# Analysis: Bluetooth Tracking for Dementia Care

## Introduction

Inspired by a LinkedIn post about the potential use of Tile devices for dementia care, this project explores the feasibility of Bluetooth tracking for aiding individuals with dementia. Below are modeled detection probabilities, adoption rates, and population dynamics over a 20-year horizon, providing insights into the challenges and limitations of this technology.

## Objectives

The primary objective of this study was to assess the effectiveness of Tile devices in aiding dementia care, focusing on:  
- Detection probabilities over time.  
- The impact of tech adoption trends.  
- How population aging affects detection rates.

## Methods

### Equations

The following equations were used in the analysis:

Detection Probability Formula:

Pd = detection probability

A wandering area (

C coverage area of a Tile device (

T total number of Tile enabled devices ()

Population Transition Formula:

Dementia Prevalence Growth:

Adoption Rate Evolution:

## Simulation Results (Simulations over a 20-year)

### Detection Probability and Adoption Rates Over Time

Detection Probability:  
To better understand the evolution of detection probability over time, the following graph illustrates the changes in detection rates across a 20-year simulation period. Detection probability starts at approximately **1%** and increases significantly, reaching **~74.8% by year 20**.

A graph with a blue line

Description automatically generated

**Key Insights from the Graph:**

1. **Initial Growth**:  
   Detection probability increases rapidly in the early years due to compounding effects of population aging and dementia prevalence.
2. **Plateau Effect**:  
   Growth slows after 15 years as the population's tech adoption rate and Tile density reach practical limits.
3. **Dependence on Population Dynamics**:  
   Detection improvements are more influenced by external factors, such as aging and prevalence, than by changes in tech adoption.
4. **Adoption Rate:**  
   - Adoption rates grew slowly, from ~2.67% to ~2.96%, reflecting limited tech penetration.

**Implications:**

* While the trend shows promising growth, the plateau effect highlights limitations in relying solely on Bluetooth-based networks for consistent coverage.
* To achieve higher detection probabilities in the long term, integrating complementary technologies (e.g., GPS or cellular tracking) may be necessary.

**Summary Table**

| **Metric** | **Year 0** | **Year 10** | **Year 20** | **Key Insight** |
| --- | --- | --- | --- | --- |
| Detection Probability | 1% | 66% | 74.8% | Plateaus after Year 15 |
| Adoption Rate | 2.67% | 2.81% | 2.96% | Slow adoption growth |

### Rate of Change Between 5-Year Intervals

Detection probability and adoption rates showed the following rate changes across 5-year intervals:

|  |  |  |
| --- | --- | --- |
| Interval | Detection Rate of Change | Adoption Rate of Change |
| 0-5 | 0.0442 | 0.0001 |
| 5-10 | 0.0835 | 0.0001 |
| 10-15 | 0.0144 | 0.0001 |
| 15-20 | 0.0054 | 0.0001 |

## Insights

- Dependency on Population Dynamics:  
 Detection relies more on aging and dementia prevalence than tech adoption.  
- Limitations of Bluetooth Technology:  
 Short-range Bluetooth (50 meters) and reliance on crowdsourced networks limit effectiveness.  
- Future Directions:  
 GPS-enabled wearables or cellular systems may offer better scalability.

***As technology evolves, what role can AI and machine learning play in enhancing dementia care solutions?***