



Digital tools against COVID-19: taxonomy, ethical challenges, and navigation aid

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Digital tools against COVID-19: taxonomy, ethical challenges, and navigation aid

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COVID-19數位工具分類、倫理挑戰與輔助工具

- 面對COVID-19大流行，發展及佈署數位公衛科技有其必要性，然而這些工具必須確保其科學及倫理的正確性，以獲得群眾的信任及採用。
- 本篇文章的類型學分析、公衛相關架構建構，以及大數據倫理議題，可以幫助政府或其他關鍵行動者來辨別複雜的倫理及法律議題。
- 藉由倫理-法律分析，本篇文章的輔助工具，可以協助決策者在發展數位公衛科技時，仍能確保過程的完整性，並減少倫理引發的相關議題。

Introduction

- 面對COVID-19全球大流行的衝擊，公私立部門紛紛蒐集並使用相關防疫資料，以做為提出相對應策略的方法。
- 不同國家與機構以及不同領域的公衛與研究學者都認為：蒐集不同來源的資料加以分析或分享，可以獲得大量的訊息。資料來源包括行動通信基地台、手機應用程式、藍芽連接、監控影片、社群媒體信息、智慧溫度計、信用卡紀錄、穿戴裝置等等。
- Apple和Google也前所未有的合作，在內建系統中開發一個供公共衛生部門使用的跨平台應用軟體，可以提供以藍芽傳輸為基礎的暴露提示系統。

Introduction

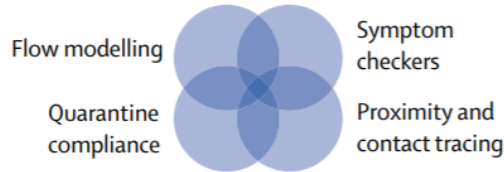
- 儘管大數據分析已經受到廣泛認可，而全球各地政府和研究人員也都在爭相發掘其潛力，但是明顯的技術限制已逐漸浮現，這些限制包括在不同數據來源間存在不同的準確性，數據範圍大小以及品質也各自不同，除此之外，數據保障措施是否足夠，以及數據間互相操作的問題和安全風險也都需要進一步考量。
- 伴隨疾病監測與預測時，也有相對應的道德和法律風險考量。民權組織，數據保護機構和學者都強調了大流行後增加數位監控所造成的風險，這些組織都強調在資料處理過程，必須達到合法，必要和相稱等基本的條件，以及對社會公正的需求和緊迫性。





Introduction

- 因此，許多公私立部門利用數位科技來對抗COVID-19時，也產生了“**拯救生命**”和“**尊重個人隱私和公民自由**”之間的爭辯。但是，跨學科研究顯示大流行期，數據處理時所面對的社會、法律和道德風險，已經超出隱私議題。
- 本篇文章專注於公共衛生結果(public health outcomes)，而非公共衛生科技(public health technologies)，在這一篇健康政策論文中，作者希望可以為對抗COVID-19而產生的數位公衛科技承諾和風險帶來的爭辯，提出貢獻。
- 本文提供使用中主要應用軟體的類型(typology)，並且討論其各自功能，最後提出為決策者提藉由健全的風險效益分析來減少風險，藉此建議執行的步驟供的輔助工具(navigation aid)，。
- 這些輔助工具根據公衛與數據倫理所產生的倫理原則，並建立在流程風險評估和政府架構上。此外，這些輔助工具可以根據每個類型學領域進行校正，以指導不同技術平台以及各個階段數位公衛科技的部署。

Typology 類型學

This typology is based on an analysis of primary cases of COVID-19 digital public health technologies. Note, there might be variations because of the rapid proliferation and evolution of national, international, and private actor initiatives in this domain. Further, some technologies might combine purposes or have overlaps in approaches.



		Key actors				Data types			Data Source					Consent				
		Government	Academics	Private	Citizens	Sensitive	Non-sensitive	Non-PII	IP	Cell site	Number	GPS	Bluetooth	Third party	Citizens	None	Opt in	Opt out
	Proximity and contact tracing	●			●	●	●	●		●			●	●			●	
	Symptom checkers	●	●	●	●	●	●		●	●	●	●			●		●	
	Quarantine compliance	●			●	●	●	●		●	●				●		●	
	Flow modelling			●	●		●		●	●					●			●

Selected example cases

TraceTogether
Location: Singapore
Type: mobile app

Comunidad de Madrid CoronaMadrid
Location: Spain
Type: mobile and web

Electronic Fence
Location: Taiwan
Type: geo-fence

Google Mobility Report
Location: Global
Type: flow model

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對抗COVID-19 數位公衛科技類型學

四個主要分類

1. Key actors 關鍵行動者
2. Data types 資料型態
3. Data source 資料來源
4. Model of Consent 同意書模式

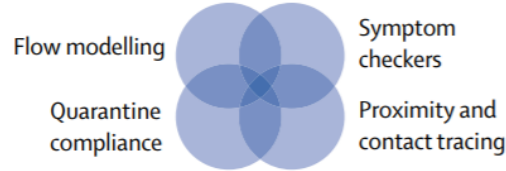
關鍵行動者指的是：設計以及實際執行數位科技的行動者，包含政府部門、學術單位、私人單位以及市民本身





Figure 1: Typology of digital public health technologies against COVID-19

IP=Internet Protocol. GPS=Global Positioning System. PII=Personally Identifying Information.

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 Quarantine compliance	●			●		●	●	●		●	●			●		●	
 Flow modelling				●	●		●		●	●				●			●

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對抗COVID-19 數位公衛科技類型學

防疫措施四個功能性分類

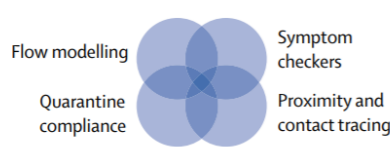
1. Proximity and contact tracing
2. Symptom checkers
3. Quarantine compliance
4. Flow modelling

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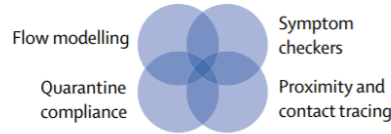
對抗COVID-19 數位公衛科技類型學

防疫措施四個功能性分類

Proximity and contact tracing
“近距離或接觸者追蹤”工具可測量使用者之間的空間距離，搭配病人報告或非數位性資料來源，可以辨別陽性個案的近距離接觸者。例如新加坡 TraceTogether APP，利用藍芽連接其他用戶，以警告暴露於陽性個案的附近民眾。使用者被警告後，就建議進行自我隔離。

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對抗COVID-19 數位公衛科技類型學

防疫措施四個功能性分類

Proximity and contact tracing “近距離或接觸者追蹤”工具

新加坡 TraceTogether 的關鍵行動者是政府及市民、資料型態是非敏感以及無法辨識個人基本資料，可利用手機位置、藍芽以及第三方組織來做為資料來源，需要使用者同意後使用。

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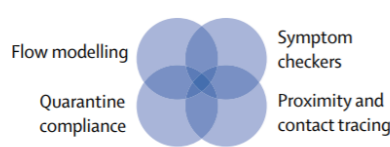
防疫措施四個功能性分類

Symptom checkers“症狀檢測”

使用者利用症狀檢測工具可以線上回報症狀，獲得初步診斷以及可能相對應的檢傷分類，是一個有經濟效益的檢傷分類方式。西班牙的CoronaMadrid，藉由政府與民眾、專家與私人單位之間互相合作，可以監控疾病、快速反應並且適時提供資源，以減少疾病大規模爆發。

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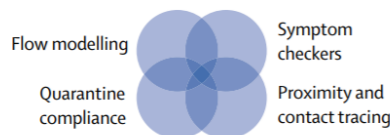
防疫措施四個功能性分類

Symptom checkers“症狀檢測”

關鍵行動者包含政府與民眾、專家與私人單位。資料可能屬於敏感或非敏感性資料，資料來源靠的是網際網路協定、手機位址、手機門號、GPS或市民自行通報，需要使用者同意後使用。

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對抗COVID-19 數位公衛科技類型學

防疫措施四個功能性分類 Quarantine Compliance 隔離者遵守狀態

包含即時監控有或沒有症狀的隔離者，是否遵守隔離規定，以避免造成大規模流行。台灣的Electronic Fence可以利用此APP追蹤海外入境隔離者是否符合隔離規範。

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對抗COVID-19 數位公衛科技類型學

防疫措施四個功能性分類 Quarantine Compliance

關鍵行動者包含政府以及市民、資料型態可能為敏感、非敏感資料或無法辨別個人資訊的資料，資料來源為手機位址、手機門號或市民本身、為公權力執行方式。

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防疫措施四個功能性分類

Flow Modelling 人口流動與行動模式

此工具可以計算並且追蹤特殊地理位置的人口流動。這項工具仰賴眾多使用者匿名的整體資訊，可以提供政府用來評估對抗COVID-19的強制隔離或人口分散政策是否有效。

This sunburst diagram presents how the six ethical principles raise ethical and legal issues when considered in relation to digital public health technologies against COVID-19. As shown by the intersecting circles at the centre, these principles apply equally to symptom checkers, proximity and contact tracing, quarantine compliance, and flow modelling.

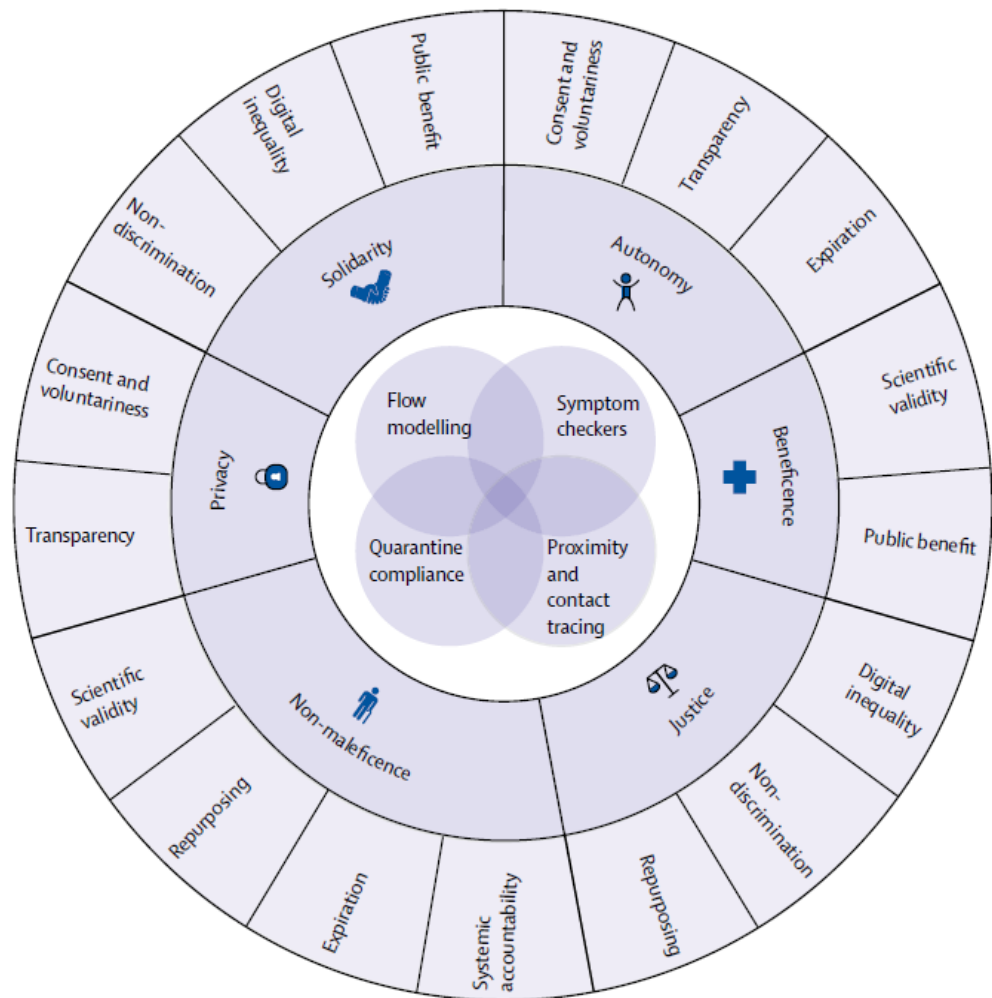


Figure 2: Sunburst diagram mapping the ethical and legal issues raised by applying ethical principles to COVID-19 digital public health technologies

Ethical-Legal Considerations 倫理法律考量

對抗COVID-19的四個數位公衛科技主要分類，可以與六大倫理原則整合如左圖。使用數位公衛科技時，我們必須做到

- 確保公眾利益
Ensuring public benefit
- 確保科學有效和正確性
Ensuring scientific validity and accuracy
- 保護隱私
Protecting privacy
- 維持自主性
Preserving autonomy
- 避免歧視
Avoiding discrimination
- 重新檢視目的，避免濫用
Repurposing
- 訂定有效日期
Setting an expiration
- 避免數位不公平
Preventing digital inequality

Ethical-Legal Considerations

倫理法律考量

- 在面對不同的倫理價值時，研究者與政策制定者可能面臨許多衝突，例如**公共利益與個人權利及公民權利始終存在著緊張關係**，這緊張關係反映著**個人自主(保護個人自由)與行善(最大化公眾利益)的衝突**，而且這一次COVID-19大流行中執行的“封城”，就是在考量群眾利益下，暫時限制了個人的行動、集會以及娛樂等自由。
- 公衛數位科技也可能造成隱私與資訊自決的衝突，這些軟體需要大量與無處不在的資料，**因此軟體是否因為群眾利益成功的佈署使用就可能與使用者隱私保護產生衝突**。
- 可以提供適當隱私保護的軟體需要一段時間來驗證，但在大規模流行時往往沒有足夠適當的時間來達到這些要求，因此Laurie提出**“科學證據”及“風險評估”**兩項評估條件。

Ethical-Legal Considerations

倫理法律考量

- Laurie提出“科學證據”及“風險評估”兩項評估條件。
 - 科學證據：前瞻性科學證據必須能預測及量化新的數位公衛科技所帶來的預期效益，並且在推出階段應該持續監控效率已得到確認。
 - 風險影響評估必須包括隱私影響評估，並能預測和量化潛在風險，包括個人權利風險。
- 數位公衛科技的部署者有道德責任遵守科學證據和風險評估的最高標準，並展現公共利益大於個人層面的風險程度。
- 在沒有明確公衛福利的證據下，對於個人的微小限制都可能導致比例失調，因此造成不公平的現象。
- 因此所有考慮必須case by case來進行風險評估。

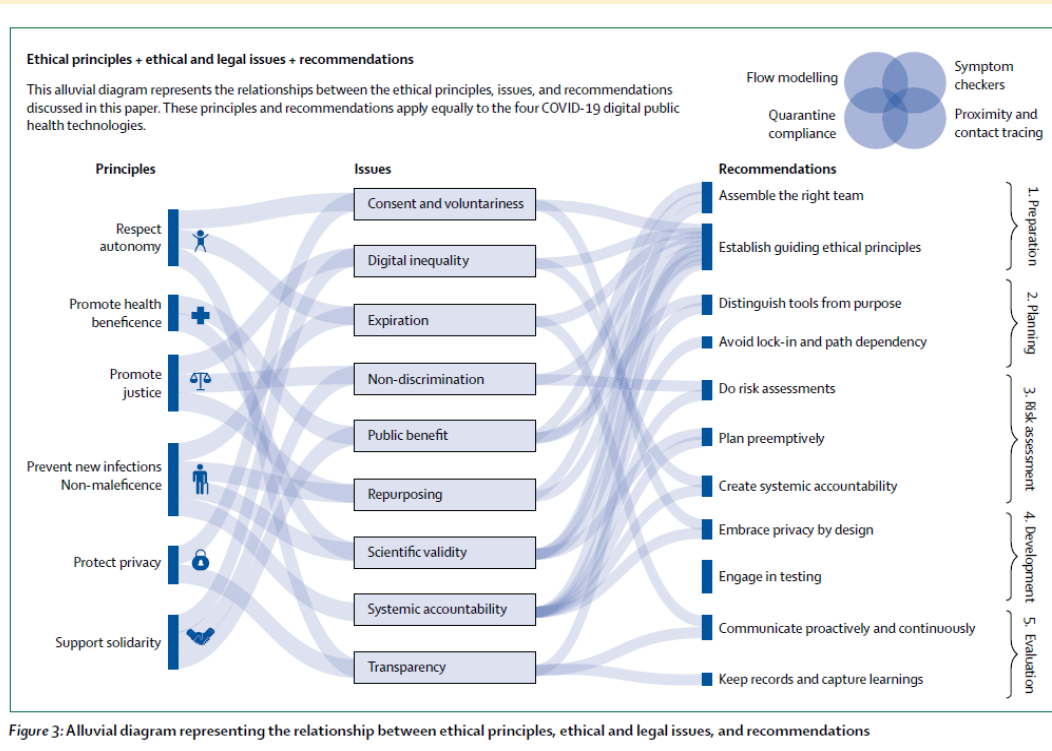
Ethical use of digital public health tools

A Navigation Aid

- 所有發展COVID-19數位公衛科技的決策者都必須要負起本篇文章中提到的倫理及法律挑戰的義務。為了能更實務的了解倫理-法律考量，本篇文章為決策者提出了輔助工具(navigation aid)，輔助工具基本核心在於大數據的過程價值，其中包含 accountability, consistency, engagement, reasonableness, reflexivity, transparency, and Trustworthiness。
- 這些輔助工具以數位科技及公共政策為架構，圍繞在風險評估的過程面，進一步分析條件所採用的通用治理方法，通常用在減少道德與法律風險。
- 輔助工具的目的為提供即時的實作指導(immediate practical guidance)，協助相關決策者進行連貫的結構化和發展，這個流程可以在快速發展各種數位公衛科技的條件下，識別、評估、管理其法律和道德風險。

Ethical use of digital public health tools

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發展步驟

- Preparation phase
- Planning phase
- Assessment phase
- Development phase
- Deployment and evaluation phase

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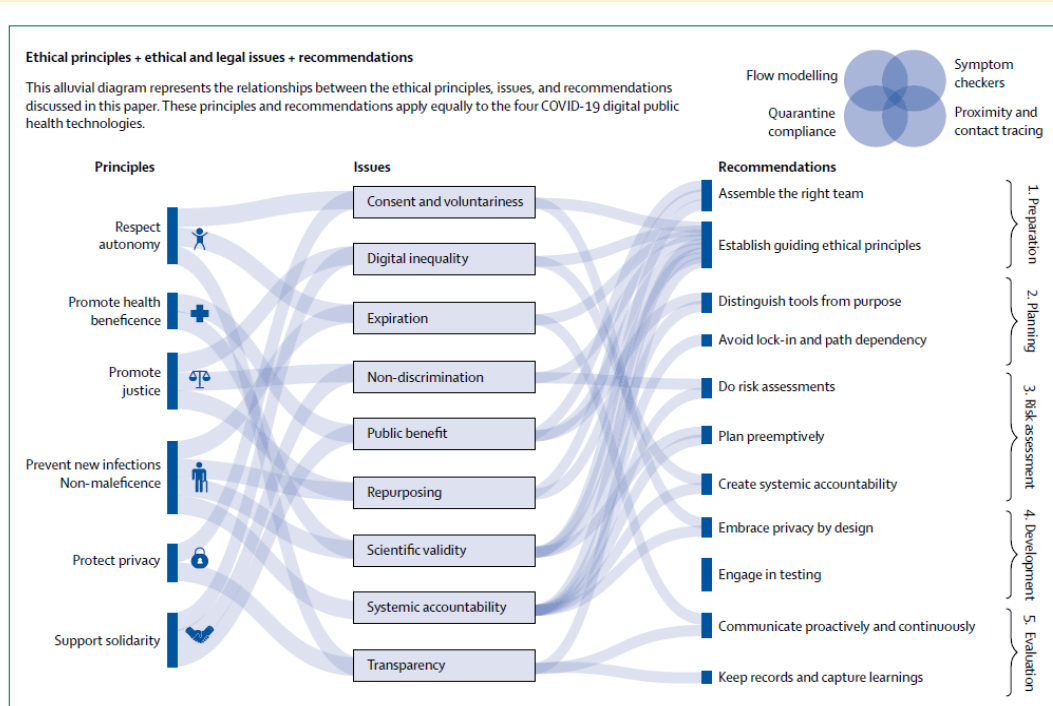


Figure 3: Alluvial diagram representing the relationship between ethical principles, ethical and legal issues, and recommendations

- Preparation phase

準備期: 組織團隊, 建立倫理原則

- Planning phase

計畫期: 依照目的分辨工具、瞭解各項工具優缺點及使用限制、避免鎖定或依賴某些工具

- Assessment phase

風險評估期: 應完成對工具的驗證及風險評估, 執行先行計畫 (plan preemptively), 包含考量資料和系統的生命週期, 建立系統當責性 (accountability)

- Development phase

發展期: 設計階段考量隱私性、並且進行測試, 避免違背倫理或法律原則或是有不良影響, 也可以公開邀請其他組織參與。

- Evaluation phase

評估期: 與公眾主動與持續性溝通、建立即時反饋機制, 保持紀錄並持續成長學習。

倫理法律原則 – 牽涉議題 – 建議 – 發展步驟
Principles – Issues – Recommendations - Steps

Limitation

本篇研究有其限制

- **類型學無法考量不同類型的科技限制**。大流行時期，開發人員開發新軟體的同時須面對時間壓力，還有不斷變化的證據，必須多加考慮的是此時新科技和數據來源的可靠性。另外複雜的技術需要長時間發展，但也容易失敗，因此可能會造成公眾的不信任，另外如何從倫理角度權衡哪些科技選擇更好，都不在本健康政策的論文討論範圍內。
- 第二是**數位公衛科技可能在本文描述的類型學之外**。具體來說，我們的類型學以及倫理考量是使用目前已存在的應用程式發展而成，因此，本文介紹的類型以及相應的類型分析可能會隨著新的數位化而發展。儘管如此，我們類型學的功能特徵依然提供了足夠的適應未來和新興的靈活性。本文沒有涉及人工智能的使用於大流行管理，也不考慮討論大量的人工智能倫理和現有的治理原則。
- 本文**不參與解決我們已經確定的倫理與法律挑戰**，因為這種參與應該在特定技術，特定醫療保健背景下來進行討論。雖然這種情況是必要的，但本篇文章選擇專注於開發輔助工具，使用輔助工具可以確保程序的完整性，更可以使決策者遠離不良的錯誤結果。

Conclusion

結論

- 面對COVID-19大流行，發展及佈署數位公衛科技有其必要性，然而這些工具必須確保其科學及倫理的正確性，以獲得群眾的信任及採用。
- 本篇文章的類型學分析、公衛相關架構建構，以及大數據倫理議題，都可以幫助政府或其他關鍵行動者來辨別複雜的倫理及法律議題。
- 藉由倫理-法律分析，我們提出了本篇文章的輔助工具，可以協助決策者在發展數位公衛科技時，確保過程的完整性並減少倫理引發的相關議題。