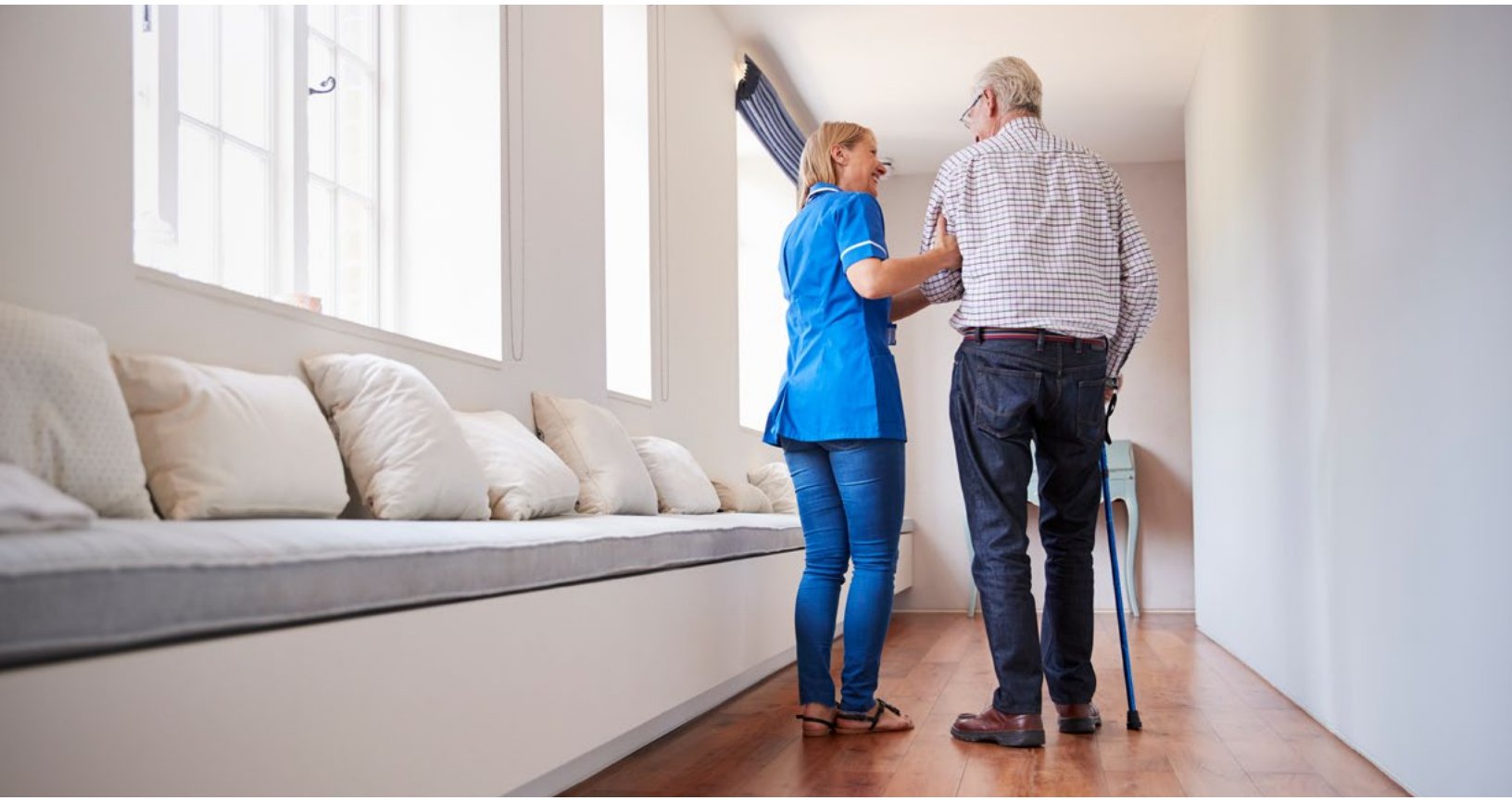
Why is InfeXBloc™ Safer?

We start this section with reiterating the new view safety that “safety is not the absence of failure, but the presence of capacity to deal with its consequences without leading to uncontrolled harm.

In our context, we can state that in a senior care facility

“safety is not the absence of infection, but the presence of capacity to deal with this infection without it causing uncontrolled harm to the residents, caregivers and the facility”



The Prism of Controls and Safeguards

We acknowledge that the arrival of infections into a Senior Care facility is an unpredictable event. We disagree with the idea (Hienrich's Accident Pyramid) that frequency and severity of events is related. Thus, it follows that our traditional solutions for safety to prevent lower severity events are not enough to prevent uncontrolled harm from unpredictable high consequence events to our residents, caregivers and facilities.

In traditional safety thinking, there is a bias to prevention. The obvious statement goes something like this "every bad thing that happens, happens because we prevent it from happening". This statement is always true, but is not relevant to unpredictable events. Prevention is attractive and important. It prevents a messy world from becoming messier. Prevention is so vital to our success that over time it has become a very large industry. We really want everything bad from happening, so much so that over time we have become overly reliant on our prevention efforts. This overwhelming belief that prevention is the key to success has created a gap in our readiness for failure.

Prevention efforts cannot prevent causes that were unexpected just as planning cannot plan for an unexpected event. Prevention cannot prevent anomalies in our normally stable systems. Prevention, then, is not a control or a barrier for anomalous events. Prevention is not a safeguard against the consequence of a significant event. There is a significant bias that when something bad happened, it happened because we failed to prevent it. This bias is harmful to our business and prohibits us from being prepared to respond in a recovering way to minimize the uncontrolled harm to our business system. I doubt that in 2020 you will drive a car that only relies on crash prevention or fly a commercial airplane that relies on prevention of aircraft control system failure. The role that seat belts and airbags play in a car or redundant hydraulic control systems play in a commercial airplane is not prevention, but recovery in case of an accident or malfunction.

InfeXBloc™ goes beyond the failed-to-prevent mindset. It is an operational architecture that distinguishes between unpredictable and predictable events.

The arrival of infection from outside the facility is an unpredictable event, while the spread of infection inside the facility is a predictable outcome (Figure 1 - 2).

InfeXBloc™ implements a combination of controls and safeguards to achieve the above results. In the section titled "Classifying controls and Safeguards in InfeXBloc™" we will categorize our recommendations.

Overall InfeXBloc™ works at three levels:

- Planning for prevention
- Safe Execution
- Recovery, in case an infection enters the facility

Planning for Prevention

InfeXBloc™ recommends proper planning to prevent the entry of infection into a facility.

- InfeXPASS™ system is an engineering control designed to prevent the entry of infection. When a relative/ visitor/ care professional/ supplier staff/ maintenance staff desires to visit the facility, they use the electronic appointment system on the facility website. That system asks basic

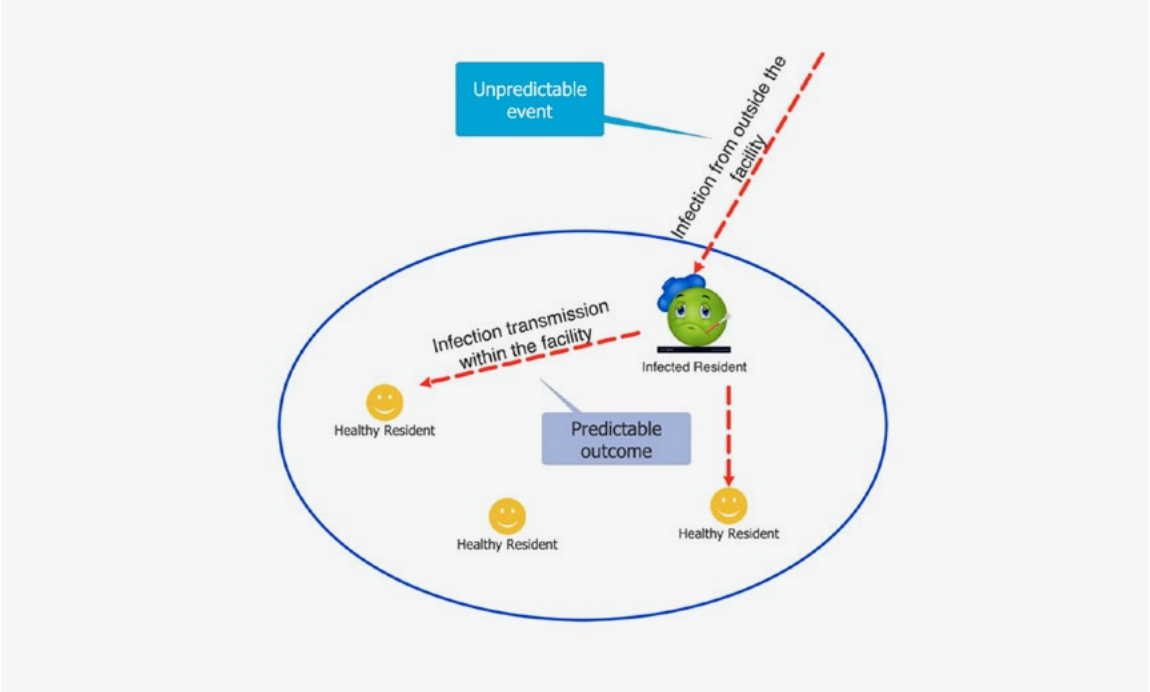


Figure 1: *Without InfeXBloc™*

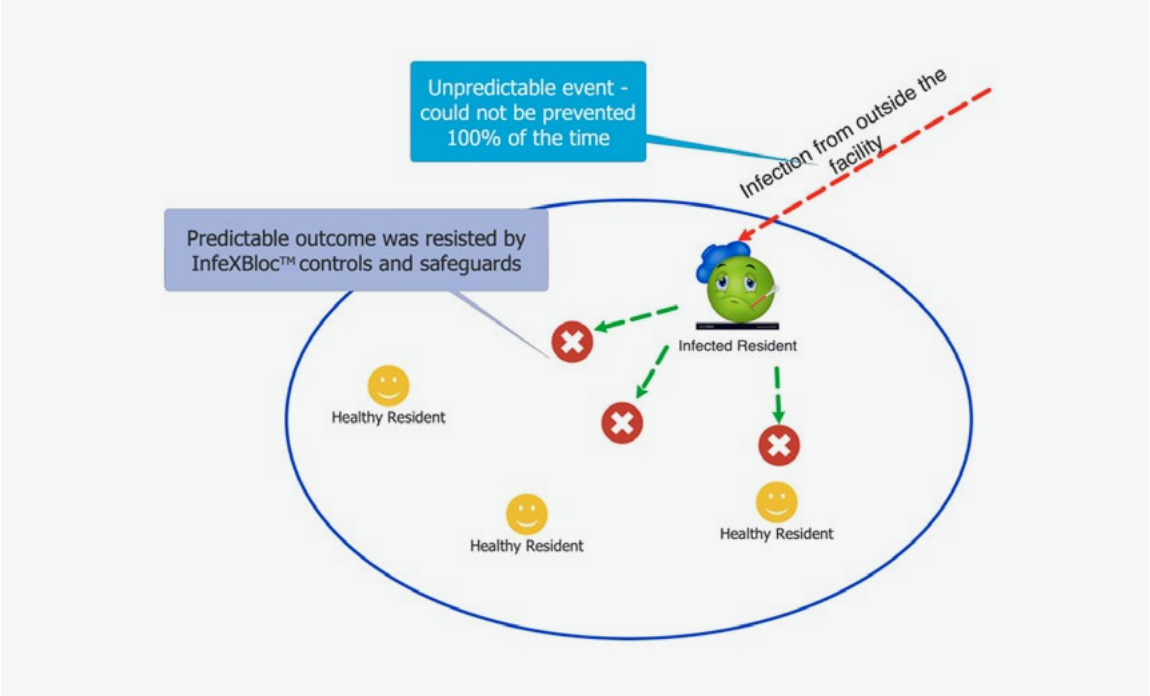


Figure 2: *InfeXBloc(TM) resists the spread*

health screening questions and records the answers.

- The above also applies to residents who may have been returning from relative visits, weekend outings or Doctor's office visits/ hospital visits/ laboratory visits. This is intended to arrest the possibility of externally acquired infections from entering the facility or if detected, appropriate controls are exercised.
- On arrival, a nurse validates essential health screening markers and issues an InfeXPASS™ that is valid for a specific duration. They are issued an access key which also controls the areas of the facility that access is valid.
- The above access key also ensures that the visitor's current location within the facility can be tracked in real time.
- The above access key's ability to access facility areas is tied to the InfeXCON™ condition of the property.

Safe Execution

InfeXBloc™ also recommends care givers proper PPE usage. There are controls to ensure that PPE are used as advised.

- Outside each resident room is a scanner that ensures that access is granted only if proper PPE have been used.
- Appropriate with the InfeXCON™ status of the facility, these scanners can enforce door access and will also record events when care giver successfully achieves access.
- InfeXBloc™ also ensures that visitors/ supplier staff/ maintenance staff/ activity staff/ volunteers/ care professionals movements within the facility as well as pertinent events are recorded.

Recovery, when infection enters the facility

- When a resident acquires an infection from outside, and this is detected by one or more of these methods (Physician/ Care professional, Facility Nurse, Caregivers, delayed lab reports detection etc.), they are placed in a quarantine in their room.
- Their room's negative HVAC system is engaged. All the rooms in the facility are equipped with isolation characteristics. All trash in the room is disposed in bio-hazard bins.
- Facility InfeXCON™ status is turned to 'Brown' (this implies that this resident is quarantined and is not permitted to mix with other residents or staff). For other residents, facility life stays as normal, meals are served in common dining areas, activities are happening.
- For the sake of the resident in quarantine, activities can be live streamed to their room.
- The care giver responsible for the 'quarantined resident' is taking extra precautions suitable to the type of infection identified.
- When the resident's physician gives an all clear, resident quarantine is terminated and the facility InfeXCON™ status returns to green.
- Meanwhile on a 24 hour cycle, all the resident's rooms and common areas are exposed to UVC light to achieve disinfection.
- All events pertaining to the InfeXCON™ status are streamed in real time on the facility website in an encrypted manner.
- If more than x% of residents are designated as 'quarantined' then the InfeXCON™ for the facility switches to Yellow. What this means is that all residents are now encouraged to be in their rooms, the quarantined residents

receive extra cautionary care, all room doors automatically stay closed. The "x%" is a parameter that can be chosen by facility management. Thus, at what threshold should the facility switch from 'Brown' to 'Yellow' is a choice that the facility management can make..

- When any resident is declared COVID positive, the condition of the facility is switched to Red, all trash in the room is treated bio-hazard, all rooms negative HVAC system is engaged, common room activities are suspended, meals are served in rooms. Care givers and professionals exercise highest level of precautions and PPE to ensure containment.
- All the 20 rooms in the facility will have the capability of containment for a COVID positive resident.
- All rooms are swept with UVC disinfection every 24 hours.

Quantitative Analysis

Quantitatively, we can look at the number of transmission vectors activated in the daily care of just one resident. We assume that:

- Each resident requires a care visit by a caregiver once every two hours. Thus daily, the care giver visits the resident's room 12 times. For each visit, the caregiver opens and closes the room door twice (once during entry and next during exit). Thus, daily the number of touches that caregiver has with the door knobs = 48
- Each resident leaves the room for breakfast, lunch, dinner, and one additional activity. So, the number of times the resident may interact with the door knob will be = 16
- Each resident uses the restroom once every 3 hours. Thus daily the number of touches = 32. (If the caregiver is assisting in restroom / showering activities, then these interactions may be executed by the caregiver.)
- Each resident uses faucets 16 times daily, flushes toilets 8 times daily, and uses grab bars 8 times daily.

Altogether, we can easily assume that the number of times that an infection transmission vector is invoked = 128 times.

Now imagine the facility had 20 beds (as in Golden Springs Ranch):

- The total number of active infection transmission vectors = 20*128 = 2,560

Now assume that one resident becomes 'infectious':

- The facility will go to InfeXCON™ 'Yellow' and that resident's room will deploy the negative HVAC feature and all doors will be closed automatically. From that point, doors will open in a touch free mode (nicknamed 'Star Trek' doors).
- Thus by designating InfeXCON™ 'Yellow' we have reduced the number of active infection vectors in the care of the other 19 residents.
- Assuming a 6:1 ratio of residents to caregivers:
  - Protecting the 'infectious' resident from the other 19 residents will lower cross-transmission possibilities by 83.3% (640 infection vectors isolated from a total of 768 infection vectors)
  - Protecting the 19 residents from the 'infectious' resident will lower the cross-transmission possibilities by 16.6% (128 infection vectors isolated from a total of 768 vectors)
- Assuming a 12:1 ratio of residents to caregivers:
  - Protecting the 'infectious' resident from the other 19 residents will lower cross-transmission possibilities by 91.6% (1,408 infection vectors isolated from a total of 1,536 infection vectors)

Caregiver to resident ratio	Lowered risk of cross-transmission for Infectious resident	Lowered risk of cross-transmission for healthy residents
6:1	83.3%	16.6%
12:1	91.6%	8.3%
20:1	95%	5%

Table 1: *Lowering of cross-transmission risk by deploying touch-free technologies*

- Protecting the 19 residents from the 'infectious' resident will lower the cross-transmission possibilities by 8.3% (128 infection vectors isolated from a total of 1,536 infection vectors)

- Assuming a 20:1 ratio of residents to caregivers
  - Protecting the 'infectious' resident from the other 19 residents will lower cross-transmission possibilities by 95% (2,432 infection vectors isolated from a total of 2,560 infection vectors)
  - Protecting the 19 residents from the 'infectious' resident will lower the cross-transmission possibilities by 5% (128 infection vectors isolated from a total of 2,560 infection vectors)

It's also important to note that the extent of risk reduction is related to the caregiver to resident ratio. As this ratio changes, so does the risk reduction.

By tabulating all of the results, we can come to some very important conclusions:

1. Deploying the technology significantly dampens the cross-transmission possibilities across the board.
2. However, the resident to caregiver ratio impacts the two populations differently:
   a. Deploying the technology lowers the risk for the infectious resident more when the caregiver to resident ratio is higher, but the healthier residents receive lesser protection. Hence deployment of technology is more beneficial to the infectious resident.
   b. Deploying the technology lowers the risk for healthier residents more when the caregiver to resident ratio is lower, but the infectious resident receives lesser protection. Hence deployment of technology is more beneficial to the healthier residents.

In either case, deployment of multiple technologies reduces the extent of infection cross-transmission for all involved, making the facility a safer environment.

Interestingly, when we go from one 'infectious' resident to two or more 'infectious' residents, the level of risk mitigation remains consistent, with no success reduction. This is because by adopting the 'proven trust' architecture, we have implemented 'micro-segmentation'. From an infection security perspective:

- In the current Senior Care home model, the blast radius of the infection is the entire facility.
- In the InfeXBloc™ home, the blast-radius is confined to a single resident room. This allows the facility to achieve maximum cross-transmission resistance at the first appearance of an infection. Therefore, any additional resident becoming 'infectious' does not raise the threat for the healthier ones beyond the initial level.

This fact means that the adoption of the InfeXBloc™ architecture helps us become "anti-fragile".

Comparative Analysis

Examining the issue qualitatively, we can see another contrast form between existing Senior Care homes and the InfeXBloc™ architecture, even when only looking at infection transmission resistance characteristics.

Category	Existing Senior Care Homes	Facilities with InfeXBloc ™	Responsibility shared with
Paradigm	Everyone is safe, unless they exhibit unsafe symptoms	Everyone is unsafe, unless they prove they are safe via a repeatable process	
Paradigm	"Castle-and-moat" defense	Each resource (resident's room) defends itself	
Paradigm	Outer perimeter was the line of defense; Entire facility was defended at outer perimeter	Perimeter has collapsed; micro-segmentation in effect; Outer perimeter as well as micro-perimeters are defended	
Paradigm	Either the entire facility was 'safe' or the entire facility was 'unsafe'	Facility can sustain 'safe' even if some rooms are 'unsafe'	
Infection entry and cross-transmission resistance	Infection has a unchecked pathway into the facility	Infection has no default entry into facility. Someone can still trick our entry checks, but that would be a deliberate act to deceive	Every entrant has signed off on their "InfeXPASS"
Infection entry	No responsibility assumed by facility if infection enters facility	Shared responsibility of screening assumed by facility	Licensed professionals (Doctors / RNs/ LVNs) Business vendors (licensed & bonded)
Cross-transmission resistance	No responsibility of cross-transmission of infection assumed by facility	Shared responsibility of transmission-resistance assumed by facility. Best effort made with leading technologies.	Vendors of technologies
Cross-transmission resistance	If resident is sick with an infectious disease, he/she could transmit it by default	If resident is sick with an infectious disease, the infection can be contained. He/She could still violate facility policies and cause transmission, but the threat is lowered	
Infection entry	If the caregiver is sick with an infectious disease, he/she could bring the infection in	If the caregiver is sick with an infectious disease, entry checkpoint will present resistance	
Infection entry	Facility does not do any work of screening non-residents	Facility explicitly takes on work of screening at entrance to grant/deny InfeXPASS™	
Resists aerial spread	Facility does not clean contaminated air	Facility does not clean contaminated air	
Surface contamination	Facility does not clean surfaces with UV lights	Facility does clean surfaces with UV lights	Patented UVC technology
Resists aerial spread	Facility does not take responsibility of contaminated air circulating via the HVAC system	Facility does take responsibility of preventing contaminated air recirculating via the HVAC system	
Resists aerial spread	Facility does not have negative pressure HVAC, hence infection can travel in corridors	Facility does have negative pressure HVAC, hence infection cannot travel in corridors	

Resists accidental contamination	Facility's resident rooms doors have no indication if the occupant is 'infectious'	Facility's resident room door has indication if the occupant is 'infectious'	
Least privilege principle	Facility resident rooms do not have default deny disposition	Facility resident rooms can have default deny disposition depending on InfeXCON™	
Enforcement	Facility does not have enforce PPE usage, only suggests it to caregivers	Facility does enforce PPE usage	
Isolation	Facility does not have isolation rooms	Facility does have isolation rooms	
Transparency	Facility does not have an InfeXCON™ status - hence no infection related precaution escalation mechanism	Facility does have an InfeXCON™ status and precautions will be escalated from Green --> Yellow --> Red	
Transparency	Facility has no formal notification for staff, visiting family and guests, contract service providers, visiting professionals of any present 'infection'	Facility explicitly notification for staff, visiting family and guests, contract service providers, visiting professionals of any present 'infection'	
Transparency	Facility does not inform family that some infection is present in the facility	Facility will notify family that some infection is present in the facility	
Transparency	Facility does not have a Scorecard to convey its infection control posture	Facility has a InfeXBloc Scorecard™ - which allows for customers, regulators and community to gauge infection preparedness	
Resists cross-transmission	Facility has door knobs, faucets, flushes which are infection transmission vectors	Facility employs hands-free faucets, flushes and doorways	
Resists cross-transmission	Facility has no separate handling of bio-hazard waste	Facility has separate handling of bio-hazard waste	
Staff friendly	Facility does not have load balancing for caregiver's workload if one of their residents (in their rotation) turns 'infectious'	Facility has load balancing for caregiver's workload if one of their residents (in their rotation) turns 'infectious'	
Resists cross-transmission	Facility does not require tele-health visits when infection present	Facility does require tele-health visits when infection present - as a protocol	

Classifying the Safeguards and Controls of InfeXBloc™

Earlier in the section titled "Hierarchy of Controls" (Figure 9) we ranked the type of controls and safeguards in order of their effectiveness. We also noted that PPE are the lowest form of effectiveness against the Coronavirus and other infections. They are the last line of defense.

It is worth noting that as a facility's process matures, it can add more controls belonging to each of these 5 hierarchy sections. The more safeguards and controls that are incorporated in the higher sections the higher the level of safety the facility can offer. We expect this to be an continuous improvement list as newer processes, technologies and PPE become available.

We now will classify the controls and safeguards in the InfeXBloc™ architecture that are proposed to improve the effectiveness of safety.

Type of Control	Control or Safeguard
Elimination	No known way to eliminate the Coronavirus or any of the other infections that harm our senior residents
Substitution	No known way to substitute Coronavirus or any of the other infections that harm our senior residents with other less harmful bugs. Vaccines have some promise, but the efficacy of vaccines in our context is questionable at best. Vaccines are known to be less effective for the senior age group who may have many underlying comorbidities and conditions that compromise their immune systems. Many of the infections we experience in our facilities have had vaccines available for decades and we still experience outbreaks.
Engineering Controls	• Negative HVAC rooms designed to prevent the escape of the bug outside of the resident's room • Touch free doors • Touch free faucets • Plexiglass visitation booths • UVC lights sweep every 24 hours cycle • Universal entrance complex • InfeXPASS™ entrance criteria • Thermal scanners • Access keycards for caregivers • PPE enforcement using scanners • Facility has a real time InfeXCON designation • Encrypted event streams are published in real time • Video surveillance • RTLS (Real time location services) • Circadian Lighting • Pool fencing • Magnetic door locks • Smoke control sections • Fire exit doors • ADA compliance characteristics • All ADL events, caregiving events, medication delivery events are logged • Only facility mobile phones are used on the premises • Self-service visitation appointments using Calendly™ • Robotic tele-visitation with Physicians • In room group activities (e.g. Intercom-Bingo) • Enforcement of least privilege principle • Micro-segmentation of the facility
Administrative Controls	• Safety dashboards are published in real time • Caregiver-buddy system to validate PPE usage • Sick leave provisions for caregivers • Group dining / In room dining option • Mandatory immunization program for caregivers
PPE	• Masks • Face shields • Protective Gowns • Booties • Gloves • Alcohol disinfectants • Soap and water

One More Orbit Around the Earth

In "Workplace Fatalities", Todd Conklin quotes a fantastic example of how NASA created capacity in its process such that the ground controllers, astronauts, flight operations, etc. could have room to do problem solving in case an unexpected snag appeared during its space shuttle landing sequences. NASA designers did this by having the capability for the space shuttle to take one more orbit around the earth. This built in capacity in the process gave the workers additional time to problem solve rather than letting the unexpected failure create uncontrolled harm.

A long haul commercial jet flight is always loaded with enough extra fuel onboard to deal with unexpected events like weather or temporary airspace closure which allows the pilot to divert to an alternative airport in the neighborhood. By doing so, the airline creates extra capacity for the pilots, air traffic controllers, ground staff, etc. to deal with the unexpected event in a problem solving manner rather than allowing the event to create uncontrolled harm.

The above are examples of how systems that successfully do high consequence work in a stable manner always build in capacity in the process to allow its workers to have some room to do problem solving before and letting unexpected events lead to uncontrolled harm.

InfeXBloc™ is an operational architecture for a senior care facility, that builds capacity in its process, to allow its workers the space to think in a creative problem solving manner rather than letting an unexpected event (like arrival of a deadly infection) to create uncontrolled harm. Sadly, senior care facilities in Newyork, New Jersey, Pennsylvania, etc. had no such inbuilt capacity and the unexpected arrival of Coronavirus caused uncontrolled harm.

To learn more about InfeXBloc™ and how your facility can leverage the architecture to move forward, enhance safety, and rebuild trust in a post-pandemic world, check out www.infexbloc.com.

INFEXBLOC™ PILOT SITE

Golden Springs Ranch

About Ashish Warudkar

Ashish has worked in the software industry for 30+ years including 19+ years in the healthcare sector. He also has been an entrepreneur for over two decades and provides consultation to "Golden Springs Ranch" which is an upcoming InfeXBloc™ home in Palmdale, California which will introduce the innovations discussed in this paper to provide its precious residents with a safe happy home and their families with peace of mind.

Ashish Warudkar is trained at:

IIT Bombay	Mechanical Engineering
UCI	Predictive Analytics (7/8)
Harvard	Disruptive Innovation Strategy with Clayton Christensen
MIT	Advanced Certificate for Executives in Management, Innovation & Technology
	Architecture & Systems Engineering of Complex Systems
	Platform Strategy – Building & Thriving A Vibrant Ecosystem
	Business Dynamics – Diagnosing and Solving Complex Business Problems
	Executive Certificate in Strategy and Innovation
Product School	Product Management
BWW	Network Marketing
Oren Klaff	Pitch Mastery

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Meetup: Monthly meeting (first Sunday 6pm CA time) of Senior Care Accountability Network https://www.meetup.com/Senior-Care-Accountability-Network-SCAN/