

# THE NEW GENERATION OF REGENERATION



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# THE NEW GENERATION OF REGENERATION

By: Lisa Minère and Martijn Naaktgeboren  
Grade: V6a  
Subject: Regenerative Medicine, Lorenzo Moroni, TU Twente  
Stedelijk Dalton Lyceum  
Dordrecht  
Mentor: Mr. Zomervrucht

# THE NEW GENERATION OF REGENERATION

## Preface

A final project must be something special. It must be a project that is truly yours and when it is finished it must give you a great amount of satisfaction and the feeling that you have done something really useful for the past year. That is exactly why we chose to work together with Imagine for our final project. After all, what is more useful than helping people in a developing country?

Maybe the hardest thing about working with Imagine is all the questions you get from your fellow classmates. Every time people ask about your project, you have to explain the goal of the competition, how it's like to work in a laboratory and why you weren't at school last Friday. But when you start talking about Regenerative Medicine, the only thing they can do is staring, listening and calling you crazy for picking such an extremely difficult subject.

We have experienced the project with ups and downs. We learned a lot from Enyini's workshop, working in the lab was an amazing experience and we had so much fun there, but in the end the lab's results were disappointing, we had to change our plan completely and we even lost a group member on our way (To be clear; he didn't die, he just quit).

We have had a lot of discussion about which way we had to go with our project, because there are pro and cons to every plan. But when we had made up our minds, we were both convinced that we would make it work.

The result of our hard work is now right in front of you. We designed a plan for inexpensive access to regenerative medicine for the people in Colombia: 'The new generation of regeneration'. We hope you will enjoy reading it.



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## Managers summary

The innovative and inexpensive Platelet Rich in Growth Factors (PRGF) technique makes it possible that the healing process of injuries goes about twice as fast as usual.

It uses a patient's own blood plasma and increases its platelet concentration. It can be used in many different fields like Dermatology, Odontology and Ophthalmology and most importantly Traumatology.

Because of the armed internal conflict in Colombia, many people get severely injured by landmines or violence. Colombia is a popular destination for medical tourists and is currently in a stage of economic growth. However, Colombia is also the seventh most unequal country in the world, and knows a very big difference between rich and poor.

Many people are unemployed or they work in the informal sector. These people have no health insurance rights and if they can't pay for the treatment, they will have no chance of getting the care they need.

We want to add a PRGF endoret department to the teletón Manizales clinic that cooperates with the university of La Sabana.

Nowadays, this clinic specializes in a full rehabilitation programme and relies on donations.

The clinic can easily commercialize the PRGF department of the clinic. Because of the diverse applications of PRGF, the paying clients will be the richer citizens of Colombia and medical tourists.

With the profit from the PRGF department, the clinic will become self-sufficient and will be able to provide \$5- treatments for those people, who cannot afford health care.

This programme contributes a lot to Colombian society.

- It is a solution for the poor people in Colombia who cannot afford health care.
- These injured people will recover quickly and be able to go back to work.
- It contributes to the innovative education environment of university La Sabana
- It creates jobs in this country with a lot of unemployment
- It makes Colombia a more interesting medical tourism destination, which boosts the country's economy.

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## Introduction

'Make up a plan to treat Traumatic injuries with regenerative medicine in a developing country.' This was the assignment Imagine gave us when we started with this project.

Regenerative medicine sounds like a difficult subject and, as a matter of fact, it is. Regenerative medicine is a new and broad field of medicine consisting of subjects like stem cell therapy and tissue engineering.

With regenerative medicine we strive to replace lost or non-functional tissue due to age, disease, accidents or congenital defects, with new tissue. This new tissue should resemble the original tissue as much as possible, should be taking over its function and this new tissue should last a lifetime.

The growing need for regenerative medicine is substantial. Globally, the population gets older and older. But with this older population, the regular treatments no longer fit the needs. New sustainable treatments are needed, and those lie within regenerative medicine.

Today, a lot of research in regenerative medicine is being done. Unfortunately, a lot of research still needs to be done before these therapies can be applied in treatment. However, the first regenerative treatments have been started since a few years now.

At TU Twente is a whole department that studies tissue engineering. While we did our practicum<sup>[1]</sup> we imagined that we would treat traumatic injuries using this new technique. Unfortunately, this bubble burst very quickly. The results of our practicum weren't very promising and we found out that there's a long way to go before tissue engineering will be applied for treating traumatic injuries.

Therefore we started looking at the developing country we would use. Prof. Moroni had strongly recommended to use Colombia as the country to use and he was right.

Colombia is well known for its armed internal conflict of which we hear often in the news, but despite this conflict, Colombia has changed into a developing country with lots of opportunities. It has lots of natural resources like oil, gas, metals and coal. Moreover, it has a very favourable range of climates, which stimulates productive agriculture. And there is possibility to high level education and health care as well. Unfortunately, in Colombia there is one of the greatest gaps between rich and poor worldwide and not everyone has access to this high level of education or health care.

Therefore we looked for less expensive regenerative treatments that we could provide to the poor and injured in Colombia. We found the treatment of plasma rich in growth factors (PRGF®-Endoret®) and we are going to use this technique in our business plan.

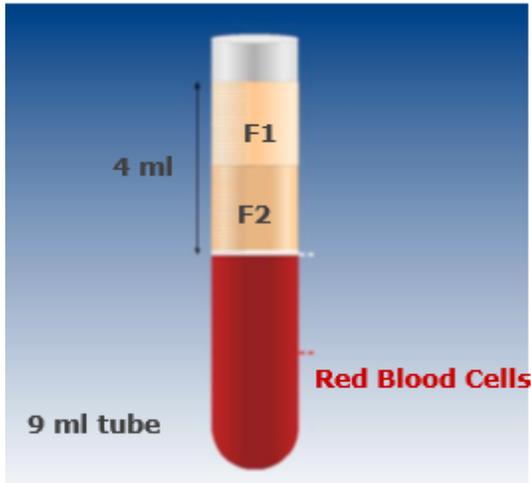
But one question remains: How can we set up a business to bring PRGF-Endoret to the poorest people of Colombia?

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## Core

### PRGF-Endoret

Plasma Rich in Growth Factors (PRGF) is a treatment that can be applied in many different kinds of medicine. It is mainly used in the fields of Odontology (Teeth), Dermatology (Skin), Ophthalmology (Eyes) and Traumatology (Injuries).

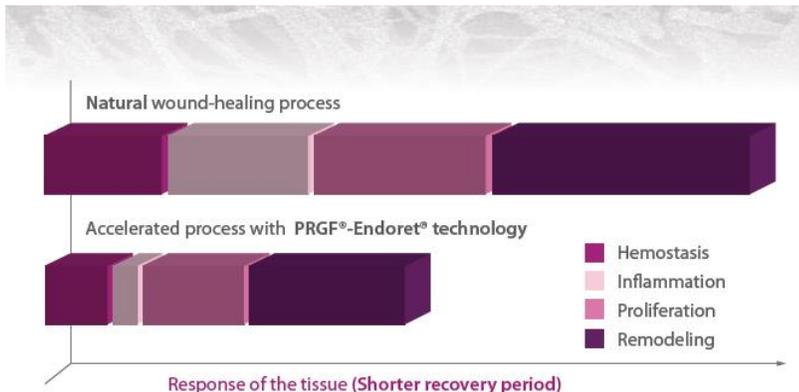


**Figure 1**

in Figure 1, there is no difference in colour between them. Both parts are separated and put into different tubes. F2 must now be activated by an activator (often calcium) within 4 hours and can then be injected in the body parts that need regeneration. However, F1 cannot be injected because of its relatively low platelet count and is used for other goals.

After the PRP is injected, it seals the (hypodermic) wound and releases all kinds of growth factors by forming a new kind intercellular matrix, which is called an  $\alpha$ -granule. The granules are the highways for the growth factors. They are free of bacteria due to the production of antibacterial proteins and they transport the growth factors. When the growth factors are released, they attract undifferentiated cells (stem cells). These stem cells will divide and specialise. They form blood vessels to bring required nutrients and oxygen to the damaged tissue and they form the new tissue that will replace the damaged tissue.

As a result, tissue regeneration will be performed very quickly (See Figure 2). The patient will have less pain and a shortened recovery period, which automatically reduces the chance of infections.



**Figure 2**

This will cause happier patients and less costs for care and rehabilitation. At first PRGF was only used in the dental industry, but after research in other industries, it was concluded that it can be used in all different kinds of fields and in different ways as well.

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If you use PRGF correctly, you can use it in the cosmetic industry.

In that way wrinkles will disappear and someone's skin will look younger. This is very attractive for e.g. TV personalities as a non-toxic replacement for Botox. Moreover, it can be used to accelerate the healing skin ulcers and to treat corneal diseases.

At the moment, it is often used to treat injured (professional) sportsmen and celebrities, because they attach much value to a quick recovery. However, it can also be used for 'normal' people that aren't very rich because the technique is inexpensive. It can be used for people with sports-related injuries, but, more importantly, it can also be used to treat all kinds of traumatic injuries caused by violence. Muscles, cartilage and ligaments all regenerate faster with an injection of PRGF, and prosthesis and bone grafts can integrate more quickly with the aid of PRGF.



On top of that, there are other ways to use PRGF than injecting it. It can be used in the laboratories to enhance cell growth in vitro. These cells can then be used for research. Secondly, it can be used as a scaffold when clotted (Figure 3). This scaffold will be full of growth factors, which is useful in the field of tissue engineering. Last but not least, it can be used as a fibrin membrane. You could see it as a plaster that can seal wounds and stimulates epithelisation, the formation of a scab.

**Figure 3**

There are many advantages to using PRGF over other PRP's. Some of them are named in previous paragraphs, like the many ways in which it can be used and the different fields of medicine it can be used in. Another major advantage of PRGF is the fact that it doesn't contain any leucocytes (white blood cells). This reduces the risk of inflammation, which is a natural response of the body to injuries. Furthermore, it uses only one centrifugation, which reduces the risk of premature activation of the platelets significantly. Lastly, it can be used safely because of the many anti-bacterial components.

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## WHY COLOMBIA

The country in which you want to start a business that provides PRGF treatments must meet the following requirements:

- The country needs to have enough clients, people who would experience benefits from the PRGF treatments.
- The medical care in that country must be highly developed, with enough high educated people to be able to execute this treatment.
- The economy should be stable, so you can successfully invest in a new business and sponsors/investors will support your business.

Colombia came out as the best country possible for this business. The following aspects of the country were good prospects to start a business in PRGF endoret.

### Conflict

Colombia is well known for its armed internal conflict of which we hear often in the news. Since 50 years Non State Armed Groups (NSAGs) have been in conflict with the government.

The human impacts of this conflict have been enormous, with at least 50,000 lives lost to date. Today the main cause of death for people between 15 and 44 years old is violence, because of this conflict.

During the last 50 years locally manufactured mines have been used by the Government and NSAGs to protect bases. Many of the mines and minefields laid by NSAGs still exist. Every year 1000 innocent citizens are severely injured by these landmines.

These accidents lead to a great number of handicapped people, which generates many social problems because there is little re-integration into the working population. The most common handicap is the loss of limbs, which requires important rehabilitation programmes to cope with this loss.

Because of violence and mines a lot of people get severely injured, for all these people PRGF treatments would surely have many positive effects.



### Science Technology and Innovation

Colombia invests a lot in development. Medellin, the cultural capital of Colombia, even has a special Science Technology and Innovation programme (STI). This STI plan focusses on three sectors: energy, health and STI. The plan supports research and development in these sectors in the region of Medellin. This plan was set up to improve the export possibilities of new emerging knowledge businesses in the region of Medellin. In 2012 Medellin won the worldwide contest of "Innovative City of the Year".

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## Medical Tourism

Medical tourism is a new and fast growing industry in Colombia.<sup>[2]</sup> Medical tourists are consumers that are willing to travel across international borders to get quicker access to high quality, and low cost medical care with the most advanced technology. Colombia is a popular destination for medical travellers.<sup>[3]</sup>

The advantage of Colombia for these medical tourists is the inexpensive medical care, without compromised quality.<sup>[4]</sup> Costs are often as much as 50% less than that of comparable procedures in the USA, Europe or elsewhere. Colombia has a sheer amount of internationally acknowledged and well qualified doctors and surgeons, who are equipped with state of the art facilities and cutting edge equipment. The treatments in Colombia are as good as, or even better than their first world counterparts.

The growing medical tourism industry in Colombia increases the amount of customers of a PRGF business in Colombia even beyond the borders of the country.

## Economy

Colombia has the third largest Gross Domestic Product in South America (\$369.6 billion, 2012) The exports have increased fourfold and the Foreign Direct Investments fivefold since 2000. In 2009, while world GDP decreased by 2 percent, the Colombian economy grew by 1.5 percent.<sup>[5]</sup> The nation is quickly becoming one of the world's leading emerging economies. It even has been included in a new class of growing economies (CIVETS), which are selected for their dynamism and high prospects for growth. But not everyone profits from this economic growth.

## PROBLEMS IN COLOMBIA

Colombia has enough prospects to start a PRGF endoret business, but it knows also a lot of problems. A PRGF endoret business could also have a positive impact on some of these problems.

### Poverty, Income Inequality and unemployment

Despite being a middle income country, one third of the Colombian citizens lives below the national poverty line.<sup>[6]</sup> Colombia knows a large income inequality. It even is the seventh most unequal country in the world.<sup>[7]</sup>

60% of national's income goes to only 20% of the population, while the lowest 20% only has 3% of national's income to share. This means that the richest 20% earns 20 times more than the lowest. 8.2% of the population lives on less than \$1.25/day and 16% only has \$2/day to spent. According to the United Nations, the gap between the rich and the poor is even widening.

Inequality in labour earnings has three main causes. Firstly, the unemployment rate, at 11% in 2011 and 8.48 % in 2013 remains high. Secondly, a large share of people is employed in the informal sector, and the income of a majority of them is well below the minimum wage. Thirdly, the wage dispersion in the formal sector is very wide.

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## Large informal sector

Colombia has a really high minimum wage compared to other countries. This, in combination with high non-wage costs in Colombia, lowers the employment prospects in the formal sector for those with low productivity, in particular the young, the low-qualified and people living in remote areas. Therefore the majority of the working population is employed in the informal sector. <sup>[8]</sup> In the informal sector the wages can be 1,8 times lower than in the formal sector for people with the same education level. <sup>[9]</sup> Defining informal workers as those who contribute to neither the health- nor the pension insurance systems, the informality rate in Colombia is as high as 70%!

## Health insurance

Colombian government has established two national health insurances. The Contributory Regime to cover those in the formal sector and the Subsidized Regime to provide health insurance for poor individuals and informal workers. In 2012, more than half of the population was covered by the subsidized regime.

The Subsidized Regime only covers basic primary health care services and selects high-cost catastrophic services.

A large part of the unemployed and the people working in the informal sector cannot afford health care if the Subsidized Regime doesn't cover it. "The corrupt practices vary from insurance company to insurance company, but in general care providers do what they have to do to bill and they don't do what they can't bill for even if that is what will keep the patient alive." (Francisco Yepes, director of postgraduate studies in the Health and Social Security Administration at Pontificia Universidad Javeriana in Bogotá and a former advocate of mixed-market medicine. In the article *A health system in crisis*. 2012 April 3)

Moreover the quality of the health care covered by the Subsidized Regime is not nearly as good as at private hospitals that serve for people who are able to pay for health insurance.

## Fair care programme

We want to set up a programme that combines PRGF treatments with a full rehabilitation in Colombia. We will do this in corporation with the teletón clinic Manizales in Manilla, a city only 200 km away from the city of Medellin. This clinic is part of Colombian university La Sabana and treats people with traumatic injuries, amputations or another forms of handicaps. They specialize in full rehabilitation programmes.

We want to add a PRGF endoret department to this clinic. Because PRGF treatments can be used very well to facilitate the kind of treatments provided in this clinic, the PRGF department will be a valuable contribution to this clinic and its patients.

This clinic accepts patients who are not able to pay for their treatment and have no right of insurance. In other clinics these people would be refused and would not be able to get the care they need. In the teletón clinic Manizales these patients are treated for free. Unfortunately the clinic is very dependent on donations to maintain itself.

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PRGF treatments are only applied in 8 centres worldwide, spread in France and England. By introducing the new innovative PRGF treatment in Colombia, where the treatment could be provided for less money, the clinic will attract a lot of medical tourists. By commercializing the PRGF treatment for medical tourists and the rich, the clinic would become self-sufficient.

## Customers

The PRGF treatment combined with the rehabilitation programme is very useful for everyone who has suffered a traumatic accident, especially for the poor and the people working in the informal sector who can't pay for treatment. A large part of this category of customers in Colombia are the victims of the internal conflict. With these victims in the rehabilitation programme, we will keep a long term personal relation.

However, the PRGF treatment is also very attractive for medical tourists. Medical tourists will only be interested in simple treatments and we will thus only have a short-term relationship with them. These are some different conditions why people could be interested in the PRGF treatment, and why.

Odontology	Faster osseointegration of bone grafts. Quicker healing of surgical wounds. Treatment of periodontal disease.
Dermatology	Healthier way of minimizing wrinkles. Healing of wounds by placing an artificial scab. Treatment of chronic ulcers.
Traumatology	Shortened and less painful recovery period of sports-related injuries. Treatment of bone and muscular injuries.
Ophthalmology	Treatment of corneal ulcers and increasing the eye's biological activity.

## Value proposition

Firstly, the programme provides a solution for the injured people in Colombia that can't afford health care. This group consists of the people in the informal sector and the unemployed citizens in Colombia. Without this programme, these people would have had no chance of getting the care they deserve, and they wouldn't learn how to deal with their handicap and wouldn't reintegrate in society. With the help of this programme they will be able to get the PRGF treatment for only \$5 and so they will participate in society again.

Secondly, the programme makes the Manizales clinic self-sufficient. Hereby this clinic won't be dependent on donations. These donations can then be used for investments to expand and provide even more fair care.

Besides, it creates an education environment in the university La Sabana that has close access to this innovative PRGF technique. This attributes to the name of the university. PhD students of this university have ideal conditions to do research about this technique, which could also result in better treatments.

Moreover, it creates jobs in Colombia. Especially in Colombia where the unemployment rate is very high, this is very important.

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On top of that, this programme makes Colombia an even more interesting destination for medical tourists. These people would pay over \$500 for this treatment, while they can get it for \$100 in Colombia.

## Key recourses and key partners

There are several key recourses needed to make this business successful:

First of all, we need space to treat our clients. This will be provided by the teletón clinic, which is also our most important partner. Since this clinic is mainly dependent on donations, they will profit greatly from a profit-making partner.

Our employees, the traumatology experts, will probably come from the La Sabena University which is a partner of the teletón clinic.

We also need PRGF equipment. This can be bought at the BTI-Technology institute, which is the inventor of PRGF and this company is profit-driven and will therefore sell us as much as they can. BTI-Technology is our second key partner.

For promotion a website will be made by a website builder. This builder will only be a short-term partner, because we will be able to make small adjustments ourselves.

## Programme in Different Stages

### Stage 1: Investment

Equipment and materials will have to be acquired. Also a two-day course will be needed for doctors to practice the PRGF endoret technique. The university La Sabana and the Manizales clinic could raise money invest in the programme.

This programme is also a very good candidate for the STI programme of Medellin, because it fits perfectly in their concept.

- It is an innovative scientific technique
- It improves health (one of the 3 main sectors which the programme is focused on)
- It has very good prospects for export (medical tourism)

Therefore this programme has good chances in obtaining support from the government, through this STI plan.

### Stage 2: Getting started

During and after the investment stage, the focus will be on getting publicity. This will be achieved with a campaign with ads and media attention. To go past borders the internet is very important, we will set up a clear website with information about the costs of a treatment, location of the clinic and other info. Moreover, we can start advertising in US medical magazines, to draw the attention of medical tourists to our clinic.

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## Stage 3: Expending and Treatments

When the PRGF endoret department in de Manizales clinic gets known and runs well, it is time to think about expansion. Within a couple of years, we will be able to expand to other teletón clinics throughout Colombia. The La Sabana students could do research to improve the PRGF treatment or to investigate other innovative treatments to use in the teletón clinics. These treatments could be implemented in the clinics again, and this would attract even more medical tourists. More importantly, we will then be able to provide even better care for the victims of the internal conflict in Colombia.

This programme has a lot of possibilities, the focus however, must stay on the primary goal: making health care available for everyone.

## Costs and Revenues

Getting Started

Years 1-3

<b>Yearly Regular Revenues</b>	
Treatment (250 treatments)	\$25000

<b>One-off Revenues</b>	
STI-project Subsidy	\$4000

<b>Yearly Regular Costs</b>	
Employee Salaries (1)	\$15000
Equipment (250 treatments)	\$1250
Administration	\$3000
Website	\$100
Total	\$21250

<b>One-off costs</b>	
Equipment	\$1000
Training Course	\$1000
Website	\$800
Total	\$2800

In the first 2 to 3 years we will mainly treat medical tourists and rich Colombians to get publicity and become well-known, because these customers are necessary to be able to treat the poor Colombians. A regular treatment will cost \$100.

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Year 4 and further

<b>Yearly Regular Revenues</b>	
Medical tourists Treatment (1250 treatments)	\$125000
Treatment for the poor (2250 treatments)	\$11250
Total	\$136250

<b>One-off costs</b>	
Equipment	\$5000
Training Courses	\$5000
Website (Expansion)	\$1000
Advertisement (Magazines)	\$9000
Total	\$20000

<b>Yearly Regular Costs</b>	
Employee Salaries (6)	\$90000
Equipment (3500 treatments)	\$17500
Administration	\$6000
Website	\$100
Total	\$113600

In the next years we will shift our focus to the poor people, we will treat them for only \$5. The medical tourists will still be treated for \$100. We will also try to expand to a clinic with more different treatments and we will hire more staff. Also, we will try to attract more medical tourist by advertising in magazines.

## Conclusion

Our business plan shows that we can introduce PRGF® Endoret® in Colombia. By making use of medical tourism, we can afford to give the poor a very inexpensive treatment that will shorten their recovery and lessen their pain. In the long term we could expand this business to the main clinic for medical tourists and in that way we can help even more Colombians suffering from injuries caused by violence.

## Special thanks

There are a few people we would like to thank for their contribution to our paper:

First of all: Mr. Zomervrucht, for being such an enthusiastic and understanding mentor throughout the project.

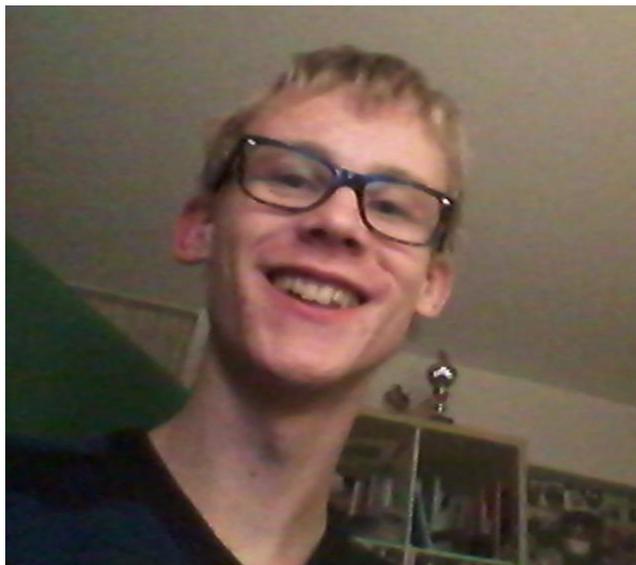
Secondly: Lorenzo Moroni, Ivan Lorenzo and the rest of the Tissue Engineering research group, for showing us the laboratory and giving us the opportunity to feel like real scientists for one day.

Thirdly: Imagine and Lotte van den Berg, because we would never have thought of such a final project without your ideas and ideals.

And of course, you, for taking the time to read this whole paper (at least we hope you did).

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## Contact Information



**Tel** +316 301 885 60

**Tel** +3178 621 2982

[martijn.naaktgeboren@hotmail.com](mailto:martijn.naaktgeboren@hotmail.com)



**Tel** +316 2 4444 137

**Tel** +3178 617 4186

[Lisa.minere@live.nl](mailto:Lisa.minere@live.nl)

## Company Information

**Company name** Teletón clinic Manizales

**Address** Transversale 36 nr. 30-41 Green City. Soacha, Cundinamarca

**Tel** (57 1) 511 1380

**Manager** Pedro Luis Martínez pedro.martinez @teleton.org.co

<http://www.teleton.org.co/CentrosTelet%C3%B3n/Manizales.aspx>



**Company name** Biotechnology institute Human Technology

**Address** 1730 Walton Rd, Suite 110 - Blue Bell, PA 19422

**Tel** (215) 646-4067 / 1 (866) 646-4067

<http://bti-biotechnologyinstitute.com/>



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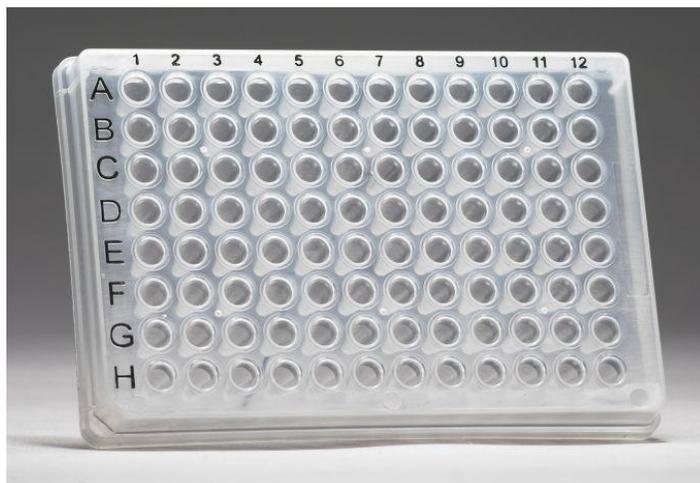
## Annexes

### [1] PRACTICAL PART

During the practical part we tried to find out in which circumstances mesenchymal stem cells, which are stem cells taken from an adult donor, would grow best. For this experiment we used a well-plate in which we could grow our cells in different conditions.

We chose to test the influences of both the concentration of glucose ( $C_6H_{12}O_6$ ) and the concentration of glutamine (an important amino-acid) on cell growth and metabolic activity. All wells were filled with 2000 cells and the minimal essential medium ( $\alpha$ -mem).

In the figure below you can see that there were 4 wells for each condition and there were 9 different conditions. On top of that there were 12 wells with the optimal mixture of nutrients, the Basic Fibroblast growth factor. (BFGF) This is a mixture of basic growth factors such as vitamin C and Fetal Bovine Serum (FBS). Unfortunately FBS consists of plasma taken from cow embryos, which is expensive and unethical. However, it is necessary to cultivate cells. Furthermore there were 12 wells, in which there were only the 2000 cells.



Well Plate

Concentration of glucose in g/L	Concentration of Glutamine in mMol/L												
		0				2				10			
4.5		170187	188106	209746	215780	206488	219336	210578	205545	211991	212575	219791	205825
9		175398	212760	282221	145071	211193	189105	189898	186465	196016	179771	208121	187396
14		182646	179679	192402	191383	195992	179792	194562	183299	193440	199278	199302	180756

Table 1

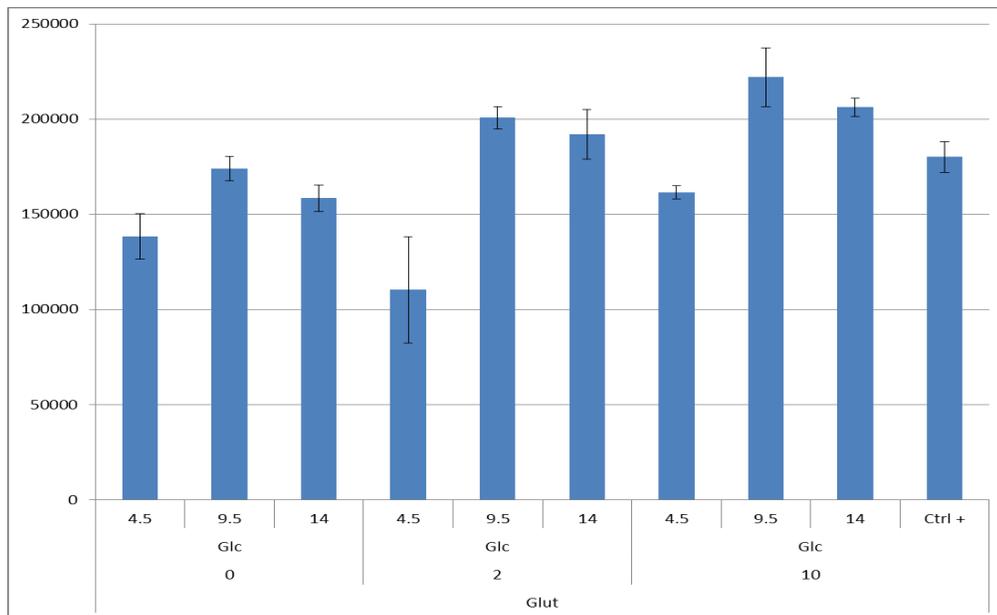
Optimal Condition	17225	18478	20150	19268	20959	20265	20055	19503	19035	18724	18464	19105
s	7	9	2	6	2	2	6	8	0	3	0	2
Only cells	13895	13735	13758	14015	14140	14225	13756	13860	13775	14121	14259	14045

Table 2

The cells were incubated for 2 days and after that, the growth factors were taken out and Presto Blue was added. This is a liquid that reacts with the cells to become fluorescent. After 4 hours we could measure the fluorescence with a Victor3 plate reader. The higher the fluorescence, the higher the metabolic activity in the cells. The numbers in the tables represent the amount of fluorescence emitted by the Presto Blue mixture. It is very clear that the cells without any added

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mixture were very inactive, but the other numbers seem to be very close to each other. Therefore we put them in a graph.



**Graph 1**

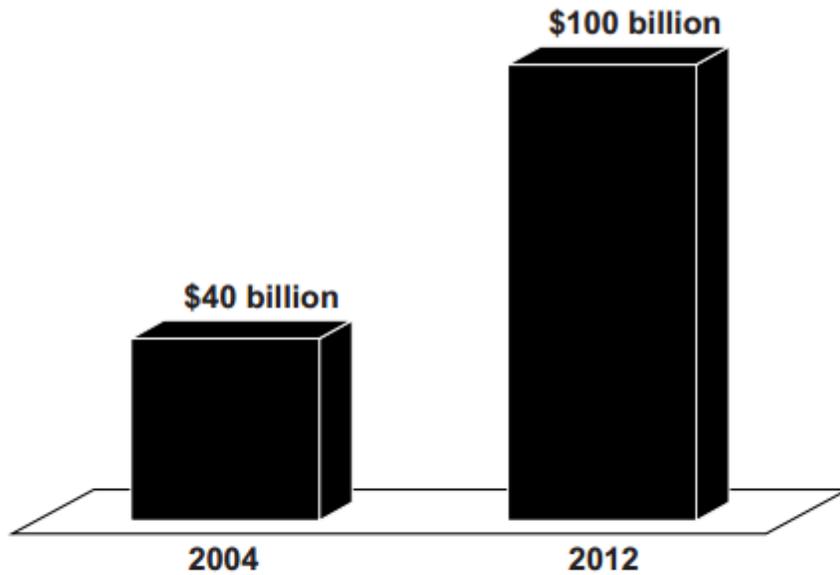
In this graph the average fluorescent emission is shown by the blue bars and the maximum deviation is shown by the black lines. One could conclude that an increase of the glutamine level would stimulate cell metabolic activity and that the optimal glutamine level is around 9.5 g/L. Unfortunately Ivan Lorenzo, the scientist we worked with, made clear that these results were not significant enough, because there are not enough differences between the metabolic activity of the samples and there were too little samples to prove anything.

During the reaction of the cells with PrestoBlue we used a Scanning Electron Microscope (SEM) to observe other cells that had been given time to develop. An SEM emits a beam of electrons. When the beam hits the sample, the atoms of the sample start to react and starts to emit electrons as well. Those electrons are detected by the microscope and then translated into images. Before using the SEM, the sample had to be prepared by sprinkling a thin layer of gold onto the sample to make it electrically conductive. If you use a non-conductive surface, the electrons start to build up and this causes the images to become unclear. When you increase the intensity of the beam, the images become more detailed, but there is a risk to this: When the intensity is too high, it slowly destroys the sample.

# THE NEW GENERATION OF REGENERATION

[2] Growing medical tourism industry

## Worldwide Medical Tourism Industry (billions of U.S. dollars)



Source: McKinsey & Company and the Confederation of Indian Industry.

[3] Medical travelers across the globe



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## [4] Medical Tourism Sample Surgery Cost Chart

Surgery	USA	Colombia	Costa Rica	India	Jordan	Korea	Mexico	Singapore	Thailand
Heart Bypass	\$144,000	\$14,630	\$25,000	\$8,500	\$10,000	\$24,000	\$20,000	\$13,500	\$24,000
Angioplasty	\$57,000	\$7,106	\$13,000	\$8,500	\$5,000	\$19,600	\$16,000	\$7,500	\$7,000
Heart Valve Replacement	\$170,000	\$10,450	\$30,000	\$1,200	\$12,000	\$36,000	\$30,000	\$13,500	\$22,000
Hip Replacement	\$50,000	\$8,360	\$12,500	\$8,000	\$8,000	\$16,450	\$13,125	\$11,100	\$14,000
Hip Resurfacing	\$50,000	\$10,500	\$12,000	\$8,000	\$8,000	\$20,900	\$12,800	\$12,100	\$16,000
Knee Replacement	\$50,000	\$7,106	\$11,500	\$7,000	\$7,000	\$17,800	\$10,650	\$10,800	\$12,000
Spinal Fusion	\$100,000	\$14,500	\$15,000	\$12,000	\$10,000	\$17,350	\$7,000	\$18,300	\$11,000
Dental Implant	\$2,000-10,000	\$1,672	\$1,000	\$700	\$500	\$3400	\$910	\$2,900	\$3,000
Lap Band	\$30,000	\$6,500	\$8,500	\$7,500	\$5,000	\$9,500	\$8,430	\$12,000	\$12,000
Breast Implants	\$10,000	\$2,600	\$3,500	\$4,500	\$3,000	\$11,000	\$8,000	\$5,400	\$3,700
Rhinoplasty	\$8,000	\$1,677	\$5,500	\$3,500	\$2,500	\$4,000	\$4,165	\$2,700	\$3,400
Face Lift	\$15,000	\$3,305	\$5,900	\$7,000	\$3,000	\$3,000	\$7,200	\$4,000	\$6,600
Hysterectomy	\$15,000	\$1,845	\$5,500	\$5,500	\$2,500	\$9,000	\$6,675	\$4,000	\$5,000

Updated July 2009

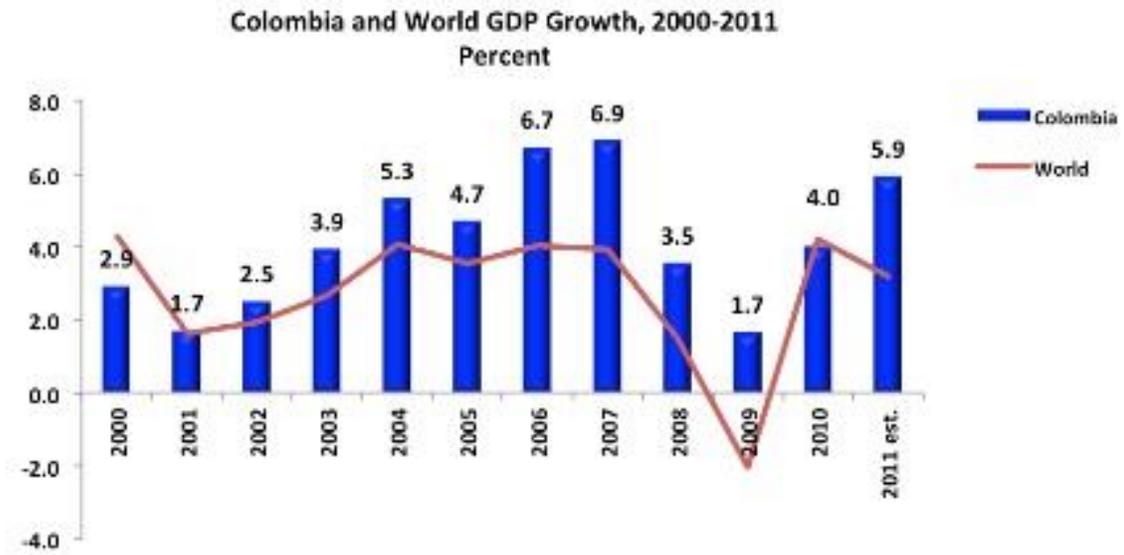
Transplants:	Asia	Latin America	United States
Kidney Transplant	\$43,550	\$30,000	Up to: \$150,000
Liver Transplant	\$134,000	\$75,000	Up to: \$315,000

Updated July 2009

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## [5] GDP Growth Economy

Colombia has a growing and resilient economy. In 2009, while world GDP decreased by 2 percent, the Colombian economy grew by 1.5 percent. In 2011, GDP growth reached 5.9 percent.



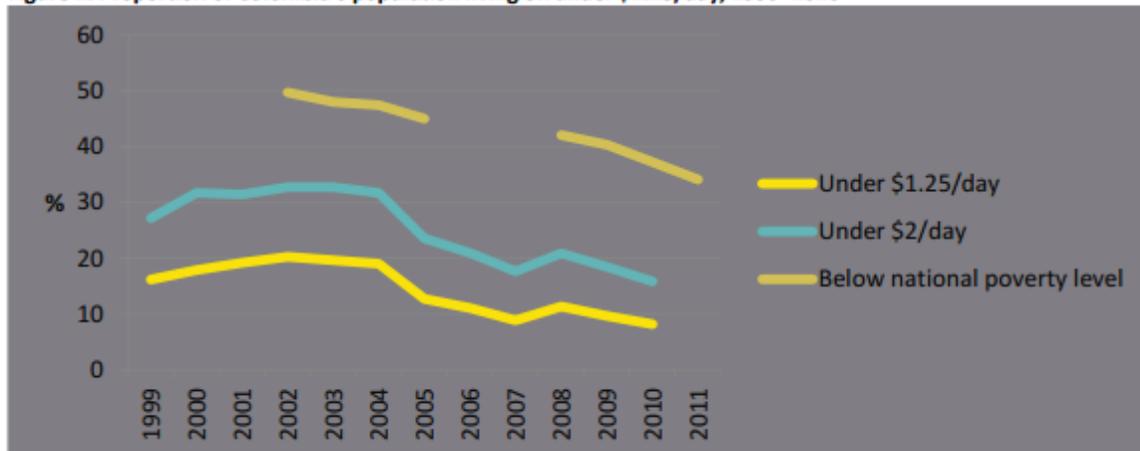
Source: World Bank, World Development Indicators (Sept 2011) and Global Economic Prospects (June 2011); Departamento Nacional de Estadística (DANE).

## [6] Poverty headcount ratio at national poverty line (% of population)

National poverty rate is the percentage of the population living below the national poverty line. National estimates are based on population-weighted subgroup estimates from household surveys.

### Poverty

Figure 2: Proportion of Colombia's population living on under \$1.25/day, 1999–2010

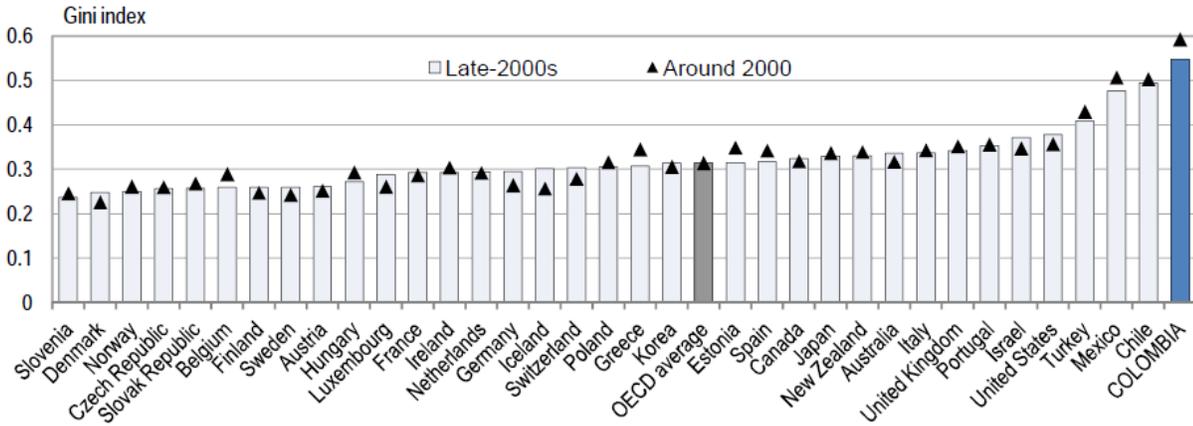


Source: Development Initiatives based on World Bank data

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## [7] High inequality (Gini coefficient)

Here you can see that Colombia has an enormous large income gap, which results in very rich and very poor people in Colombia.

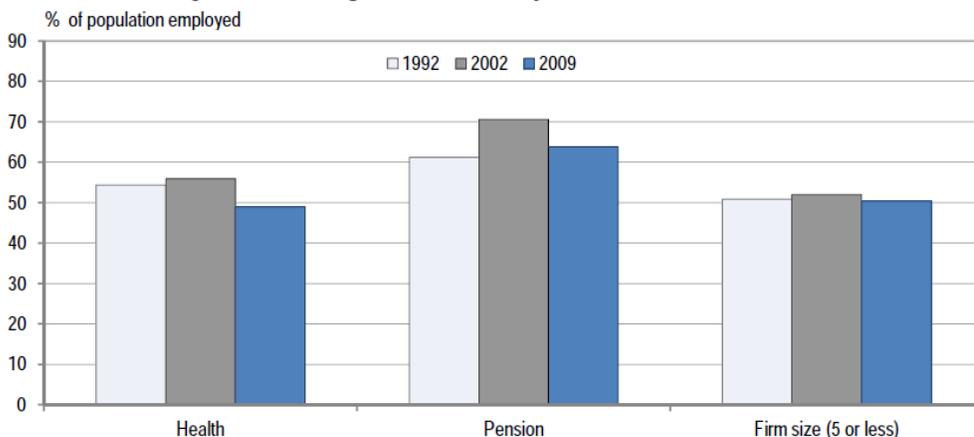


by OECD

The Gini coefficient is a measure of statistical dispersion. It represents the distribution of household's disposable income (market income after taxes and transfers) of the total population. A Gini coefficient of zero expresses perfect equality, this occurs if all values would be the same (where everyone has the same income). A Gini coefficient of one/ 100% it expresses maximal inequality possible (if only one person has all the income)

## [8] Informal sector - Informality rate

Figure 6. The degree of informality varies across definitions



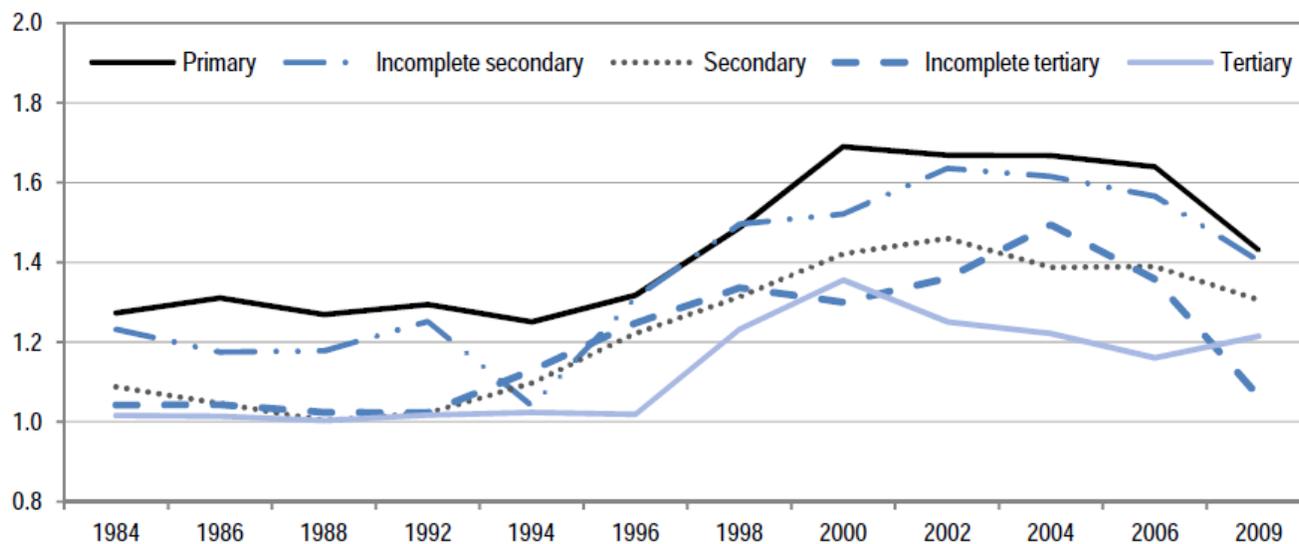
Notes: The health/pension columns relate to the share of those employed, but not contributing to the health/pension insurance schemes. The firm size column corresponds to the share of the population employed in firms of five or less persons. For this column data are for 2007, 2009 and 2012 (not 1992, 2002 and 2009).

Source: Sanchez Torres and Alvarez Vos (2011); DANE.

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## [9] Informal sector - Income gap between formal and informal workers

Figure 7. Income gap between formal and informal workers with the same education level  
Ratio of compensation in the formal to the informal sector



Note: The term "tertiary education" encompasses all the post-secondary education, which Colombians call "educación superior".

Source: Sanchez and Alvarez (2011) based on national household surveys by Colombia's National Statistics Department (DANE).

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