Analytical.	Germany.	150	DOGL Prof. P.M. Rudd
03-Mar-2007	IACR	Cancer Research.	Domestic – Ireland.	50	DOGL Prof. P.M. Rudd
19 March 2007	SME & Health Workshop organized by the Health Research Directorate of the EC	Young Innovative Companies in EU health research projects	International	100	RNTB
14-15 April 2007	RT_PCR Training Course organized by Applied Bio System Strasbourg	Molecular biologist	International	10	RNTB
25-26 April 2007	GeneSpring GX Software Training	Molecular biologist bioinformatics	National	15	RNTB
06-May-2007	DiPIA 2007.	Academic.	USA.	250	DOGL Prof. P.M. Rudd
09-May-2007	NCIB	Cancer Research.	USA.	150	DOGL Prof. P.M. Rudd
13-May-2007	Press release	General	Israel	Country wide	Procognia
23-May-2007	ESF Exploratory Workshop on Glycoscience.	General.	Croatia.	60	DOGL Prof. P.M. Rudd
30-May-2007	University of Leiden.	Medics.	Netherlands.	50	DOGL Prof. P.M. Rudd
05-June-2007	University of Leuven.	General.	Belgium.	100	DOGL Prof. P.M. Rudd

20-June-2007	Midizinische Hochschule Hannover.	General.	Germany.	60	DOGL Prof. P.M. Rudd
July 2007	XXIV International Carbohydrate Symposium	Academic	International	200	BGU Dr. Rachel Lichtenstein
July 2007	XXIV International Carbohydrate Symposium	Academic	International	150	BGU Michal Perlmutter
10-Jul-2007	Poster presentation	international	Europe, USA, Japan, India	70	MUN Jasna PK.
10-Jul-2007	Poster presentation	international	Europe, USA, Japan, India	70	MUN Laura B.
11-July-2007	27th Sapporo Cancer Seminar.	Cancer Research.	Japan.	200	DOGL Prof. P.M. Rudd
31-July-2007	Public Understanding of Science, Cambridge.	General.	United Kingdom.	150	DOGL Prof. P.M. Rudd
5-8 September 2007	17th World Congress of International Association of Surgeons, Gastroenterologists and Oncologists	Medics	International	500	RNTB
October 2007	ISBIE	Academic	International	100	BGU Oshrat Levi-Ontman
10-Oct-2007	NIBN presentation	Academic	National	30	BGU Angel Porgador
10-Oct-2007	Water Innovation Meeting	General	Domestic – Ireland	50	DOGL Dr. Jonathan Bones.
21-Oct-2007	8th Jenner Glycobiology and Medicine Symposium.	Academic / Medical.	International.	100	DOGL Prof. P.M. Rudd
13-Nov-2007	Post Translational Modification Conference.	Academic.	International.	100	DOGL Prof. P.M. Rudd
January 2008	Ilanit	Academic	National	200	BGU Prof. Angel Porgador
January 2008	Ilanit	Academic	National	200	BGU Meital Cohen-Kupervaser
17-22-Feb-2008	Oral presentation	international	USA, UK, DE, EU, Japan,	250	MUN
04-Mar-2008	Analytical Techniques in Glycobiology Training Course – NIBRT.	Industrial / Academic.	International	50	DOGL Dr. Jonathan Bones.
05-Mar-2008	Oral presentation	international	DE, NL, USA, RO,	250	MUN Jasna PK.

05-Mar-2008	Poster presentation	international	DE, NL, USA, RO,	250	MUN Laura B.
07-Mar-2008	BCI Symposium: Glycosylation and Disease.	Industrial / Academic.	International.	100	DOGL Prof. P.M. Rudd
11-Mar-2008	Public Understanding of Science Meeting, Minesota.	General.	USA.	200	DOGL Prof. P.M. Rudd
08-April-2008	Glycosciences Ireland Launch.	Industrial / Academic.	International.	200	DOGL Prof. P.M. Rudd
April-2008	Isra-analytica	Industrial/ Academic	International	250	BGU Oshrat Levi-Ontman
27- April-2008	The Israeli 11th Bioinformatics Symposium	Academic	National	150	BGU Tamir Erez
06/05/2008	SEB Meeting	Academic	International	500	Prof. P.M. Rudd, DOGL
15/05/2008	32nd HPLC Conference	Industrial / Academic	International	500	Prof. P.M. Rudd, DOGL
24/05/2008	4th Glycan Forum	Industrial / Academic	International	150	Prof. P.M. Rudd, DOGL
05/06/2008	Oral seminar at WWU Münster Biochemistry Department	Graduate students and post-docs in department of biochemistry, WWU Münster	D, India	50	MUN
15/06/2008	Biotechnology Engineering Meeting	Academic	Israel	120	Mr Kap Tschaci, BGU
14/07/2008	Seminar, Complex Networks Systems Group, Hebrew University	Academic	Israel	100	E. Rubin, BGU
7 / 2008	Seminar, Fox Chase Cancer center, Philadelphia	Academia	USA	100	A. Porgador, BGU
7 / 2008	Seminar, NE Boston University, Boston	Academia	USA	80	A. Porgador, BGU
7 / 2008	2nd Rediscovering Biomarkers: Detection, Development & Validation (poster)	Academia / Industry	USA	200	A. Porgador, BGU
27/07/2008	24th International Carbohydrate Symposium	Industrial / Academic	International	500	Prof. P.M. Rudd,
11/08/2008	NIBRT-BD Technologies for Biomarkers Business Meeting	Industrial	Gernamy	5	Prof. P.M. Rudd Dr. J. Bones, DOGL
11/09/2008	RSC Carbohydrate Symposium	Academic	International	100	Prof. P.M. Rudd, DOGL

21-25/09/2008	International Symposium on Chromatography 2008, Münster, D (2 Posters)	Scientists from academia and industry	D, UK, F, CH, Italy, Austria, Finland, NL, Sweden, USA	350	MUN
30/9-3/10/ 2008	14th International Symposium on Separation Sciences (ISSS), Primosten, Croatia (Plenary Lecture)	Scientists from academia and industry	Croatia, D, UK, F, CH, Italy, Austria, Finland, NL, Sweden, USA, New Zealand	250	MUN
01/11/2008	Seminar Series Barnett Institute, NEU, Boston	Academic	USA	50	Prof. P.M. Rudd Dr. J. Bones, DOGL
11/2008	NIBN meeting	Academy / Industry	Israel	50	A. Porgador BGU
30/11-02/12/2008	Joint 19th Glycobiology Meeting 2008, Wageningen/NL (2 Posters)	Glycobiology scientists from academia and industry	D, B, F, NL	250	MUN
15/12/2008	Annual Conference of the Society for Glycobiology	Academic	USA	500	Mrs Meital Edri, BGU
15/12/2008	Glycobiology conference	Academic	USA	500	Dr. Isam Khalaila, GBU
20/01/2009	Gordon Conference	Academic	USA	150	Dr. Rachel G. Lichtenstein, BGU
20/01/2009	Gordon Conference	Academic	USA	150	Dr. Isam Khalaila, BGU
23-26/1/2009	21st ASMS Sanibel Conference on Mass Spectrometry "Lipidomics and Lipid Mass Spectrometry", , St. Petersburgh, FL, USA	Mass spectrometrists from academia and industry	USA, D, F, Australia, Austria	150	MUN
31/01/2009	MRC Meeting Edinburg	Academic	UK	20	Prof. P.M. Rudd, DOGL
04/02/2009	Seminar, NIBN	Industrial / Academic	Israel	50	E. Rubin, BGU
01-04/03/2009	Annual Meeting of the German Mass Spectrometry Society 2009, Konstanz/D, (2 Posters)	Mass spectrometrists from academia and industry	D, USA, NL, Schweiz	300	MUN
8-11/3/2009	Jahrestagung der Deutschen Gesellschaft für Massenspektrometrie	Academia	Germany	100	MUN
10-11/03/2009	6th International Conference on Biomedical Application of Nanotechnology, Berlin/D, (Poster)	Medical doctors and physicists from academia and industry	D, USA, NL, Schweiz, Russia	500	MUN

12-14/3/ 2009	Lecture at the Graduiertenkolleg 1026 „Conformational Transitions in Macromolecular Interactions“, Martin-Luther-Universität Halle-Wittenberg/Schloss Oppurg	Graduate students and post-docs from the departments of chemistry, biophysics, biochemistry	D, Check Republic, Poland, UK	100	MUN
17/04/2009	CFG Meeting on Advances in Analytical Glycobiology	Academic	International	100	Prof. P.M. Rudd Dr. J. Bones, DOGL
30/04/2009	2nd Annual GSI Meeting	Industrial / Academic	Ireland	200	Prof. P.M. Rudd, DOGL
03/05/2009	Seminar, Maccabi Health Care Services	Industrial	Israel	20	E. Rubin, BGU
5/2009	CITIM conference	Academy	Europe / USA	200	A. Porgador, BGU
31/5-4/6/2009	Annual Meeting of the Americal Society of Mass Spectrometry	Academic / Industry	USA	200	MUN
14/06/2009	Presentation	Prof. Rafi Catane Head of Oncology Division, Sheba Hospital ,Israel	Israel	Division Physicians	Procognia
23/06/2009	Oral Colloquium at the Zaferna Retreat (Internal Seminar IMPB, WWU Münster) Kleinwalsertal/A	Graduate students and post-docs from the department of biophysics	D, Ukraine, Russia, India, Chech Republik, Singapore	40	MUN
29/06/2009	ISMB2009	Industrial/ Academic	International	2000	E. Rubin, BGU
01/07/2009	Biotechnology Engineering Meeting	Academic	Israel	100	Mrs Merav Shaul, BGU
5-12/7/2009	3rd Summer Course on mass Spectrometry in biotechnology and Medicine, July 5-12, 2009, Dubrovnik, Croatia (1 Poster, 1 lecture)	Graduate students, post-docs and scientists from life sciences and medicine	D, Croatia, Switzerland, Bulgaria, Russia, India, Chech Republic, Italy	50	MUN
10/07/2009	FEBS Meeting	Academic	International	500	Prof. P.M. Rudd, DOGL
16/07/2009	Oral Seminar at the Institute for Medical physics and Biophysics IMPB, Münster/D	Graduate students and post-docs from the department of biophysics	D, Ukraine, Russia, India, Chech Republik, Singapore	40	MUN
19/07/2009	15th European Carbohydrate Symposium	Industrial / Academic	International	500	Prof. P.M. Rudd, DOGL

20/07/2009	Mucins in Health and Disease	Academic	UK	50	Prof. P.M. Rudd, DOGL
16/08/2009	238th ACS Fall National Meeting & Exposition	Industrial / Academic	International	1000	Prof. P.M. Rudd, DOGL
16/08/2009	Presentation	Dr. Shomron Ben Horin Gastroenterology Department ,Sheba Hospital	Israel	Department Physicians	Procognia
30/08-04/09/2009	International Mass Spectrometry Conference 2009, Bremen/D (Poster)	Mass spectrometrists from academia and industry	USA, Russia, Canada, South America, Australia, Europe, Japan, China, Israel	2500	MUN
01/09/2009	State of the Art Protein Analysis, Barnett Institute, NEU, Boston	Industrial / Academic	USA	50	Prof. P.M. Rudd Dr. J. Bones, DOGL
08/09/2009	Report to Israeli stock exchange	General	Isreal and others	Country wide	Procognia
08/09/2009	Hebrew press release	General	Israel	Country wide	Procognia
09/09/2009	English press release	General	International	worldwide	Procognia
12/09/2009	9th Jenner Glycobiology & Medicine Meeting	Academic	International	100	Prof. P.M. Rudd, DOGL
14/10/2009	Presentation	Prof. Nadir Harber Head of Cancer Prevention ,Ichilov Hospital, Israel	Israel	Department Physicians	Procognia
20-21/10/2009	.INVERS workshop	Academy / Industry	Europe	100	MUN
08-10/11/2009	20th Glycobiology Join Meeting 2009, Cologne/D, (Poster I)	Glycobiology scientists from academia and industry	D, B, F, NL	200	MUN
08-10/11/2009	21st Glycobiology Joint Meeting 2009, Cologne/D, (Poster II)	Glycobiology scientists from academia and industry	D, B, F, NL	200	MUN
09/11/2009 13/11/2009	Business Meetings Annual Conference of the Society for Glycobiology	Extera Partners-US Business Development Co. Academic	U.S. International USA	Meeting with CEO 450	Dr. Rachel G. Lichtenstein, BGU
29/11/2009	International Symposium on Glycoconjugates, Peurto Rico	Industrial / Academic	International	250	Prof. P.M. Rudd, DOGL

07/12/2009	Business Meetings	Gamida for Life	Israel, International	Meeting with CEO	Procognia
22/12/2009	Presentation	Prof. Daniel Chan ,John Hopkins Med. Center ,U.S.A.	U.S.A.	In person	Procognia
11/2009-06/2010	Business Meetings	6 multinational Diagnostic companies	U.S. International	In person meetings with key Managers	Procognia
14/01/2010	Oral Seminar at WWU Biochemistry Department, Münster/D	Graduate students and post-docs in department of biochemistry, WWU Münster	D, India	40	MUN
04/02/2010 04/02/2010	The 38th Annual Meeting of Israel Immunology Society Lecture at the Croatian Academy of Sciences and Arts, Zagreb, Croatia.	Academic Academicians, scientists from the Universities of Zagreb and Rijeka, graduate students and post-docs	International Croatia, USA	550 100	Mrs Shaul Merav, BGU MUN
14/02/2010	TSRI Desert Meeting, Palm Springs, CA, USA	Invited	USA	20	Prof. P.M. Rudd, DOGL
18/02/2010	Israeli Genetics Society	Industrial/ Academic	International	500	E. Rubin, BGU
21/02/2010	Euroglycoforum, Lisbon	Academic	European	100	Prof. P.M. Rudd, DOGL
07-10/03/2010	Annual Meeting of the German Mass Spectrometry Society 2010, Halle(Saale)/D (Poster)	Mass spectrometrists from academia and industry	D, USA,	300	MUN
08/03/2010	Seminar Series Barnett Institute, NEU, Boston	Academic	USA	50	Prof. P.M. Rudd, DOGL
20/03/2010	EDDP meeting, Munich	Industrial/ Academic	International	500	E. Rubin, BGU
06/04/2010	Poster/Israeli Bioinformatics Symposium	Industrial/ Academic	International	500	E. Rubin, BGU
12/04/2010	Informa Meeting London	Industrial / Academic	UK	100	Prof. P.M. Rudd, DOGL
27/04/2010	Presentation	Prof. Mordechai Kramer Head of Pulmonary Institute ,Rabin Med. Center ,Israel	Israel	Department Physicians	Procognia
05/05/2010	Oral Seminar IMPB, Münster/D	Graduate students and post-docs from the	D, Ukraine, Russia, India, Chech Republik,	40	MUN

		department of biophysics	Singapore		
12/08/2010	RECOMB	Industrial/ Academic	International	2000	E. Rubin, BGU

Section 3: Publishable results

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