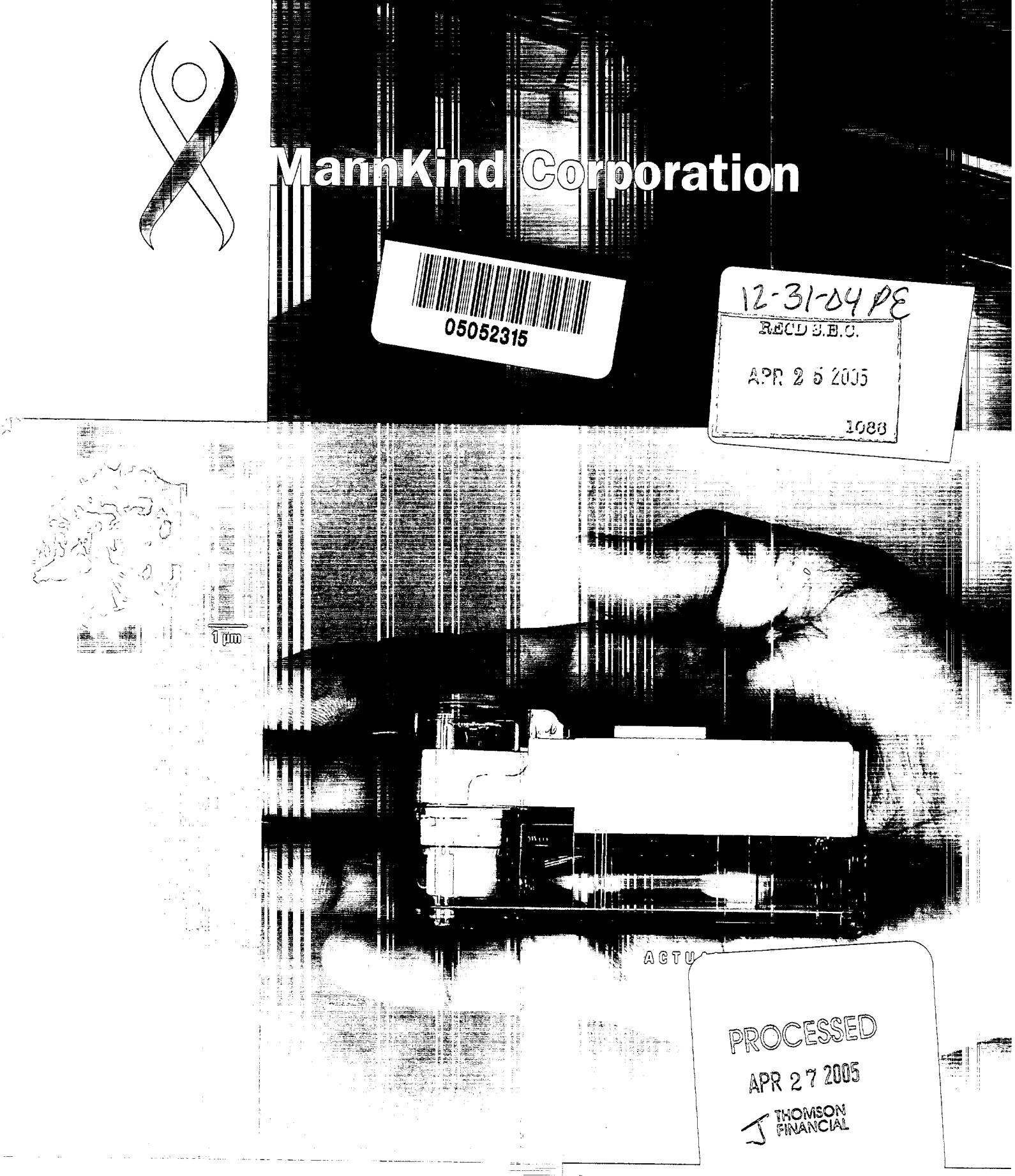
MannKind Corporation



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2004 Annual Report

2004 was an exciting year for MannKind Corporation. We completed the Phase 2 clinical trials of our Technosphere Insulin System in the United States, essentially completing the exploratory phase of trials to establish the optimum dosing for efficacy and safety. We also held the important End-of-Phase 2 meeting with the Food and Drug Administration, to close out this phase of the regulatory process. In Europe, we have already begun Phase 3 pivotal trials, which are the long-term studies to substantiate the efficacy and safety of our product over a broad patient population, and continue to run a late Phase 2 trial of the Technosphere Insulin System. One other important milestone was our initial public offering last summer, in which we raised net proceeds of approximately $83.2 million.

As of 2002, approximately 18.2 million Americans were estimated to have diabetes, which is about 6.3% of the population. Diabetes is currently the fifth leading cause of death by disease and is the leading cause of new cases of blindness among adults, kidney disease and non-traumatic lower-limb amputations. The American Diabetes Association estimates that diabetes in the United States costs society over $132 billion each year. In 2002, the direct cost for the drug treatment of diabetes was estimated at $12 billion.

At MannKind, our focus is the discovery, development and, ultimately, the commercialization of therapeutic products for diseases for which there is a significant unmet medical need, such as diabetes and cancer. Our lead product, the Technosphere Insulin System, is a pulmonary insulin therapy that is currently being evaluated for the treatment of diabetes, and exemplifies the type of groundbreaking product for which we strive at MannKind. This therapy consists of our proprietary dry powder Technosphere formulation of insulin that is inhaled into the deep lung using our MedTone inhaler. As we continue to study the safety and efficacy profile of the Technosphere Insulin System, we are starting to see its potential for changing the way insulin has been used for more than eight decades to treat diabetes, offering patients the possibility of gaining greater control over their blood glucose and avoiding the degenerative health issues associated with the disease.

Today, patients with diabetes are treated using a variety of therapeutic interventions. These range from rigorous management of diet and exercise, to oral medications that act to increase insulin secretion by the pancreas or boost the insulin sensitivity of peripheral tissues, and finally to injections of regular insulin or faster-acting insulin analogs, often along with oral drugs. Insulin therapy is widely considered to be the best treatment for type 2 as well as type 1 diabetes, but patients tend to resist it because insulin has needed to be injected. Sometime in 2006, we expect the first launch by a competitor of a pulmonary insulin product that will offer a less painful and more convenient way to take insulin compared to subcutaneous injections. The introduction of this pulmonary insulin system will be an important advance in diabetes therapy. However, it will essentially only address the inconvenience of insulin injections, as this product appears to act the same as conventional therapy using fast-acting insulin.

We believe that our Technosphere Insulin System will be different from other pulmonary insulin products. In fact, we think it will be better than any other diabetes therapy, either on the market or in development. We believe this because our Technosphere Insulin System delivers insulin to the bloodstream rapidly enough to approximate the first-phase insulin release spike – a signal that normally turns off the release of glucose by the liver when a healthy individual begins to eat a meal, thereby shutting down a supply of glucose that acts to fuel the body between meals. Patients with diabetes cannot produce this first-phase spike, so their liver continues to release glucose, which adds to the glucose absorbed from the meal. As a result, patients develop abnormally high levels of blood glucose, which predisposes them to serious, adverse health consequences.

A first-phase spike in a healthy person normally occurs within 5 to 10 minutes of food first reaching the digestive system. With the Technosphere Insulin System, peak insulin levels are achieved within 10 to 14 minutes of dosing, which is significantly faster than any other marketed or development-stage insulin product. Published reports have stated that other pulmonary insulin products cause insulin levels to peak in a time-frame that is comparable to a subcutaneous injection of rapid-acting insulin analogs, which peak in approximately 35 to 90 minutes.

The ability of the Technosphere Insulin System to approximate the normal first-phase insulin release has led us to suggest that our therapy may be suitable for use throughout the spectrum of type 2 diabetes, even in patients that have not yet progressed to insulin therapy. Currently, oral medications are used after diet and exercise have failed, while insulin injections are reserved for the later stages of the disease. Our clinical trial data shows that the early use of Technosphere Insulin, with its ability to restore the signaling function of the first-phase spike, can lead to better glucose control without the risk of excessive hyperglycemic excursions or hypoglycemia, meaning too much or too little glucose, respectively, both excursions being potentially serious. Key opinion leaders in diabetes believe that improved glucose control could slow or possibly even prevent the progression of the disease. That is why we are so excited about the potential for the Technosphere Insulin System to bring about a paradigm shift in the treatment of diabetes.



In the following pages of this annual report, we describe some recent clinical studies that have examined the ability of our Technosphere Insulin System to control glucose levels. These studies show that we can significantly lower blood glucose levels in patients with type 2 diabetes who previously were experiencing inadequate control of their disease, all without any indication of significant safety concerns.

The year ahead for us will be very active in terms of clinical progress and building for the future. In particular, we plan to complete our European late Phase 2 trial, initiate Phase 3 studies in the United States, complete enrollment of our in-progress European Phase 3 trial and initiate the expansion of our manufacturing capacity to full commercial scale. Our focus for now remains on the Technosphere Insulin program, but we are also developing additional applications for our Technosphere technology by formulating other drugs for pulmonary delivery. We are also moving our cancer program toward renewed clinical trials in 2006.

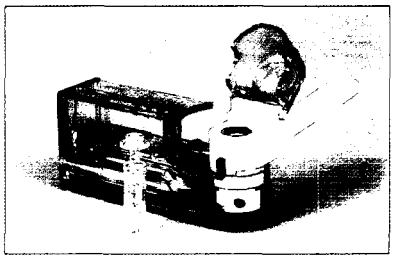
In closing, we would like to extend our appreciation to the investors who have demonstrated their support for the MannKind business strategy and our Technosphere Insulin therapy by participating in our IPO and our earlier private offerings. The investments you have made in our company are funding a thoughtful clinical development program that is advancing into pivotal testing. We look forward to sharing our progress with you in the coming months.

Alfred E. Mann
Chairman and Chief Executive Officer

Hakan S. Edstrom
President and Chief Operating Officer

Focus on Recent Phase 2 clinical studies

TI-003B STUDY (completed Summer 2004)



OBJECTIVE:

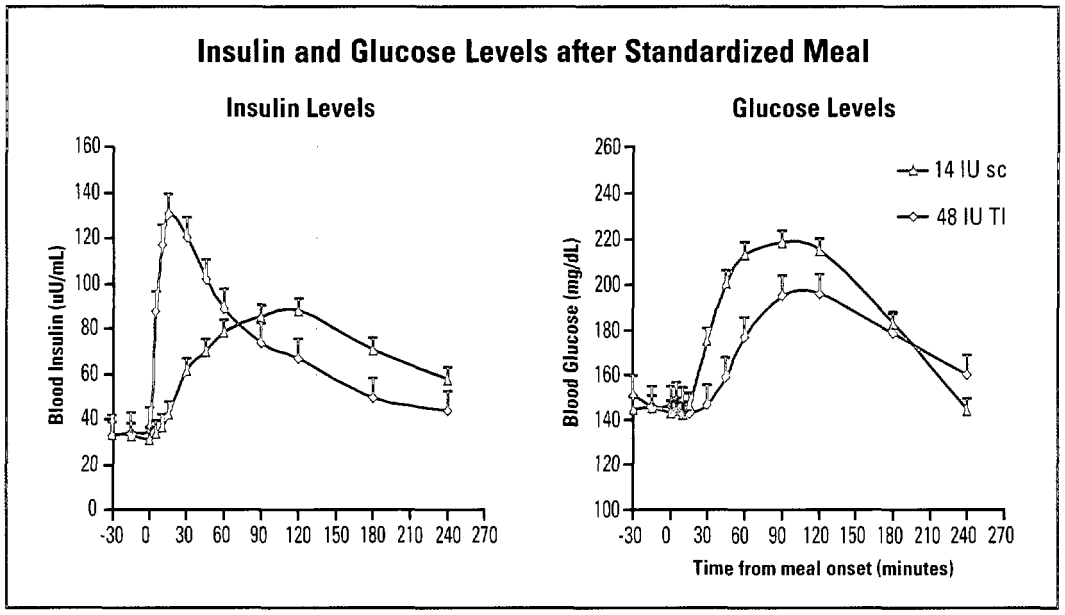
To determine the safety and effect on blood glucose levels of mealtime administration of Technosphere Insulin compared to mealtime administration of subcutaneous insulin.

PATIENT INCLUSION CRITERIA:

We studied 16 patients with type 2 diabetes whose pre-study treatment regimen consisted of separate injections of basal insulin and mealtime insulin. Patients continued their usual basal insulin injections during the study.

STUDY DESIGN:

After screening and receiving diabetes education, patients were randomized into either a group that inhaled Technosphere Insulin or injected subcutaneous regular insulin at mealtimes. Patients received this treatment for a period of 5-7 days. At the end of this period, patients were administered a meal challenge test, which consisted of their mealtime insulin in conjunction with a standardized meal. Following the meal, their blood insulin and glucose levels were monitored for a period of four hours. After a washout period of 2-7 days, patients crossed over to the other treatment for 5-7 days. At the end of the second treatment period, another meal challenge test was administered.

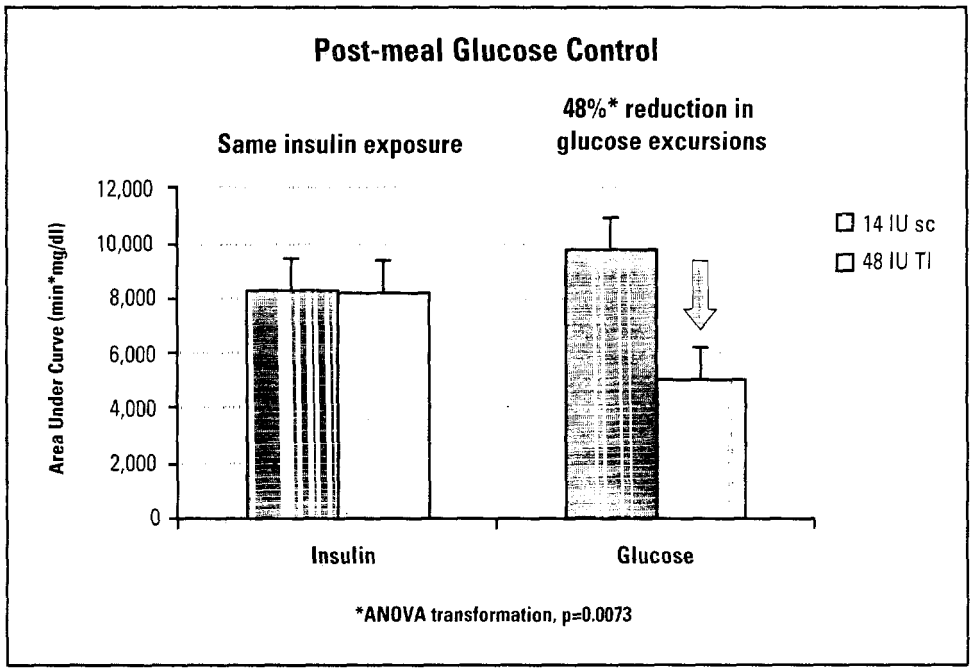


RESULTS:

The graphs to the left show mean blood levels of insulin and glucose following administration of the meal challenge to each patient at the end of the different treatment periods. The graph on the left-hand side shows the mean changes in insulin levels following administration of either Technosphere Insulin or subcutaneous insulin. One of the most striking observations is the rapid appearance of insulin in the bloodstream when Technosphere Insulin is administered as compared to the much slower increase following subcutaneously administered insulin. We have repeatedly observed that inhalation of Technosphere Insulin leads to a rapid rise in blood insulin levels, reaching a peak in 10 to 14 minutes. In contrast, insulin injected subcutaneously can take as long as 120 to 180 minutes to reach peak levels, as shown in the graph. Note that we are able to directly compare these data for Technosphere Insulin and for subcutaneous insulin because these measurements were obtained from a single group of patients that participated in both arms of the study, with each patient acting as his or her own control.

The right-hand side of the graph shows the corresponding post-meal excursions of glucose absorbed from the meal following administration of either Technosphere Insulin or subcutaneous insulin. These data show that Technosphere Insulin was able to limit the excursion of blood glucose levels during the post-meal period to a much greater extent than insulin administered subcutaneously.

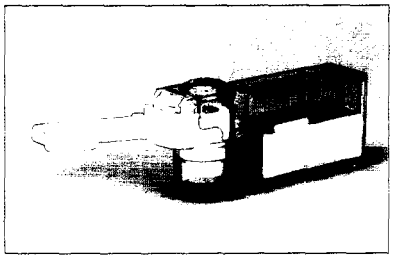
This effect was quantified by calculating the areas under the mean insulin and glucose curves, which are presented in the bar graph below. The bars on the left-hand side show that the areas under the insulin curves were virtually identical, indicating that patients received the same total exposure to insulin, whether from Technosphere Insulin or subcutaneous insulin. However, as shown by the bars on the right-hand side, when patients inhaled Technosphere Insulin, there was a significantly decreased excursion in post-meal levels of blood glucose. Across all patients, the mean excursion of post-meal glucose levels following administration of Technosphere Insulin was 48% less than the mean excursion observed following administration of subcutaneous insulin.

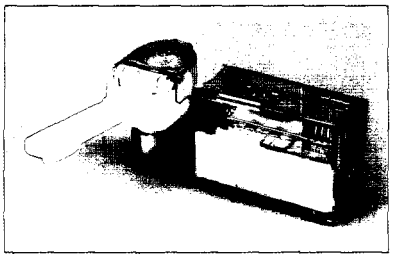


CONCLUSION:

This study suggested that approximating the first-phase insulin release spike allows patients with type 2 diabetes to achieve greater control over their glucose levels during the period immediately after a meal. By acting in this manner, we expect that our Technosphere Insulin System will allow patients with some remaining pancreatic function to achieve greater control over their glucose levels, which we expect may reduce exhaustion of insulin-secreting cells in the pancreas. As well, we would expect that our insulin therapy might be able to achieve better control over the patient's glucose levels throughout the day, not just following a meal. In a separate Phase 2 clinical study, we examined the longer-term effects of mealtime Technosphere Insulin on blood glucose levels. A summary of this study is presented on the following pages.

INS-008 STUDY (completed Fall 2004)





OBJECTIVE:

To evaluate the effect of mealtime use of Technosphere Insulin over a 12-week treatment period to mealtime use of an inhaled placebo (i.e., carrier without active drug), in both cases against a background of ongoing diabetes treatment.

PATIENT INCLUSION CRITERIA:

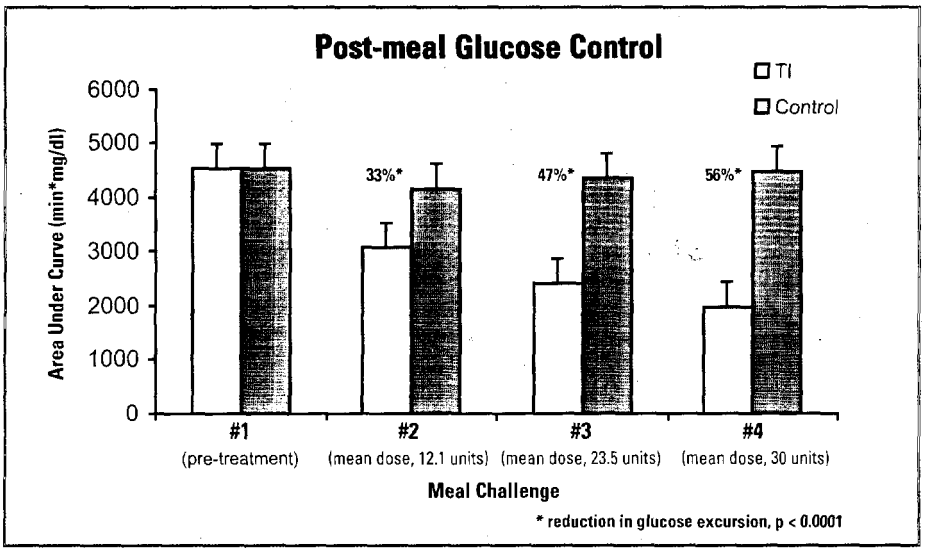
We studied 123 patients with type 2 diabetes whose pre-study treatment regimen consisted of either diet and exercise or one or more oral diabetes medications; we did not include patients whose diabetes had progressed to the point that they were already taking daily insulin. Patients were included in the study if their initial HbA1c level (a measure of the average blood glucose level over the previous three to four months) was between 6.6% and 10.5%, which is an indication that they were not achieving optimal glucose control on their current therapy. Patients were evaluated in two groups: those with moderately severe elevations of HbA1c levels at baseline of 8.0% and above (values identified by the American Diabetes Association as requiring definitive therapeutic intervention to minimize complications) and those with mild to moderate elevations of HbA1c levels at baseline of 6.6% to 7.9%.

STUDY DESIGN:

All subjects received diabetes education and were then randomized into either the mealtime Technosphere Insulin group or the mealtime placebo group in a double-blind fashion. The use of a study agent at mealtimes was the only variable in this study; all subjects continued their usual treatment regimen (diet and exercise or oral medications) for the 12-week duration of the study. On the basis of an initial meal challenge, physicians determined a suitable initial dose. The meal challenge was repeated after four weeks of therapy (meal challenge #2) and then again at eight weeks (meal challenge #3). At any time, physicians could elect to reduce or increase the dose of study drug by 6 or 12 unit increments up to the maximum dose of 48 units. The final visit took place after 12 weeks of therapy, at which time a final meal challenge (#4) was administered.

RESULTS:

There were no serious adverse events related to the use of the study drug. No episodes of severe hypoglycemia occurred in any of the patients treated with Technosphere Insulin. As well, mild hypoglycemic episodes occurred no more frequently in the Technosphere Insulin group than in the control group. With respect to pulmonary function, there was no clinically or statistically significant difference between the baseline values and final test results in the patient group receiving Technosphere Insulin. There was also no evidence of treatment-induced insulin antibodies occurring in patients treated with Technosphere Insulin. Importantly, insulin therapy traditionally leads to weight gain, but in this study there was no weight gain.



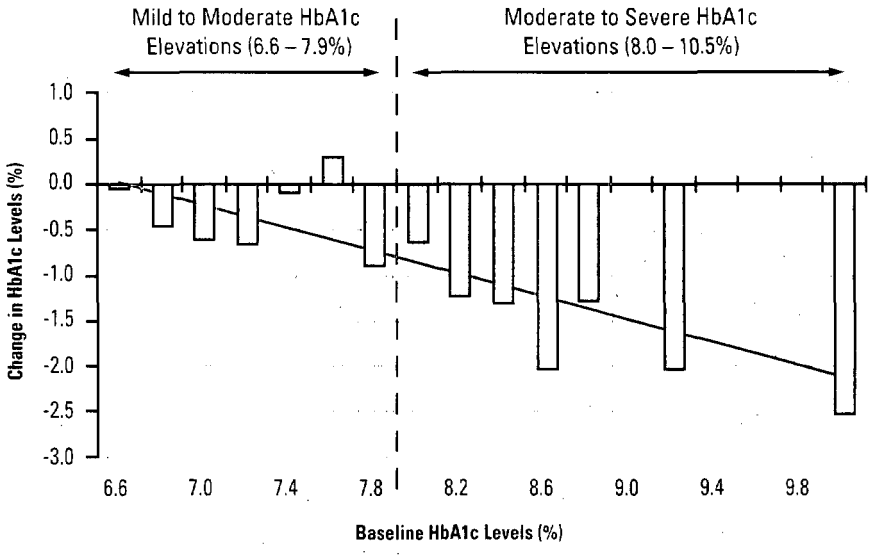
The graph to the left shows the mean post-meal glucose excursions at each of the meal challenges, calculated as area under the time-glucose curve. We observed significant reductions in post-meal glucose excursions in patients that inhaled a dose of Technosphere Insulin at mealtime, compared to the group of patients whose treatment regimen did not include Technosphere Insulin. The improvement in glucose control appeared to have a linear relationship to the dose of Technosphere Insulin administered.

In addition, patients who inhaled Technosphere Insulin prior to each meal demonstrated a significantly greater reduction in HbA1c levels over the study period than was observed in the control group. Patients with moderately severe elevations of HbA1c levels, treated with Technosphere Insulin, experienced a mean reduction of 1.37 percentage points over the limited duration of the study, compared to a mean reduction of 0.51 percentage points in the control-treated group. The difference in reduction of HbA1c levels between the Technosphere Insulin and the control groups was statistically ($p = 0.0007$) and clinically significant in favor of Technosphere Insulin. Patients with mild to moderate elevations of HbA1c levels, treated with Technosphere Insulin, experienced a mean reduction of 0.43 percentage points, compared to a mean reduction of 0.18 percentage points in the control-treated group. This difference was also statistically ($p = 0.0447$) and clinically significant in favor of Technosphere Insulin.

The results obtained in the latter group are noteworthy. In this study, we saw significant reductions in HbA1c levels in patients with only mildly elevated baseline levels – a population for whom insulin therapy would not traditionally be prescribed because the modest expected improvements in glucose control would not justify the heightened risk that these patients would experience hypoglycemia. However, we were able to significantly reduce HbA1c levels without inducing any episodes of severe hypoglycemia or finding any difference in the occurrence of mild to moderate hypoglycemia between the active treatment and control groups.

A goal of this study was to determine the dose of Technosphere Insulin that was most commonly prescribed by physicians in order to bring patients' glucose control to desired levels. During the last four weeks of the study – after patients' glucose levels had stabilized – the mean dose was found to be approximately 30 units of Technosphere Insulin, regardless of whether patients had entered the study with mild or with severe elevations of HbA1c. Interestingly, as illustrated in the graph to the right, the reduction of HbA1c levels across the study population seemed to be proportional to the degree to which HbA1c levels exceeded the normal upper limit at baseline. These observations suggest that Technosphere Insulin therapy may be self-regulating within a certain dose range, which is consistent with our belief that restoring the signaling function of the first-phase insulin release spike provides an important therapeutic benefit in addition to the direct glucose-lowering effect of exogenous insulin.

Trend Suggests Greater Efficacy When Glucose Control is More Severely Impaired



CONCLUSIONS:

The results indicate that Technosphere Insulin can effectively lower blood glucose levels in patients with type 2 diabetes who previously were experiencing inadequate control of their disease. The typical risks of frequent or severe hypoglycemia associated with insulin therapy appear to be minimal with Technosphere Insulin, giving it a potentially significant safety advantage over other therapies. However, HbA1c levels are a gross measure of average blood glucose levels over the preceding three to four months. Given that a number of patients were not dosed at their final maximum level until they had already completed all but a few weeks of treatment, it is somewhat difficult to assess the full impact of Technosphere Insulin on blood glucose levels from this Phase 2 study. We plan to examine HbA1c data, as well as the effect of Technosphere Insulin on post-meal glucose excursions, in the longer-term studies planned for Phase 3, which are expected to study efficacy over 26 weeks of treatment.

MannKind Corporation

Corporate Information

Board of Directors

Alfred E. Mann
Chairman
& Chief Executive Officer

Hakan S. Edstrom
President, Chief Operating Officer
& Director

Kathleen Connell, Ph.D.
President, Connell Group, Inc.

Ronald Consiglio
Managing Director,
Synergy Trading

Michael A. Friedman, M.D.
President & Chief Executive Officer,
City of Hope National Medical Center

Llew Keltner, M.D., Ph.D.
Founder & Chief Executive Officer,
EPISTAT

Kent Kresa
Chairman Emeritus,
Northrop Grumman Corporation

David H. MacCallum
Managing Partner,
Outer Islands Capital, L.P.

Henry L. Nordhoff
President & Chief Executive Officer,
Gen-Probe Incorporated

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Chairman
& Chief Executive Officer

Hakan S. Edstrom
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& Director

Richard L. Anderson
Corporate Vice President
& Chief Financial Officer

Dan R. Burns
Corporate Vice President &
President, BioPharmaceuticals

Wayman Wendell Cheatham, M.D., FACE
Corporate Vice President
& Chief Medical Officer

Diane M. Palumbo
Corporate Vice President,
Human Resources

David Thomson, Ph.D., J.D.
Corporate Vice President, General
Counsel & Corporate Secretary

Annual Meeting

The Company's annual meeting of stockholders will be held:

May 24, 2005
9:00 a.m. (Pacific)
Valencia Hyatt Hotel
24500 Town Center Drive
Valencia, CA 91355

Transfer Agent

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Los Angeles, CA 90071

Legal Counsel

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Independent Auditors

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Stock Information

MannKind Corporation stock is publicly traded on the NASDAQ National Market under the symbol "MNKD."

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Investor Relations

Reports regarding the Company are filed electronically with the SEC. You may access these reports and additional information without charge from our website at www.mannkindcorp.com and from the SEC's website at www.sec.gov. In addition, you may contact the Company's investor relations department through "Information Request" on the Company's website or by sending an email to: IR@mannkindcorp.com.

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This material contains forward-looking statements relating to the development and efficacy of MannKind's proposed products and future operating results that are subject to certain risks and uncertainties that could cause actual results to differ materially from those projected. The words "believe," "expect," "intend," "anticipate," "plan," variations of such words, and similar expressions identify forward-looking statements, but their absence does not mean that the statement is not forward-looking. These statements are not guarantees of future performance and are subject to certain risks, uncertainties and assumptions that are difficult to predict. Factors that could affect MannKind's actual results and the development of its proposed Technosphere Insulin product include conditions in the capital markets in general and in the life science sector in particular, specifically those that may affect potential future financing sources for the development of MannKind's business, the progress and costs of clinical trials and the timing of regulatory approvals, the availability of clinical materials from third-party suppliers, and MannKind's ability to manufacture and commercialize Technosphere Insulin in a timely and cost-effective manner, and other risks and uncertainties described in MannKind's current and periodic reports filed with the Securities and Exchange Commission, including MannKind's annual report on Form 10-K for the year ended December 31, 2004.