

## **Dr. Toomas Neuman**

CSO, Protobios  
Tallinn, Estonia

### **Abstract**

#### **“Immunome profiling: a powerful tool for diagnostics and therapeutics”**

The immune system is a key mechanism to fight diseases. Profiling of the activity of the antibodies (binding to antigens) enables researchers and clinicians to understand and predict impact of the immune system on human health and develop novel diagnostic tools for variety of diseases and conditions. A technology has been developed to identify and monitor the global activity of immunoglobulins and thereof significantly improve methods of diagnostics and therapy of diseases. Currently, analysis of a small number of autoantibodies is used in diagnostics of autoimmune and other diseases. The desired medical application of immunome profiling, however, would be to rapidly assess the spectrum of different health conditions that have a reflection in the antibody profiles and have highly predictive value of health risks of the person. Important examples here include cardiovascular diseases, allergies, and cancer.

Exposure to infections accounts for 17% of human cancers, with human papillomavirus (HPV) being one of the most prevalent infections related to oncogenesis. HPV infection causes almost all cervical cancers as well as a significant proportion of cancers of the vulva, vagina, penis, anus, and oropharynx; together these HPV-related cancers account for >5% of all human cancers.

The antibody response to HPV is, in general, virus subtype-specific, and profiling of the global antibody activity would contribute to determining of the spread of type-specific HPV infections in populations, monitoring of the effect of HPV vaccines in inducing protective antibodies, but most of all to evaluation of oncogenic threat of the infection. The antibody response to HPV is complex since infection and disease lead to distinct virus subtype-specific antibody responses. At present there is no clinically useful serological assay of HPV exposure or susceptibility.

A clinical study was performed to identify and validate peptide mimotopes for HPV-associated cervical cancer diagnostics. Sera from women with HPV infection and women with HPV infection and diagnosed CIN2/3 cervical cancer lesions were analyzed to identify antibody activity profiles using immunome profiling method. The immunome profiling method presented here combines phage display with high throughput DNA sequencing of selected phages. This approach allows large and complex sero-epidemiologic studies with profiles compiled of several thousands of peptide mimotope groups to discriminate between individuals, health and disease or personal disease states. Results of immunome profiling showed a strong association of cervical cancer with antibody profiles to a 339 mimotope set ( $P < 0.001$ ) enabling to identify immunome signature that differentiates between benign infection and precancerous state.

Validation of the set of 96 peptide mimotopes using sera from 50 women with HPV infection and from 50 women with HPV infection and diagnosed CIN2/3 cervical cancer lesions using Luminex xMAP platform enabled us to identify a group of peptide biomarkers that would be highly suitable as diagnostic biomarkers for cervical intraepithelial neoplasia (CIN 2/3) lesions.

These results demonstrate the power of the developed technology and the strategy adopted.

## Biography

### CURRICULUM VITAE TOOMAS NEUMAN

**PERMANENT RESIDENCE:** Põllu 28a –1, Tallinn, Estonia

**DATE OF BIRTH:** April 22, 1953

**PLACE OF BIRTH:** Tallinn, Estonia

**CITIZENSHIP:** Estonia

**MARITAL STATUS:** Married

### EDUCATION

Tartu State University Tartu, Estonia	Biology (embryology, cytology)	1976
Institute of Developmental Biology, Moscow, USSR	Developmental Biology Ph.D.	1983

### PROFESSIONAL APPOINTMENTS

Department of Genetics, Tartu State University Tartu, Estonia	Research scientist	1976-1977
Department of Biochemistry Institute of Cybernetics, Tallinn, Estonia	Research scientist	1977-1980
Department of Molecular Genetics, Institute of Chemical Physics and Biophysics, Tallinn, Estonia	Senior research scientist, group leader	1980-1988
Department of Virology University of Helsinki, Helsinki, Finland	Visiting Scientist	1987-1988
Department of Molecular Cell Biology Max Planck Institute of Biophysical Chemistry, Göttingen, Germany	Max-Planck society fellowship	1988-1990
Department of Anatomy and Neurobiology Colorado State University Fort Collins, CO, U S A	Assistant Professor	1991 - 1996

Department of Surgery Cedars-Sinai Medical Center Los Angeles, CA, USA	Director, Neurobiology Research Research Scientist II	1996 - 2001
Celmed BioSciences, Inc. Los Angeles, CA	Program Director	2001 - 2002
CeMines, Inc La Jolla, California	Chief Science Officer	2003 - 2006
CeMines, Inc.	Consultant	2006-present
OncoTx, Inc. Beverly Hills, California	Consultant	2005-present
Tallinn University of Technology Tallinn, Estonia	Professor	2006-present
OÜ Protobios Tallinn, Estonia	Consultant	2006-present
OÜ FibroTx Tallinn, Estonia	Scientific adviser	2006-present

## **MAJOR RESEARCH INTERESTS**

My research centers on the cell and molecular biology. My main interests are focused on transcriptional regulation of gene expression, regulatory mechanisms of cell homeostasis and homeothesis, molecular mechanisms of diseases, development and regeneration including cell therapy and stem cells.

## **TEACHING**

Cell Biology  
Molecular Biology  
Molecular Neurobiology  
Developmental Biology  
Systems Biology

### **Supervisor for Ph.D. thesis**

Urmas Arumae 1987  
Heiti Paves 1989  
Daniel Shain 1995  
Kurt Brubaker 1996

### **Postdoctoral trainees**

Urmaz Arumae	1987-1988
Elizabeth Knapik	1991
Kikuo Suda	1992-1994
Jianzhong Zhao	1993-1994
Mazakazu Miyajima	1994-1995
Michael Fitzgerald	1994-1995
Helene Lilja	1996-1997
Yukio Matahari	1997-1998
Tuija Saline-Nordstrom	1998- 1999
Kestutis Planoutis	1998-2000
Kaia Palm	1998-2001
Peter Kabos	1999-2001
Andrea Kabosova	1999-2001

### **Short description of professional achievements**

#### Department of Virology, University of Helsinki, Helsinki, Finland. 1987-1988

During my stay at the Department of Virology we were focusing on extracellular proteolysis in neuronal cells and tumors. Prof. Antti Vaheri's lab was one of the first who have demonstrated that u-PA and t-PA (plasminogen activators) have high expression in neuronal tumors.

#### Department of Molecular Cell Biology, Max Planck Institute of Biophysical Chemistry, Goettingen, Germany 1988-1990.. Research fellow

My research in Goettingen was focused on transcriptional control of mammalian development. I participated in the work that resulted in discovering several novel transcription factors that control early stages of nervous system development and stem cell functions.

#### Department of Anatomy and Neurobiology, Colorado State University, Fort Collins, CO. 1990-1996. Assistant Professor

My research at Colorado State University was focused on transcriptional mechanisms of neuronal regeneration. We have isolated and characterized several novel transcription factors that play critical role in neuronal regeneration. This work resulted in 24 scientific publications and several patent applications. In addition to the analysis of transcriptional control my research was focusing on developing new techniques for genetic engineering of nervous system to stimulate regenerative "power" of adult neurons. We developed a technique to stimulate DNA synthesis in adult neurons that can be used to integrate genetic material into nonproliferating cells.

#### Department of Surgery, Cedars-Sinai Medical Center, Los Angeles, CA, 1996-2001, Director of Neurobiology Research

At Cedars I was leading a team of researchers who were focusing on developing techniques to obtain nervous system stem cells from the adult human brain. We have succeeded on developing several techniques that enabled us to isolate and propagate stem cells from the hippocampus and ventricular zone of adult human brain. In collaboration with Dr. Levesque we conducted first autologous transplantation of differentiated stem cells into Parkinson's disease patient brain and initiated a clinical study to treat Parkinson's disease using cell therapy.

#### Celmed BioSciences, Inc., Los Angeles, CA. 2001-2002. Director of research

Based on Dr. Levesque's and my work at Cedars Sinai Medical Center a biotech company Celmed Biosciences was founded.

CeMines, Inc . La Jolla, CA 2003 – present, Chief Scientific Officer, Consultant  
CeMines was founded on April 2000 by Dr. Kaia Palm, Mr. Richard Cavalli and myself. Initial goal of the company was to market research products such as antibodies, RNA and DNA. Soon the company changed its focus and started to develop molecular diagnostic techniques for early detection and monitoring of cancer using CeMines Molecular Fingerprinting platform technology. CeMines Biosystems division was developing tools for the analysis of genome wide transcriptional mechanisms and CeMines Diagnostics and Therapeutics division had several research projects focusing on drug discovery using transcription factors as drug targets. On 2005 we filed a 510K and CE Mark applications for diagnosis of lung cancer based on detection of auto-antibody patterns using peptide (epitope) arrays. In November 2008 CeMines licenced its lung cancer biomarker system to Johnson&Johnson company Ortho Cliical Diagnostics for codevelopment and worldwide marketing.

OÜ FibroTx 2006- present.

FibroTx was founded to commercialize our research results at Tallinn Technical University. Main focus of the company is on the biology of stromal cells and more specifically on regulation of ECM homeostasis in variety of conditions including fibrosis, cirrhosis, aging (skin wrinkles). Company has developed a set of genomic and proteomic tests to monitor synthesis and degradation of components of ECM. Company has several R&D projects in the area of drug discovery that are focusing on signal transduction and transcriptional mechanisms of ECM regulation.

## LIST OF PUBLICATIONS

### TOOMAS NEUMAN

Neuman, T., Laasberg, T., Kärner, J. 1983. Ultrastructural localization of adenylate cyclase and cAMP phosphodiesterase in the gastrulating chick embryo. Roux's Arch. Dev. Biol. 192: 42-44

Neuman, T. 1983. Cyclic nucleotide phosphodiesterase activity changes in early chick development. Experientia 39: 96-97

Mikhailov, A., Neuman, T., Gorgoljuk, N., Söber, J. 1983. "Neuralizing substances"- testing invitro using embryonic ectoderms from amphibia and birds. Proc. Acad. Sci. USSR 270: 712-714

Neuman, T., Laasberg, T., Kärner, J. 1984. The effect of cyclic nucleotides on the morphogenetic and ultrastructural peculiarities of the chick Hensens node in organotypic cultures. Ontogenez 15: 88-91

Saarma, M., Neuman, T., Talpsep, T., Toots, I., Siigur, J. 1984. Monoclonal antibodies to NGF from venom of Vipera lebetina. Biochemistry (USSR) 277: 1267-1269

Laasberg, T., Neuman, T. 1985 Changes in the acetylcholinesterase and choline acetyltransferase activities in the early development of the chick embryo. Roux Arch. Dev. Biol. 194: 306-310

Saarma, M., Neuman, T., Arumae, U., Siigur, E., Siigur, J. 1985. Functional properties of NGF - study with monoclonal antibodies. Biotechnology (USSR) 2: 97-102

Siigur, E., Neuman, T., Jarve, V., Tara, A., Siigur, J. 1985. Isolation and characterization of nerve growth factor from Vipera lebetina (snake) venom. Comp.Biochem., Physiol. B. Comp. Biochem. 81: 211-216

Saarma, M., Toots, U., Raukas, E., Zhelkovsky, A., Pivazian, A., Neuman, T. 1986. Nerve growth factor induces changes in (2'-5') oligoA synthetase and 2'-phosphodiesterase activities during differentiation of PC12 pheochromocytoma cells. *Exp. Cell Res.* 166: 229-236

Laasberg, T., Neuman, T., Langel, U. 1986. Acetylcholine receptors in the gastrulating chick embryo. *Experientia.* 42: 439-440

Siigur, J., Arumae, U., Neuman, T., Samel, M., Siigur, E., Saarma, M. 1986. Isolation and characterization of nerve growth factor from *Vipera berus berus* (Common viper) venom. *Comp. Biochem. Physiol.* 83B : 621-625

Arumae, U., Siigur, J., Neuman, T., Saarma, M. 1987. Monoclonal antibodies against *Vipera lebetina* venom nerve growth factor cross-react other snake venom nerve growth factors. *Molec. Immun.* 24: 1295-1302.

Glinsky, G., Ivanova, A., Vinnitsky, V., Arumae, U., Siigur, J., Neuman, T. 1987. Nerve growth factor may be the metastasis growth factor. *Annals New York Acad. Sci.* 496: 656-659

Siigur, J., Arumae, U., Neuman, T., Siigur, E., Saarma, M. 1987. Monoclonal antibody immunoaffinity chromatography of the nerve growth factor from snake venoms. *Comp. Biochem. Physiol.* 87B: 329-334

Laasberg, T., Pedak, A., Neuman, T. 1987. The muscarinic receptor -mediated action of acetylcholine in the gastrulating chick embryo. *Comp. Biochem. Physiol.* 86C: 313-316

Paalme, V., Arumae, U., Siigur, J., Neuman, T., Slepilov, S., Saarma, M. 1988. The salivary glands of poisonous and nonpoisonous snakes synthesize and secrete nerve growth factor. *Proc. Acad. Sci. USSR.* 301: 754-756

Paves, H., Neuman, T., Metsis, M., Saarma, M. 1988. Nerve growth factor induces rapid redistribution of F-actin in PC12 cells. *FEBS Lett.* 235: 141-143

Laasberg, T., Pihlak, A., Neuman, T., Paves, H., Saarma, M. 1988. Nerve growth factor increases the cyclic GMP level and activates the cyclic GMP phosphodiesterase in PC12 cells. *FEBS Lett.* 239: 367-370

Arumae, U., Neuman, T., Sinijarv, R., Saarma, M. 1989. Sensitive time -resolved fluoroimmunoassay of nerve growth factor and the disappearance of nerve growth factor from rat pheochromocytoma PC12 cell culture medium. *J. Immun. Methods.* 122: 59-65

Neuman, T., Stephens, R.W., Salonen, E-M., Timmusk, T., Vaheri, A. 1989. Induction of morphological differentiation of human neuroblastoma cells is accompanied by induction of tissue-type plasminogen activator. *J. Neurosci. Res.* 23: 274-281

Raid, R., Neuman, T., Kärner, J. 1989. Changes in the distribution of adenylate cyclase activity in PC12 cells under the influence of nerve growth factor. *Ontogenez,* 20(5): 543-551

Paves, H., Neuman, T., Metsis, M., Saarma, M. 1990. Nerve growth factor induces rapid reorganization of microfilaments in PC12 cells: possible roles of different second messenger systems. *Exp. Cell Res.* 186: 218-226

Neuman, T., Reeben, M. Palgi, J., Palm, K., Paalme, V., Saarma, M. 1990. Regulation of rat light neurofilament gene by NGF in PC12 cells. *Regulation of Gene Expression in the Nervous System.* Wiley-Liss, Inc. pp77-91.

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Hatzopoulos, A.K., Stoykova, A.S., Erselius, J., Goulding, M., Neuman, T., Gruss, P. 1990. Structure and expression of the mouse Oct2a and Oct2b, two differential splicing products of the same gene. Development, 109, 349-362.

Suzuki, N., Scholer, H., Rohdevoid, H., Neuman, T., Gruss, P. 1990. Oct 6: a POU transcription factor expressed in embryonal stem cells and in the developing brain. The EMBO Journal, 9, 3723-3732.

Neuman, T., Keen, A., Knapik, E., Shain, D., Ross, M., Nornes, H., Zuber, M.X. 1993. ME1 and GE1: basic helix-loop-helix transcription factors expressed at high levels in the developing nervous system and in morphogenetically active regions. Eur. J. Neuroscience, 5, 311-318.

Neuman, T., Metsis, M., Persson, H., Gruss, P. 1993. Cell type specific negative regulatory element in low affinity nerve growth factor receptor gene. Molecular Brain Research, 20, 199-208.

Neuman, T., Keen, A., Zuber, M.X., Kristjansson, G.I., Gruss, P., Nornes, H.O. 1993. Neuronal expression of regulatory helix-loop-helix factor Id2 gene in mouse. Developmental Biology, 160, 186-195.

Soosaar, A., Chiaramello, A., Zuber, M.X., Neuman, T. 1994. Expression of helix-loop-helix transcription factor ME2 during brain development and in the regions of neuronal plasticity in the adult brain. Molecular Brain Research, 25, 176-180.

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Suda, K., Nornes, H.O., Neuman, T. 1994. Class A basic Helix-Loop-Helix transcription factors in early stages of chick neural tube development: evidence for functional redundancy. Neurosci. Letters, 177, 87-90.

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Chiaramello, A., Soosaar, A., Neuman, T., Zuber, M.X. 1995. Differential expression and distinct DNA-binding specificity of ME1a and ME2 suggest a unique role during differentiation and neuronal plasticity. Molecular Brain Res., 29, 107-118.

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Neuman, K., Soosaar, A., Nornes, H.O., Neuman, T. 1995. Orphan receptor COUP-TF I antagonizes retinoic acid induced neuronal differentiation. Journal of Neuroscience Research, 41, 39-48.

Zhao, J., Nornes, H. O., Neuman, T. 1995. Expression of Rb, E2F, cdc2, and D and B cyclins in developing spinal cord. Neuroscience Letters, 190, 49-52.

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Chiaramello, A., Neuman, K., Palm, K., Metsis, M., Neuman, T. 1995. Helix-loop-helix transcription factors mediate activation and repression of the p75LNGFR gene. *Mol. Cell. Biol.*, 15, 6036-6045.

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Soosaar, A., Neuman, K., Nornes, H.O., Neuman, T. 1996. Cell type specific regulation of orphan receptor COUP-TF II promoter activity. *FEBS Lett.*, 391, Nr.1/2, 95-100.

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Rozga J, Lilja H, Suk Suh K, Eguchi S, Neuman T, Demetriou AA. 1997. A bioartificial liver: how does it work ?. In: "Bioartificial liver support systems - the critical issues." Eds.G.Crepaldi, A.A.Demetriou and M.Muraca. International Up To Date - 208, CIC Edizioni Internazionali, Via Lazzaro Spallanzani, 11-00161 Rome, Italy, pp.98-103.

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Kamohara Y, Lilja H, Neuman T, Demetriou AA, Rozga J. 1998. Activity of proliferation-associated and liver-enriched transcription factors in rats with surgically-induced liver failure. *Surg Forum* 49:157-158.

Lilja H, Kamohara Y, Neuman T, Demetriou AA, Rozga J. 1998. Transforming growth factor b1 maintains expression of liver-enriched transcription factors in mitogen-stimulated primary rat hepatocyte cultures. *Surg Forum* 49: 176-178.

Shain DH, Zuber MX, Norris J, Yoo J, Neuman T. 1998. Selective conservation of an E-protein gene promoter during vertebrate evolution. *FEBS Lett* ., 440, 332-336.

Suh, K.S., Lilja, H., Kamohara, Y., Eguchi, S., Arkadopoulos, N., Neuman, T., Demetriou, A.A., Rozga, J. 1999. Bioartificial liver treatment in rats with fulminant hepatic failure: effect on DNA-binding activity of liver-enriched and growth-associated transcription factors. *J. Surgical Res.*, 85, 243-250.

Lilja, H., Kamohara, Y., Neuman, T., Demetriou, A.A., Rozga, J. 1999. Transforming growth factor  $\beta$ 1 helps maintain differentiated functions in mitogen-treated primary rat hepatocyte cultures. *Mol. Cell Biol. Res. Comm.*, 1, 188-195.

Palm, K., Salin-Nordstrom, T., Levesque, M.F., Neuman, T. 2000. Fetal and adult human CNS stem cells have similar molecular characteristics and developmental potential. *Molecular Brain Research*, 78, 192-195.

Kamohara, Y., Sugiyama, N., Mizuguchi, T., Inderbitzin, D., Lilja, H., Middleton, Y., Neuman, T., Demetriou, A.A., Rozga, J. 2000. Inhibition of signal transducer and activator transcription factor 3 in rats with acute hepatic failure. *Biochem. Biophys. Res. Comm.* 273, 129-135

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Metsis, M., Brunkhorst, A., Neuman T. 2001. Cell type specific expression of the TFIID component TAF<sub>ii</sub>135 in the nervous system. *Exp. Cell Res.*, 269, 214-221

Mizuguchi, T., Kamohara, Y., Hui, T., Neuman, T., Mitaka, T., Demetriou, A.A., Rozga, J. 2001. Regulation of c-met expression in rats with acute hepatic failure. *J. Surg. Res.*, 99, 385-396.

Kabos, P., Kabosova, A., Neuman, T. 2002. Blocking HES1 expression initiates GABAergic differentiation and induction of p21<sup>CIP1/WAF1</sup> in human neural stem cells. *J. Biol. Chem*, 277, 8763-8766.

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Kabos, P., Kabosova, A., Neuman, T. 2002. Neuronal injury affects expression of Helix-Loop-Helix transcription factors. *NeuroReport*, 13(18), 2385-2388.

Brunkhorst A, Neuman T, Hall A, Arenas E, Bartfai T, Hermanson O, Metsis M. 2004. Novel isoforms of the TFIID subunit TAF4 modulate nuclear receptor-mediated transcriptional activity. *Biochem Biophys Res Commun.* 2004; 325(2):574-579.

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Jääger K, Neuman T. 2010. Human dermal fibroblasts exhibit delayed adipogenic differentiation compared to mesenchymal stem cells. *Stem Cells Dev.* 2010 Dec 8. [Epub ahead of print]

## **Papers submitted**

### **Patents**

Neuman, T., Connor, H., Nornes, H.O. Method for upregulation of trkB and trkC expression in CNS neurons. U.S. Patent No. 5,880,153, issued March 9, 1999.

Neuman, T., Suda, K., Nornes, H.O. Method for inducing DNA synthesis in neurons. U.S. Patent No.6,087,171, issued July 11, 2000.

Levesque, F.M. and Neuman, T. Conversion of non-neuronal cells into neurons: transdifferentiation of epidermal cells. U.S. Patent No. 6,087,168, issued July 11, 2000.

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Neuman, T., Nornes, H.O. Method of stable integration of DNA into neurons. U.S. Patent No.6,268,174, issued July 31, 2001.

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Neuman, T., Levesque,M. Compositions and methods for isolation, propagation, and differentiation of human stem cells and uses thereof. U.S. Patent No.7,632,680, issued December 15, 2009.

Palm, K., Neuman, T. Profiling tumor specific markers for the diagnosis and treatment of neoplastic disease. U.S. Patent No. 7,812,124, issued October 12, 2010.

### **Patent applications.**

Neuman, T. and Levesque, F.M.  
Compositions and methods for isolation, propagation, and differentiation of human stem cells and uses thereof. United States Patent Application No. 20030118566

PCT/US20050129615  
Rozga, J and Neuman, T.  
Non-invasive system for detecting skin cancer. United States Patent Application 20050129615  
Filed June 16, 2005

PCT/US2005/018995  
Composition and methods for the treatment of skin cancer.  
Inventor: Toomas Neuman  
Docket Reference: 186702-PC-TAL  
Filed May 31, 2005

PCT/US2005/023709

Composition and methods for detecting protein interactions with target DNA sequences

Inventor: Wenpei Su and Toomas Neuman

Docket Reference: 34594-PC-TAL

Filed June 30, 2005

PCT/US2005/023708

Methods and composition for the diagnosis, prognosis and treatment of cancer

Inventors:Kaia Palm, Daiwei Shen, Toomas Neuman

Docket Reference: 34593-PC-TAL

Filed : June 30, 2005

PCT/US2005/019234

Controlled delivery of therapeutic compounds

Inventor:Toomas Neuman

Docket Reference: 34211-PC-TAL

Filed: May 31, 2005

PCT/US20040219575

Neuman, T. and Palm, K. Methods and compositions for the diagnosis, prognosis, and treatment of cancer.

Filed: November 4, 2004

SerialN o.: 121018,041

Inventors: Rita Zobel, Anzelika Liik, Helle Sadam, Toomas Neuman

Screening methods used to identify compounds that modulate skin stromal cells' (fibroblasts') ability to modify function of extracellular matrix.

Filed: January 22, 2008

Serial number 121062.15

Inventors: Liik, A, Laas, A, Rita Z., Neuman, T.

Transcriptional Modulation of Extracellular (ECM) of Dermal Fibroblasts.

Filed: April 3, 2008

U.S. Provisional Patent Application was filed with USPTO on May 12, 2008. Serial number 61/052,393

Inventors: Anzelika Liik, Ave Laas, Helle Sadam and Toomas Neuman

Prognosis and management of skin wounds

U.S. Provisional Patent application was filed with USPTO on May 16th, 2008. Serial number 61/053,872

Inventors: Rutt Lilleoja, Anzelika Liik and Toomas Neuman

Proteinases as diagnostic biomarkers.

U.S. Provisional Patent application was filed with USPTO on May 16th, 2008. Serial number 61/053,868

Inventors: Anzelika Liik, Ave Laas, Rutt Lilleoja and Toomas Neuman

Diagnostic skin patch for selection of cosmeceuticals and drugs that match persons skin cell biology.

### **Published abstracts (1991 - current)**

Neuman,T., Nornes,O.H., Zuber,M. 1991. Multiple homologs of E12/E47 helix-loop-helix transcriptional factors in developing mouse nervous system. Society for Neuroscience Meeting 1991, Abstracts, p 531.

Knapik,E., Nornes, O.H., Neuman,T. 1991. Expression of helix-loop-helix transcriptional factor E12/E47 homologues in chick developing nervous system. Society for Neuroscience Meeting 1991, Abstracts, p 1514.

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