Interdisciplinary Cancer Risk Management:

Canadian Life and Economic Impacts

Introducing Life at Cancer Risk

Presentation to the 1st Cancer Control Congress in Vancouver,

October 23-26, 2005

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RISK Analytica

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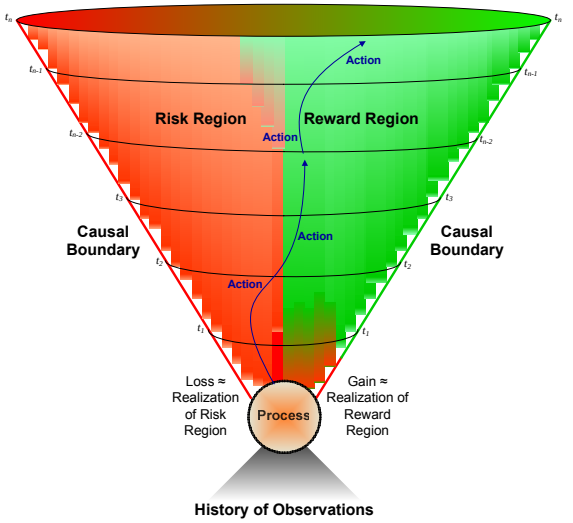
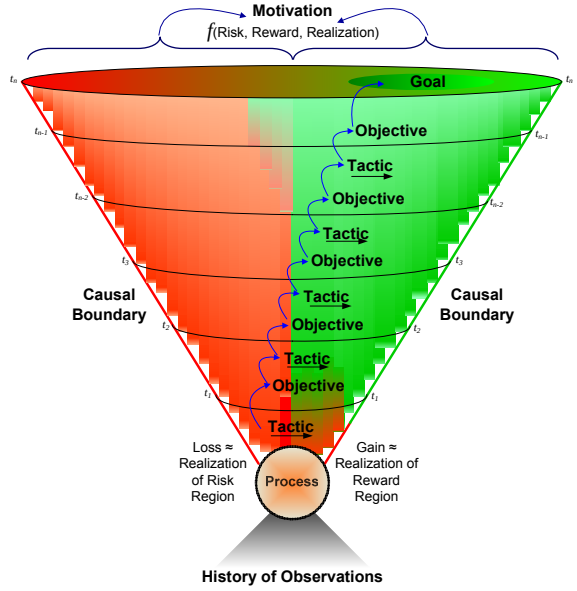
Life at Cancer Risk: Basic Messages

- Risk Management is about influencing possibilities towards rewards and away from risks. The realization of gains and the avoidance of loss.
- No such thing as a predictions, just regions/forecasts of possibility
- Getting it roughly right rather than exactly wrong
- Problem definition: distinguishing between what can and cannot be done
- Application of Physics provides reliability, accuracy, discipline and endurance/repeatability
- Application of risk measurement/management practices provides relevant and actionable metrics for human action





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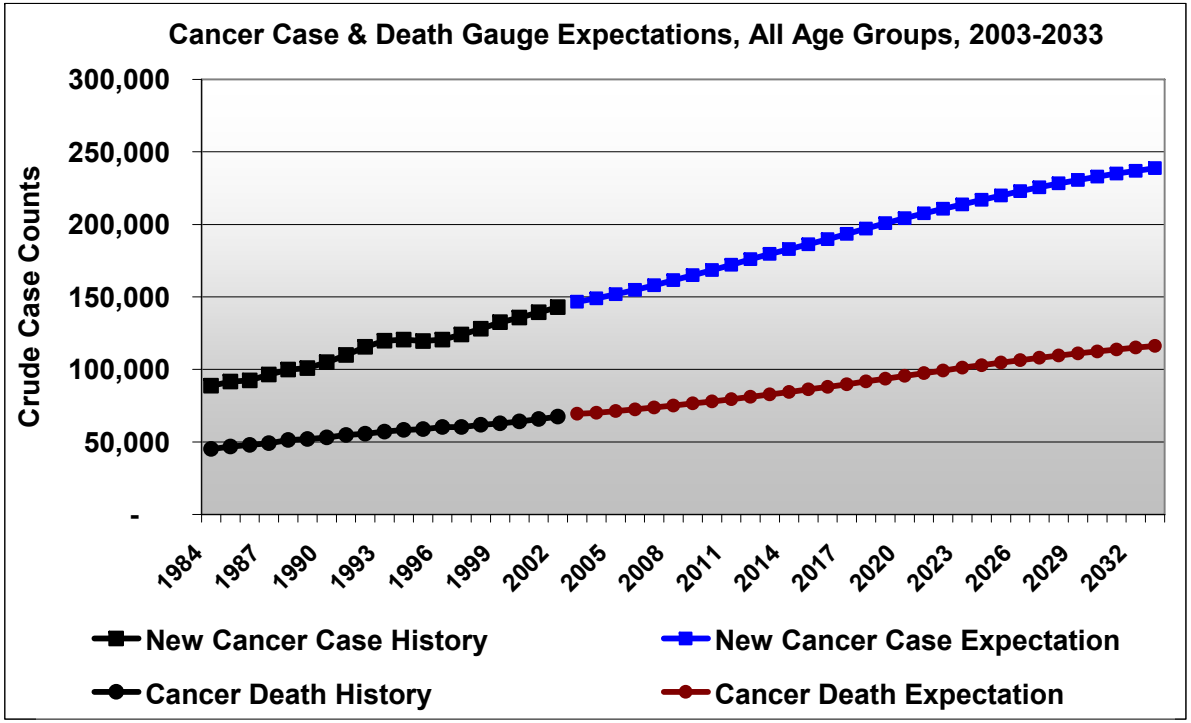
The Problem: As traditionally Identified

The problem is usually defined in terms of the expected size and timing of the actual phenomena.

This is not a measurement of the problem.



Source: RiskAnalytica Life at Cancer Risk 2005

Citation: Smetanin, Paul., and Kobak, Paul. Canadian Life at Cancer Risk. Sponsored by The National Cancer Institute of Canada and RiskAnalytica, October 2005.

Cancer Control is a continuous management action requiring:

- Understanding of the possible paths of cancer propagation and impacts
- Significant foresight
- Communication using different languages (medicine, life, economics)
- Understanding of differences
- Performance Evaluation, monitoring of resource utilization

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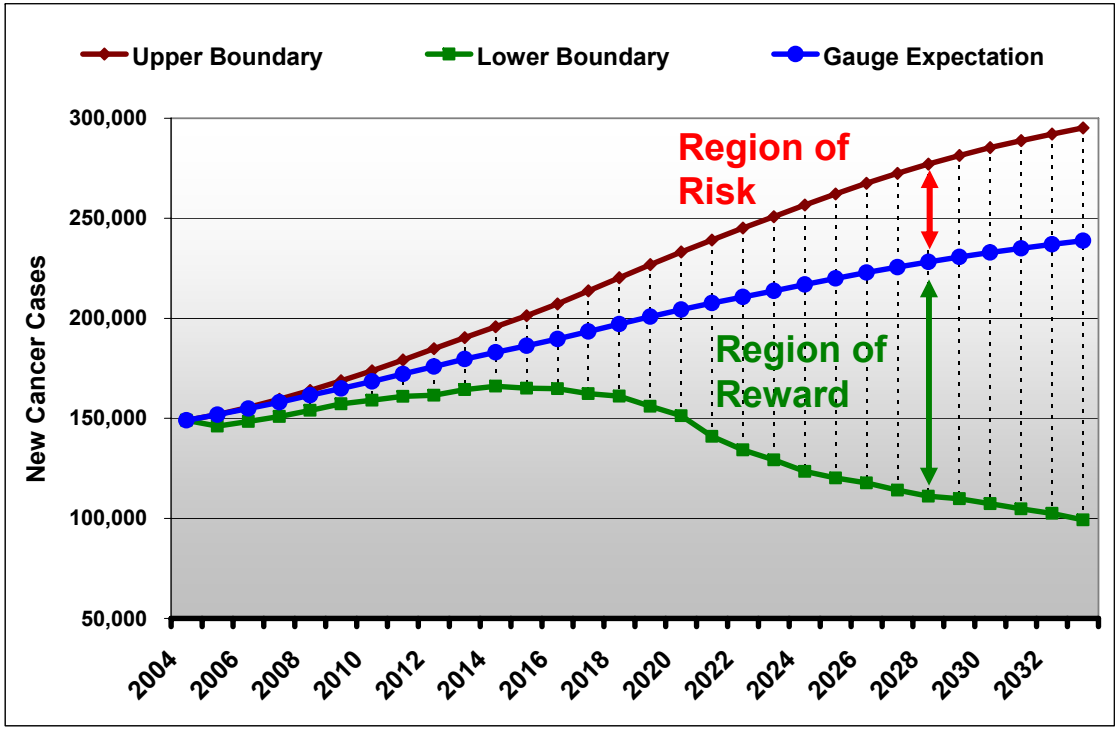
Life at Cancer Risk: New Cancer Case Results

New Cancer Case Possibility Space, Yearly, 2004-2033, All Age Groups, Both Genders



Cumulative (2004-2033)

Cancer Case Simulations

	Total New Cancer Cases 2004-2033	Total Cancer Deaths 2004-2033	2033 Cancer Prevalence	Total PYLL Disability & Death 2004-2033
→	6,688,011	3,213,655	2,257,201	58,704,365
→	5,911,283	2,787,275	1,763,644	51,592,365
→	4,193,791	2,070,304	1,293,398	40,737,668

Source: RiskAnalytica Life at Cancer Risk 2005

Citation: Smetanin, Paul., and Kobak, Paul. Canadian Life at Cancer Risk. Sponsored by The National Cancer Institute of Canada and RiskAnalytica, October 2005.

New Cancer Cases expected to rise 55.5% over the next 20years (2004-2023) as compared to the previous 20years (1984-2003)

The essence of human action is the management towards regions of reward and away from regions of risk. Cancer control action: Maximizing the reduction of cancer impact possibilities, Minimizing the increase of cancer impact possibilities, Under constraints.

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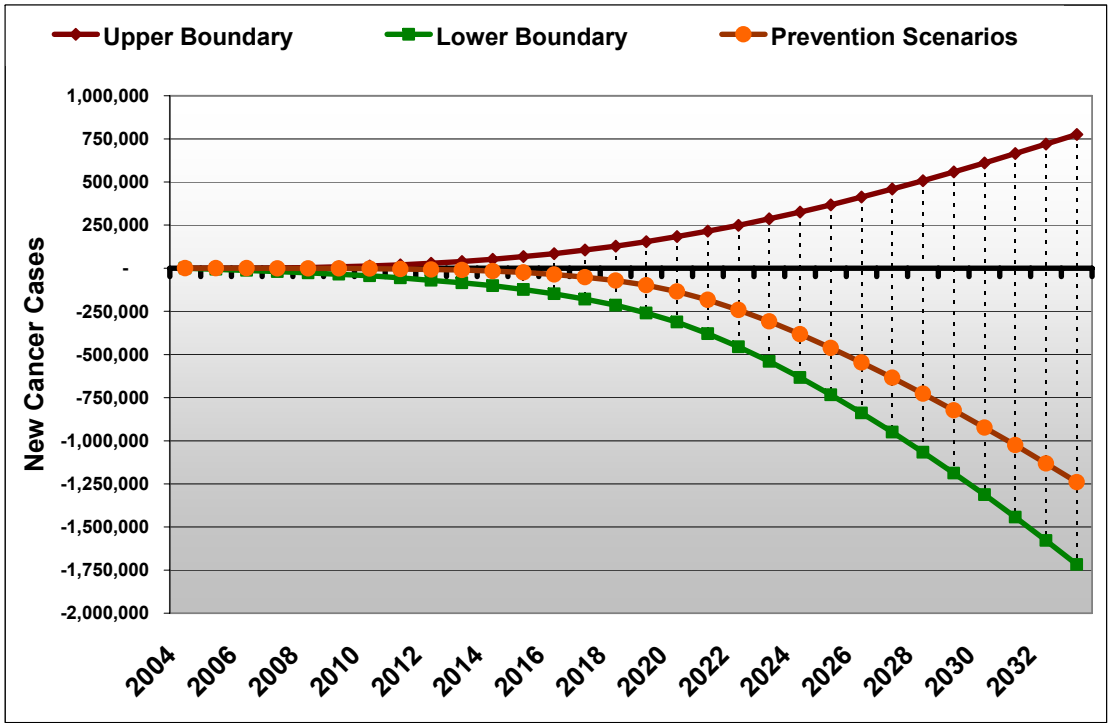
Life at Cancer Risk: Prevention Bundle Results

New Cancer Case Possibility Space, 2004-2033 Cumulative Differences from Gauge Expectation, All Age Groups, Both Genders



Cumulative (2004-2033)

	New Cancer Case Simulations		Cancer Death Simulations	
	Difference from Gauge Expected 2004-2033	Total New Cancer Cases 2004-2033	Difference from Gauge Expected 2004-2033	Total Cancer Deaths 2004-2033
→	776,728	6,688,011	426,380	3,213,655
→	0	5,911,283	0	2,787,275
→	-1,239,843	4,671,440	-423,224	2,364,051
→	-1,717,492	4,193,791	-716,971	2,070,304

Source: RiskAnalytica Life at Cancer Risk 2005

Citation: Smetanin, Paul., and Kobak, Paul. Canadian Life at Cancer Risk. Sponsored by The National Cancer Institute of Canada and RiskAnalytica, October 2005.

Cancer Control is a continuous management action requiring significant foresight:

21% Prevention of new cancer cases over 30 years

15.1% Prevention of premature cancer deaths over 30 years

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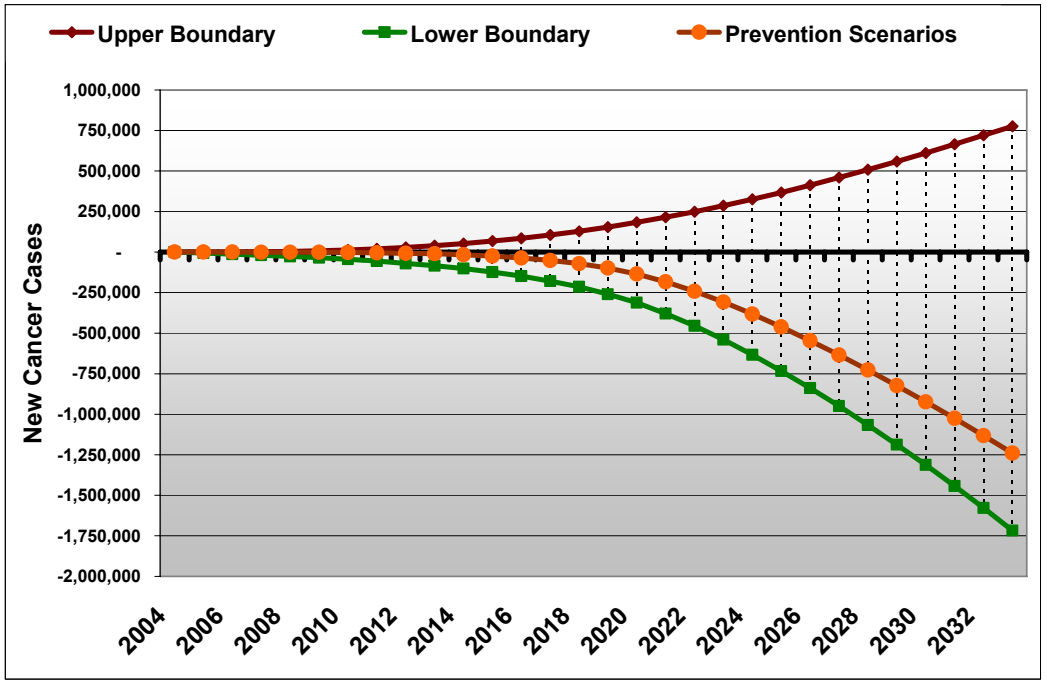

Cumulative (2004-2033) $Billion

	Private Sector Economic Valuation		Public Sector Economic Valuation	
	Private Sector Disposable Income, Difference from Expected	Private Sector Disposable Income $2004 Present Value	Public Sector Disposable Income $2004 Present Value	Public Sector Disposable Income $2004 Present Value
→	-$97	-$642	-$29	-$456
→	$0	-$545	$0	-$427
→	$106	-$439	$72	-$355
→	$139	-$406	$96	-$331

Source: RiskAnalytica Life at Cancer Risk 2005

Citation: Smetanin, Paul., and Kobak, Paul. Canadian Life at Cancer Risk. Sponsored by The National Cancer Institute of Canada and RiskAnalytica, October 2005.

Cancer Control requires communication in different languages

Prevention of 18.1% Lost Wages, 13.5% of Lost Taxation Revenue, 21.4% of Increased Heath Costs over 30 years

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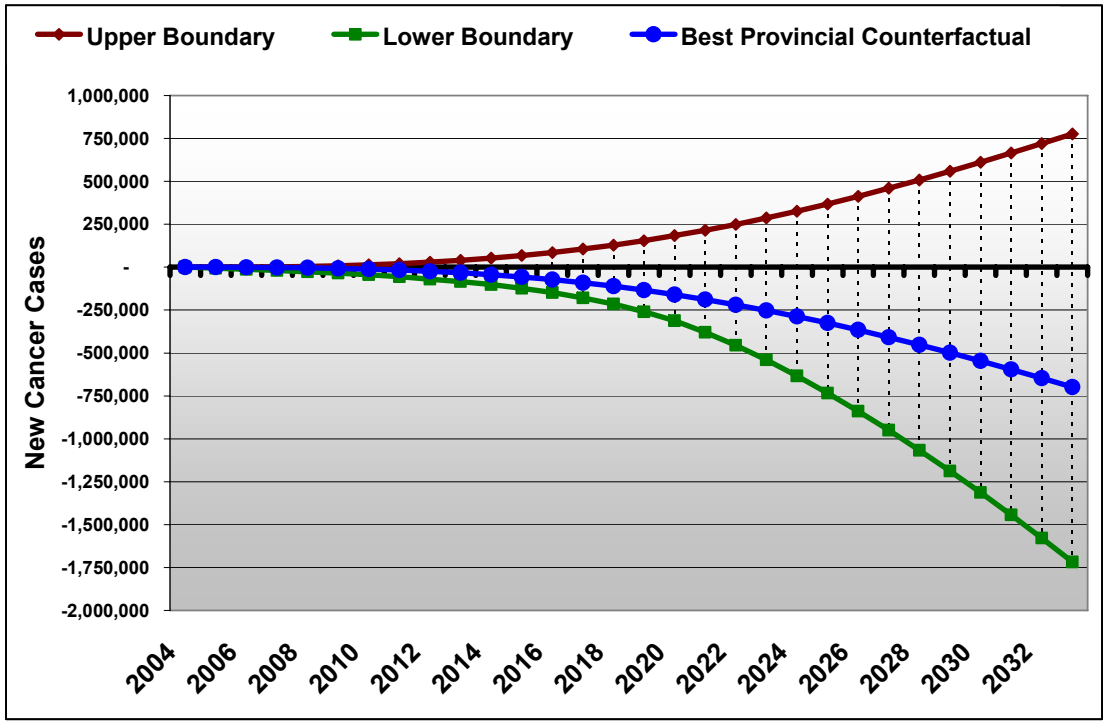
Life at Cancer Risk: Best Provincial Counterfactual Results

New Cancer Case Possibility Space, 2004-2033 Cumulative Differences from Gauge Expectation, All Age Groups, Both Genders



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→	776,728	6,688,011	426,380	3,213,655
→	0	5,911,283	0	2,787,275
→	-698,999	5,212,284	-379,743	2,407,531
→	-1,717,492	4,193,791	-716,971	2,070,304

Source: RiskAnalytica Life at Cancer Risk 2005

Citation: Smetanin, Paul., and Kobak, Paul. Canadian Life at Cancer Risk. Sponsored by The National Cancer Institute of Canada and RiskAnalytica, October 2005.

Cancer Control requires understanding differences:

11.8% Prevention of new cancer cases over 30 years

13.6% Prevention of premature cancer deaths over 30 years

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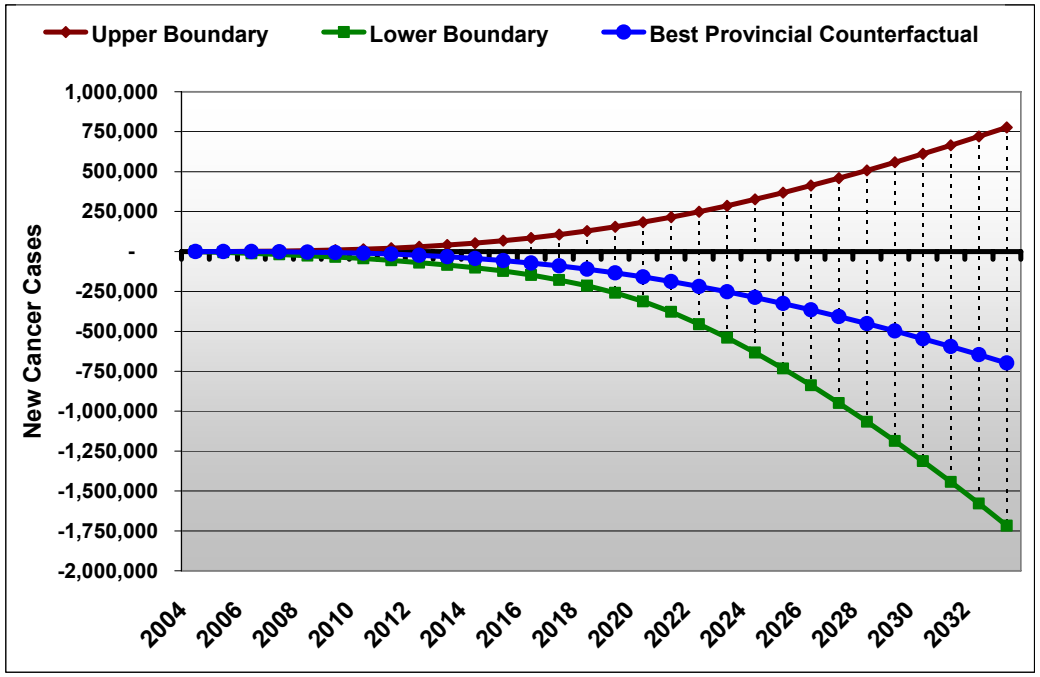
Life at Cancer Risk: Best Provincial Counterfactual Results

New Cancer Case Possibility Space, 2004-2033 Cumulative Differences from Gauge Expectation, All Age Groups, Both Genders



Cumulative (2004-2033) $Billion

	Private Sector Economic Valuation		Public Sector Economic Valuation	
	Private Sector Disposable Income, Difference from Expected	Private Sector Disposable Income $2004 Present Value	Public Sector Disposable Income $2004 Present Value	Public Sector Disposable Income $2004 Present Value
→	-$96.6	-$641.8	-$28.9	-$456.1
→	$0.0	-$545.2	$0.0	-$427.2
→	$85.9	-$459.3	$41.0	-$386.2
→	$139.4	-$405.9	$96.4	-$330.8

Source: RiskAnalytica Life at Cancer Risk 2005

Citation: Smetanin, Paul., and Kobak, Paul. Canadian Life at Cancer Risk. Sponsored by The National Cancer Institute of Canada and RiskAnalytica, October 2005.

Cancer Control requires understanding differences:

Prevention of 12.4% Lost Wages, 7.3% of Lost Taxation Revenue, 12.9% of Increased Heath Costs over 30 years

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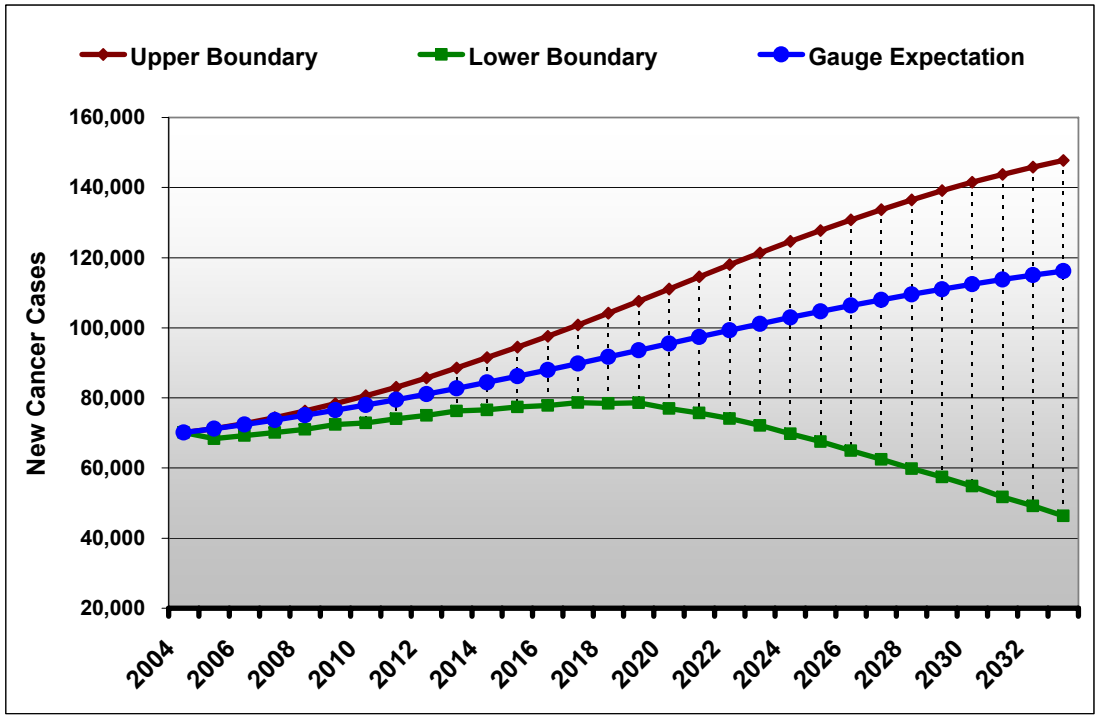
Life at Cancer Risk: Cancer Death Results

Cancer Death Possibility Space, Yearly, 2004-2033, All Age Groups, Both Genders



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Cancer Case Simulations

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→	4,193,791	2,070,304	1,293,398	40,737,668

Source: RiskAnalytica Life at Cancer Risk 2005

Citation: Smetanin, Paul., and Kobak, Paul. Canadian Life at Cancer Risk. Sponsored by The National Cancer Institute of Canada and RiskAnalytica, October 2005.

Premature Cancer Deaths for the population expected to rise 47.8% over the next 20years (2004-2023) as compared to the previous 20years (1984-2003)

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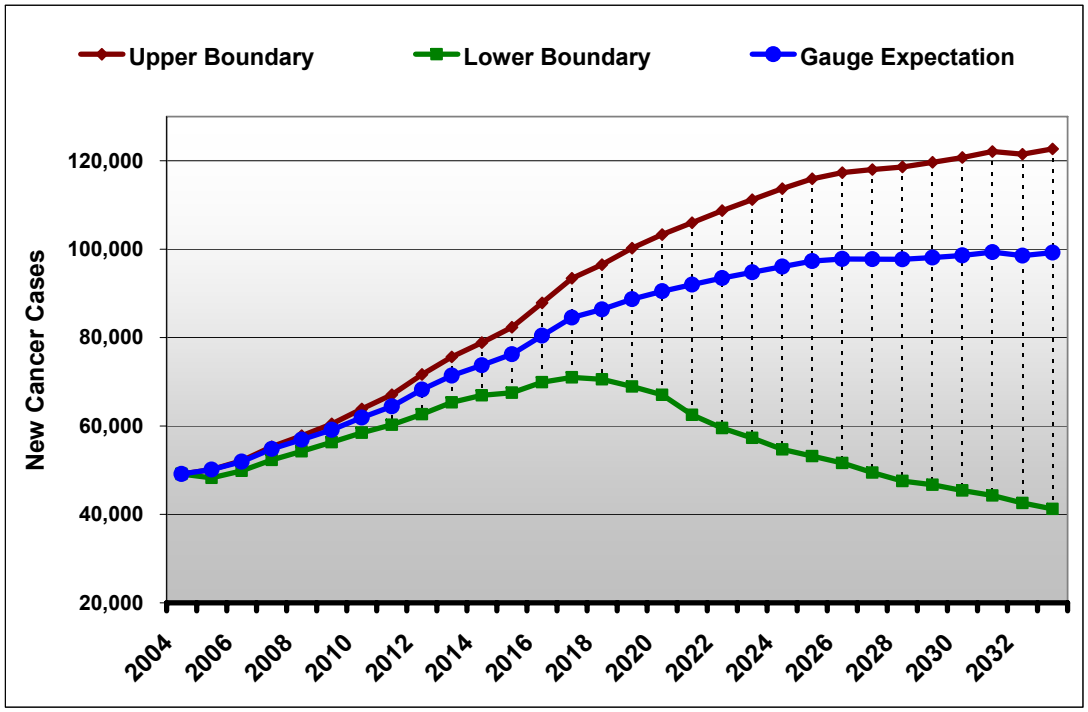
Life at Cancer Risk: Labour Force Results

Labour Force, New Cancer Case Possibility Space, Yearly, 2004-2033, All Age Groups, Both Genders



Cumulative (2004-2033)

Cancer Case Simulations

	Total New Cancer Cases 2004-2033	Total Cancer Deaths 2004-2033	2033 Cancer Prevalence	Total PYLL Disability & Death 2004-2033
→	2,762,335	1,011,775	1,003,158	23,520,971
→	2,429,618	872,504	880,473	21,009,321
→	1,695,383	605,753	598,760	16,203,577

Source: RiskAnalytica Life at Cancer Risk 2005

Citation: Smetanin, Paul., and Kobak, Paul. Canadian Life at Cancer Risk. Sponsored by The National Cancer Institute of Canada and RiskAnalytica, October 2005.

Cancer Control requires considering different perspectives:

New Cancer Cases for the labour force expected to rise 107.3% over the next 20years (2004-2023) as compared to the previous 20years (1984-2003)

Premature Cancer Deaths for the labour force expected to rise 84.4% over the next 20years (2004-2023) as compared to the previous 20years (1984-2003)

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Some Physics Concepts

- **System:** A group of agents which interact according to a common set of dynamical laws.
- **Perspective:** Each agent is characterized by a unique perspective with respect to which all measurements are performed. Parallel transports provide a means of connecting these perspectives.
- **Invariance of dynamics:** The laws which govern the evolution of the system as well as the evolution of the agents cannot depend on the choice of the perspective (units used).
- **Optimization of Action**: The evolution equations must result from the optimization of an invariant action.
- **Intrinsic incompleteness:** Statements about the system made within a perspective must be incomplete (Gödel, 1931).
- **Completeness of states:** An agent's state cannot be represented by an exo perspective (external to the system) and an endo perspective (external to the system) simultaneously.
- **Correspondence Principle**: The results of any simulation based on the adopted rules must reduce to a series of simple limits (in which the behavior is known).
- **Possibility:** The generation of possibility space (within a unique perspective) can be approximated by a series of stochastic processes which are constrained by the action of the environment. The action principle determines the future path of the agent with respect to all simulations of possibility.

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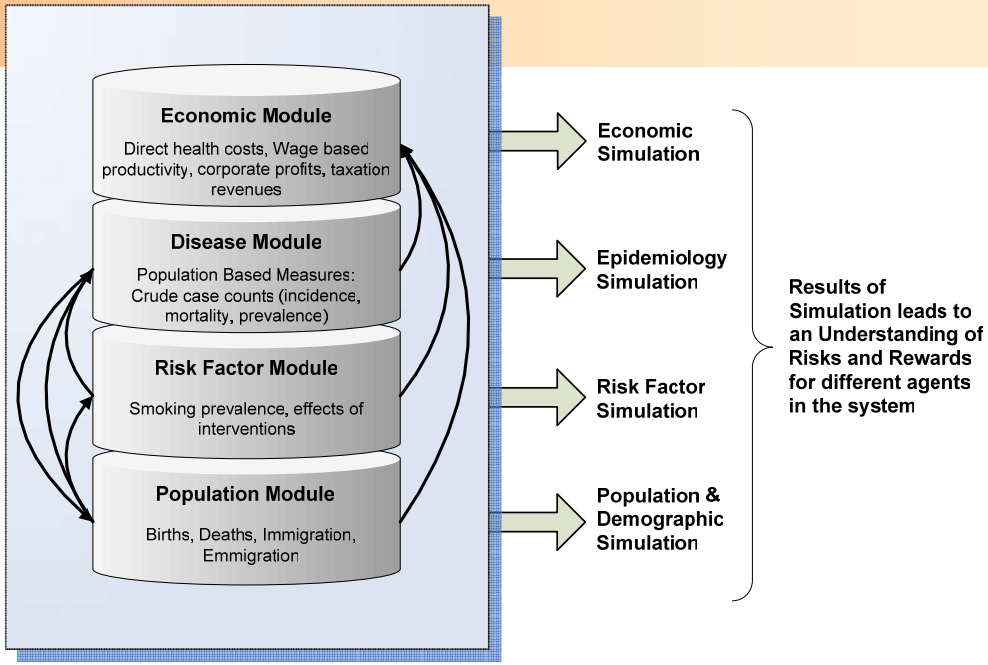
Model Outline

The model employs:

- Lattice gauge theory to help establish an invariant action.
- Differential geometry to establish the mathematical representation of each (relevant) perspectives and their respective relationships (parallel transport).
- A hybrid Monte Carlo algorithm to simulate the possible future states.
- Kolmogorov-Smirnov test to determine the best transition probability distributions.
- Lyapunov analysis to determine numerical convergence and help understand the source of any possible non linear dynamical behavior.



- Perturbation and Approximation theory to establish the respective contributions of the environment and the agent on the dynamics of the system.
- General Relativity to help interpret the geometrical representation of the model in the context of a Cancer risk management framework.

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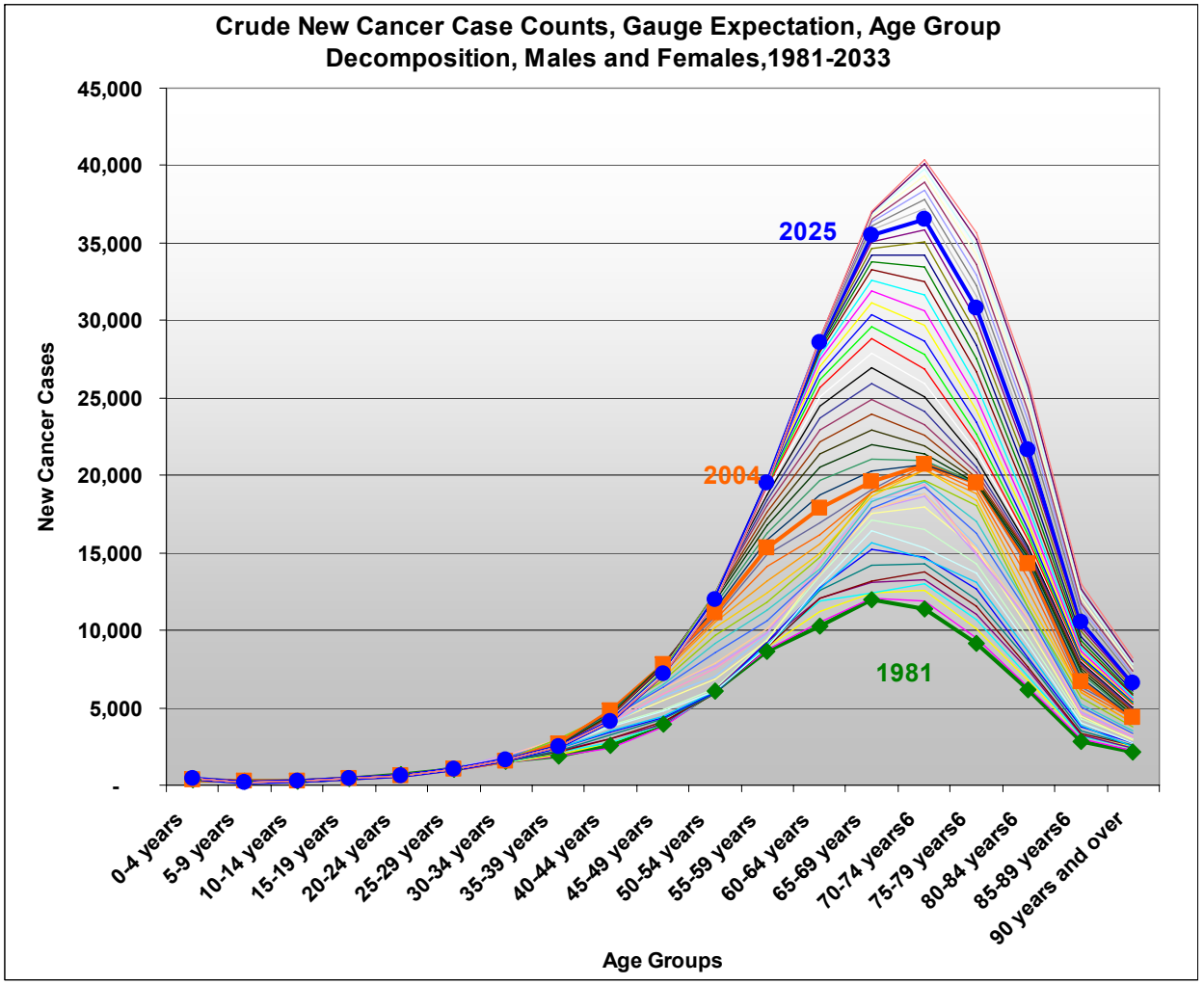
Cancer Simulation Results: New Cases



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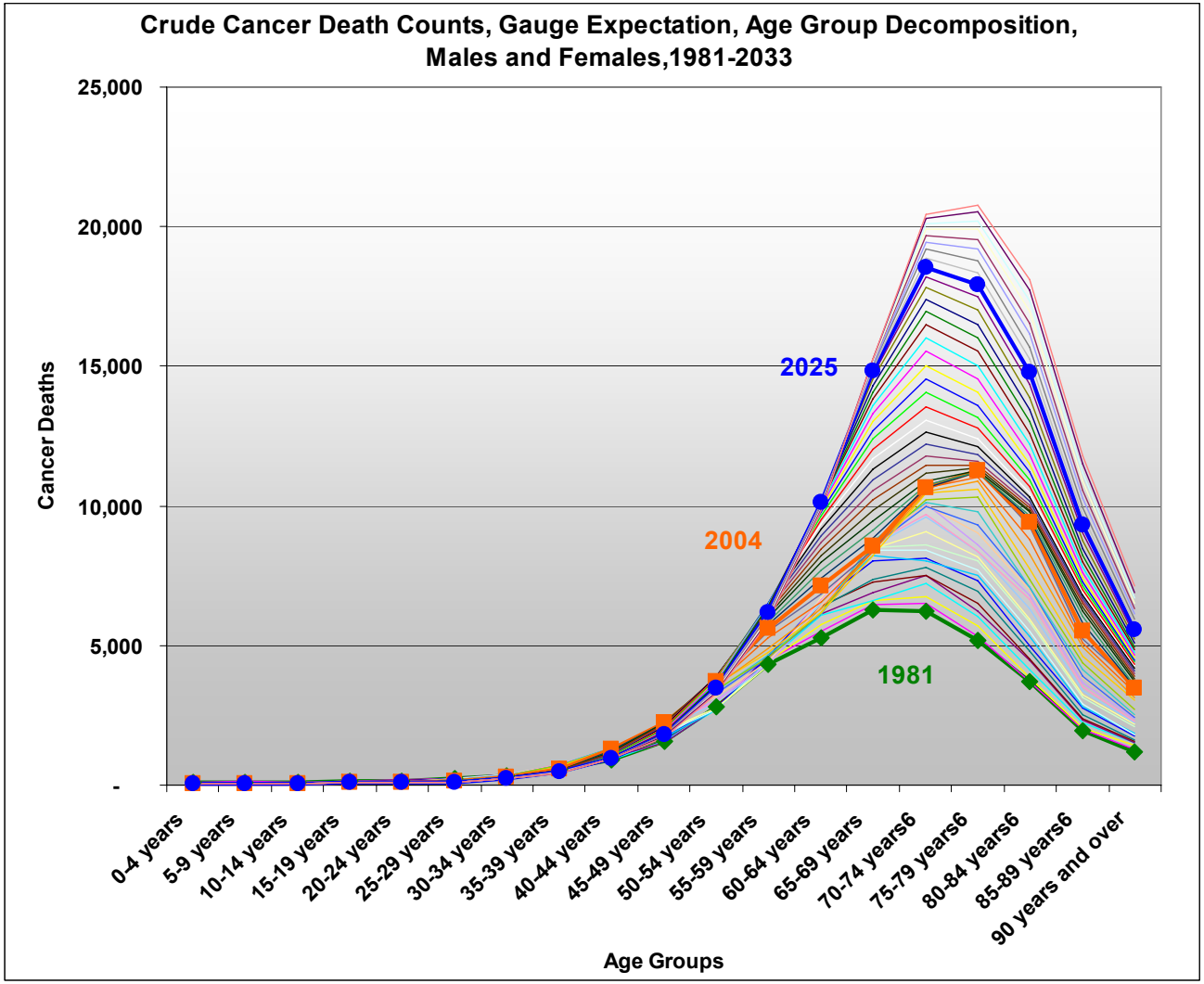
Cancer Simulation Results: Death



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