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Power Through Partnership: Mitochondria, Medicine, and the Future of Hospital Leadership – What Biology Can Teach Us About Resilience and Effective Healthcare Performance



McCully B^{1*} and Aboda A²

1A/Professor, Monash University & Department of Obstetrics & Gynaecology, Mildura Base Public Hospital, Australia

2Department of Obstetrics & Gynaecology, Mildura Base Public Hospital, Australia

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***Corresponding author:** A/Professor Brian McCully, Monash University, Department of Obstetrics & Gynaecology, Mildura Base Public Hospital, Australia

Abstract

This paper explores the evolution of mitochondria as a metaphor for leadership and multidisciplinary collaboration in healthcare systems. Drawing on the biological model of endosymbiosis — the process by which one cell incorporates another to form a more powerful whole — the paper illustrates how modern hospitals function as complex, interdependent systems. It argues that high-performing healthcare organizations mirror this ancient partnership, thriving not through hierarchy or uniformity but through coordinated diversity, shared purpose, and adaptive leadership.

Tensions such as burnout, communication breakdown, and organizational stress are reframed as natural products of complexity — not as failures but as signals those systems must evolve. The paper highlights practical leadership responses, including communication structures, team trust, and system resilience. It shows how collaboration can generate organizational energy, but only if channelled with intention.

By weaving together biological insight, organizational theory, and lived realities of healthcare delivery, the paper offers a fresh framework for navigating today's healthcare challenges. Ultimately, it reframes leadership not as control, but as integration — the art of aligning people, processes, and purpose in a system capable of healing itself and others.

Keywords: Healthcare leadership; Endosymbiosis; Multidisciplinary teams; Collaboration; Hospital systems; Organizational resilience

Introduction

In the earliest days of life on Earth, something unprecedented occurred. One single-celled organism engulfed another and, instead of digesting it, formed a partnership. From this moment of cooperation, the mitochondrion emerged — a cell within a cell, capable of producing energy far more efficiently than either could alone [1,2]. This unlikely union gave rise to the complexity of multicellular life, including the human body and, exponentially, the organizations we build.

This paper uses the endosymbiotic origin of mitochondria as a metaphor for healthcare leadership and multidisciplinary teamwork. The mitochondrial-host relationship is a biological model for what happens when distinct systems combine to create something more powerful than either could become alone [3].

However, it also shows that even the most promising partnerships are not free of friction. Whether in cells or hospitals, collaboration brings both potential and challenge.

In the healthcare industry — in hospitals, clinics, and research institutions — complex goals demand integration across multiple disciplines. Doctors, nurses, allied health professionals, administrators, and patients must all work together. Success depends not on dominance by any one group but on how well they synchronize their efforts [4]. This paper explores how the story of mitochondria can help us better understand the power and limits of collaboration in healthcare systems, and how adaptive leadership can harness synergy and stress to achieve more resilient, effective care.

Symbiosis as a Model for Healthcare Collaboration

Hospitals are among the most complex environments in modern society. They bring together a wide range of professionals — surgeons, nurses, social workers, administrators, dietitians, and physical therapists — each with specialized knowledge and responsibilities. Like the components of a living cell, these disciplines must function together to deliver care. The effectiveness of any hospital depends not only on individual expertise but on how well those different parts collaborate [5,6].

The origin of mitochondria provides a useful framework for thinking about how effective collaboration works. In biological terms, symbiosis involves mutual benefit — each organism gains something it could not achieve independently. The same applies to interprofessional teams that improve outcomes through coordination and shared goals in healthcare [7,8]. No one role is sufficient on its own, but together, teams can offer care that is both comprehensive and patient-centred.

However, collaboration in healthcare also brings tension. Each discipline has its distinct language, culture, and priorities. Nurses may focus on continuity of care, while physicians may prioritize diagnostic efficiency. Administrators may emphasize financial sustainability, while patients value access and empathy. Just as the host cell and its mitochondrial guest had to renegotiate their boundaries, healthcare teams must find ways to work across their differences [9].

“Whatever comes out of these gates, we’ve got a better chance of survival if we work together... If we stay together, we survive.”

— *Maximus, Gladiator (2000)*

We might also look to our bodies for a reminder: each human being carries within them a vast and invisible ecosystem — the microbiome — a delicate, bustling world of microbes that thrives on balance, cooperation, and mutual benefit. Like the teams within hospitals, these microbial partners do not speak the same language, yet their alignment sustains our very lives.

“As clinicians, as administrators, as people of goodwill, we are called to redesign systems of care with a clear focus on cooperation, not competition; on patient needs, not professional preferences.”

— **Donald M. Berwick, MD, MPP**

The key to successful integration lies in recognizing interdependence. A team does not need uniformity but clarity of roles, mutual respect, and shared purpose. This allowed the symbiotic cell to thrive — and now allows a hospital to function as more than the sum of its parts [10].

The Promise and Perils of Partnership

While collaboration in healthcare is essential, it can be challenging in practice. The same dynamic that gave rise to the power of mitochondria — integration of different systems — also introduced vulnerabilities. Mitochondria generate energy.

However, they also produce reactive oxygen species that can damage the cell if not properly regulated. This mirrors the tensions in multidisciplinary teams: the collaboration that makes advanced care possible can also be a source of conflict [11].

In hospitals, collaboration often involves professionals with differing training, workflows, and expectations. These differences can lead to miscommunication, duplication of effort, or clashes in decision-making [12]. A team might struggle to coordinate discharge plans because physicians prioritize clinical resolution, while case managers focus on insurance requirements and family readiness. What begins as collaboration can devolve into confusion without shared protocols and clear leadership [13].

However, these frictions do not mean the system is broken. In fact, like the cell’s evolution of antioxidant defences, organizations can develop tools to manage conflict and complexity. Structured communication tools like SBAR (Situation-Background-Assessment-Recommendation), daily multidisciplinary huddles, and shared electronic records help coordinate care across diverse teams [14].

True leadership in these settings is not about eliminating all disagreement. It is about designing environments where different perspectives can surface safely, be acknowledged, and then aligned. Listening, mediating, and integrating viewpoints become a leadership competency as vital as clinical skills. As with mitochondria, the group’s energy must be harnessed without overwhelming the whole [15].

Energetics of Systems: Power, Complexity, and Growth

One of the most transformative consequences of endosymbiosis was the energy gain. Mitochondria allow cells to produce much more ATP — the fuel of biological activity — enabling them to grow, specialize, and become complex. In healthcare systems, the equivalent of energy is capacity: the resources, coordination, and clarity needed to operate efficiently and compassionately under pressure [2,16].

Just as multicellularity arose to give early life forms the ability to stretch beyond the fragility of a single unit and take on greater challenges collectively, healthcare institutions use team-based structures to extend reach, expand function, and endure stress. This is the value of complexity — it brings resilience, but only when organized [13].

When healthcare teams are aligned and systems are well integrated, they can manage greater complexity without becoming overwhelmed. For example, a multidisciplinary team in a neonatal intensive care unit must simultaneously consider the infant’s physical stability, parental bonding, long-term development, and discharge planning. Without collaboration and communication, this complexity would lead to fragmentation and burnout. However, the team can achieve remarkable outcomes with clear goals, defined roles, and mutual trust [5,17].

However, as energy can destabilize cells when not regulated, uncoordinated growth in healthcare organizations can lead to inefficiency and fatigue. Rapid expansion of services without supporting infrastructure or rolling out electronic medical records without adequate training are examples where energy is available but not effectively channelled [18].

Leadership plays a crucial role in managing this dynamic. The job is not just to inspire but to structure and ensure that effort is not wasted and that innovation does not outpace implementation. Just as the mitochondrion's energy had to be integrated into the host cell's metabolic systems, hospital leaders must ensure that ambition is grounded in strategy [19].

Balanced systems — ones that match energy with infrastructure — can expand their services and sustain their mission over time.

Crisis and Reinvention: Navigating Organizational Stress

Even the most effective healthcare teams face breakdowns. Conflict, fatigue, and systemic gaps are not signs of failure but of the complexity inherent in delivering care. Mitochondria, though essential, also produce products that damage the very systems they support. In cells, this oxidative stress is not just a threat but also a trigger for renewal. Cells respond with repair mechanisms, recycling programs, and, when necessary, controlled cell death to protect the organism [20].

From pond slime to the towering Cheewat Giants of Canada, every organism is governed by a simple truth: without energy, everything stops. This is true of cells and systems. Hospitals pushed past their capacity cannot run on good intentions alone. They, too, need the fuel of staffing, structure, and rest to endure.

In hospitals, we face stress. Staff burnout, moral injury, medical errors, and communication failures are the human equivalents of cellular damage. These challenges, left unchecked, can compromise safety and performance. However, if addressed constructively, they can also drive improvement [19].

While mitochondria enabled cooperation, they also powered conflict. With more energy came more complexity — but also more competition. Predation, aggression, and the drive to dominate emerged not despite mitochondria but because of them. These behaviours, hardwired through millions of years of evolutionary advantage, persist in modern humans. In healthcare teams, they manifest as turf wars, status hierarchies, or resistance to change [12].

Leadership today must contend with this dual legacy. We are not only collaborative beings — we are competitive ones. Teams do not always default to unity; they must be guided toward it. Part of leading complex systems is understanding that conflict isn't aberrant — it's ancestral. The task is not to erase competition but

to channel it constructively. To convert drive into innovation, and challenge into alignment [15].

Organizational resilience depends on recognizing stress signals early and responding appropriately. This might involve redesigning care pathways, improving staffing ratios, or creating safe forums for team members to voice concerns. For example, many hospitals now use debriefing sessions after critical events to process emotions and identify system weaknesses. In doing so, they turn crisis into insight [14].

Leaders who embrace this adaptive mindset foster a work culture that is proactive rather than reactive. They invest in feedback loops, support team development, and create structures that absorb shocks without collapsing. Just as mitochondria have mechanisms to self-regulate and adapt under stress, healthcare organizations must build internal systems for recovery and reinvention.

Effective leadership is not about avoiding crisis; it's about using it. What matters is not how a system performs when in a steady state but how it responds when challenged and how it emerges afterwards.

Evolutionary Leadership: Lessons from the Mitochondrial Model

The story of mitochondria is not just a biological tale but a model for leadership in complex systems. Effective healthcare leaders operate less like commanders and more like systems integrators. Their role is to coordinate, align, and create the conditions for others to succeed. They don't hold all the power or knowledge — instead, they recognize that value is distributed, and that strength comes from connection.

Leadership in multidisciplinary settings requires more than strategic planning. It demands humility, the ability to listen, and a willingness to adapt. Leaders who succeed in healthcare environments can navigate competing priorities — clinical, operational, and financial — while staying focused on the shared purpose of patient care. They are fluent in both the big picture and the small details.

As with the ancient cell and its mitochondrial guest, the key is not control but cooperation. Leaders must learn how to accommodate different perspectives, synthesize conflicting inputs, and build systems that work across silos. They must create environments where people feel safe to speak up, take initiative, and contribute their expertise [15,16].

What mitochondria demonstrate — and what healthcare leaders must practice — is that long-term success depends on innovation and integration. Power must be shared, energy must be focused, and complexity must be embraced rather than avoided [13].

Conclusion: Healthcare as a Living System

Hospitals and healthcare systems are living, breathing ecosystems. They thrive when their parts work in concert, energy flows in the right direction, and systems are built to adapt rather than break. The story of endosymbiosis reminds us that transformative growth often begins in unlikely places — through cooperation, not conquest.

The challenges of healthcare — from patient safety to staff retention to cost pressures — require leadership that understands both the science of systems and the human side of collaboration. They require leaders who can turn stress into resilience, diversity into strength, and connection into capability.

“Better is possible. It does not take genius. It takes diligence. It takes moral clarity. It takes ingenuity. Moreover, above all, it takes a willingness to try.”

— Atul Gawande, MD, MPH

Mitochondria did not make the cell perfect. However, they made it possible for cells to do more, to become more. In the same way, collaboration doesn't remove complexity in healthcare. It makes it manageable. Moreover, doing so opens the door to care that is not only efficient but human, not only coordinated but compassionate.

Each atom in us has travelled a long and improbable journey, forged in stars, stitched into life, and passed down across billions of years. In that way, our organizations are not only built — they are inherited. Our leadership shapes what comes next.

a) Leadership built on these principles — on shared purpose, adaptive systems, and deep collaboration — will shape the next era of healthcare. We innovate. We institutionalize. We look toward new partnerships — even beyond biological boundaries. In doing so, we carry forward the ancient lesson of mitochondria: that power grows not from control but collaboration not just once, but again and again and for as many times as it takes to keep things working.

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